TENDER SPECIFICATION

BHEL:PSSR:SCT: 1242

FOR

Handling at Site Stores / Storage yard, Transportation to site of work, Erection, Testing and Commissioning of Electrical and Control & Instrumentation System for 1 x 20 MW Co-Generation Plant (Stage II)

At

Chennai Petroleum Corporation Limited

(CPCL) ,
Manali, Chennai ,Tamilnadu .

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 : 1242

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: 1242

Messrs Date:

Dear Sir,

SUB: Handling at Site Stores / Storage yard, Transportation to site of work, Erection, Testing and Commissioning of Electrical and Control & Instrumentation System for 1 x 20 MW Co-Generation Plant (Stage II) at Chennai Petroleum Corporation Limited (CPCL) , Manali Chennai, Tamilnadu .

Please find enclosed one set of non-transferable tender Specification documents containing - 189 - pages along with Separate Booklets for general conditions of contract and Rate schedule for the above work.

You are requested to go through the tender documents, 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. 1,50,000/- (Rupees One lakh Fifty Thousand only)** in the form Demand Draft drawn in favour of M/s.Bharat Heavy Electrical Limited Chennai - 35. **Bids with Deviations from the tender conditions will be rejected**.

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

The completed quotations shall reach the office of the under signed on or before 24.07.2007 at 15.00 Hrs. The Technical bids, will be opened on the same day at 15.30 hrs.

We shall separately intimate the date for opening the price bids only to those parties who are technically qualified. You are requested to depute your authorized representative at the time of opening.

ANY REVISION OF RATES / PRICES WHAT SO EVER 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

ADDL. GENERAL MANAGER / CONTRACTS

This Tender document is not transferable.

Place : Chennai -35

Encl: One set of Tender documents along with GCC Booklet

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

SPECIAL INSTRUCTIONS TO BIDDERS

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

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

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

02. 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 pertaining to this scope of work only.

05. Latest Income Tax clearance certificate.

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

07. Declaration sheets as per Appendix of Tender Specification.

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

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

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

11. Other relevant details as per GCC and checklist.

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

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

14. QUALIFICATION REQUIREMENT

a) The bidders should have successfully executed microprocessor based TG or GT controls or Boiler controls or station C&I system, switch gear, Transformer and other related works like cabling, impulse pipes, etc, in the last seven years in any power Plant or Process or Chemical Industries.

b) The bidders should have a minimum average financial turn over of Rs.53.20 Lakhs per year in the preceding three years ending 2006.

The bidder must have earned profit in any one of the last three financial years ending 31.03.2006 and should have positive net worth as on 31.03.2006

The bidder should submit audited balance sheet and profit and loss account of the company for the last three years ending 31.03.2006 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 its control and the decision of BHEL is final.

d) Approval of agency by customer.

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

15. A DECLARATION SHEET INDICATING THAT THERE IS NO DEVIATION IN TENDER DOCUMENTS (AS IN **PAGE 8)** IS TO BE FURNISHED. 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 only

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 Addl. 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.1,50,000/- (Rupees one lakh fifty thousand only). This EMD amount shall be submitted in the form demand draft only drawn in favor 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 WHAT SO EVER AFTER THE TIME AND DATE MENTIONED IN TENDER SPECIFICATION FOR SUBMISSION OF COMPLETED QUOTATIONS SHALL NOT BE ENTERTAINED UNLESS CALLED FOR SPECIFICALLY BY BHEL.

Addl. 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: **1242**

Description	EMD
Handling at Site Stores / Storage yard, Transportation to site of work, Erection, Testing and Commissioning of Electrical and Control & Instrumentation System for 1 x 20 MW Co-Generation Plant (Stage II) at Chennai Petroleum Corporation Limited (CPCL) , Manali Chennai, Tamilnadu .	Rs.1,50,000/- (Rupees One lakh Fifty Thousand only)

Cost of Tender Documents (Including all Taxes)	:	Rs.1105/-	
Sale Starts on	:	04.07.2007	
Sale closes on	:	21.07.2007	
Due date and Time for Submission	:	24.07.2007	15.00 Hrs.
Date and time for opening Of Technical Bids	:	24.07.2007	15.30 Hrs.

QUALIFICATION REQUIREMENT

a) The bidders should have successfully executed microprocessor based TG or GT controls or Boiler controls or station C&I system, switch gear, Transformer and other related works like cabling, impulse pipes, etc, in the last seven years in any power Plant or Process or Chemical Industries.

b) The bidders should have a minimum average financial turn over of Rs.53.20 Lakhs per year in the preceding three years ending 2006.

The bidder must have earned profit in any one of the last three financial years ending 31.03.2006 and should have positive net worth as on 31.03.2006

The bidder should submit audited balance sheet and profit and loss account of the company for the last three years ending 31.03.2006 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) Approval of agency by customer.

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

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

Bharat Heavy Electricals Limited takes no responsibility for any delay, loss or non-receipt of tender documents sent by post and also reserves the right to reject any or all the tender without assigning any reason therefor.

ADDL. GENERAL MANAGER/CONTRACTS

TENDER SPECIFICATION : BHEL:PSSR:SCT:1242

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

Addl. 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: 1242 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.1,50,000/- (Rupees one lakh fifty thousand 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.1,50,000/- (Rupees one lakh fifty thousand only) mentioned above, to make up the Security Deposit for the work as provided for in the Tender Specification within the stipulated time as may be indicated by BHEL, Power Sector : Southern Region, Chennai – 600 035.

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

DATE: CONTRACTOR:

PLACE: ADDRESS:

Witness with their address

Signature Name Address

PROJECT INFORMATION

01	**Owner**	**Chennai Petroleum Corporation Limited**
02	**Project Title**	**1 x 20 MW Co-Generation Plant**
03	**Location**	**Manali, Chennai Latitude 13 degree 04' N Longitude 80 degree 15' E**
04	**Power Station Site**	**Elevation above Mean Sea Level (MSL) 3.5 Meters**
05	**Nearest Railway Station**	**Chennai Central (15 Kms)**
06	**Nearest City**	**Chennai**
07	**Nearest Air port**	**Meenampakkam Air Port (35 Kms)**
08	**Nearest Sea Port**	**Chennai (25 Kms)**
09	**Road Approach**	**Available**
10	**Dry Bulb Temperature**	**35 deg C**
11	**Relative Humidity**	**70%**
12	**Altitude**	**3.5 Meters Above MSL**
13	Ambient Range	
	Mean Ambient Temperature	**18 deg C**
	Normal / Average Temperature	**35 deg C**
	Maximum Temperature	**45 deg C**
14	Rain Fall Data	
	Rain fall for 1 hour period	**100 mm**
	Rain fall for 24 hour period	**254 mm**
15	**Design Wind Speed**	**a) 50 m/s or as per IS 878 (Part 3) b) Factor K1 : 1.08 c) Factor K2 : For terrain Category 2 d) Factor K3 : 1.0**

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 charges. Contractor has to make his own arrangements for 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 cost nearer to the project site. 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.

Suitable crane for erection of transformers , busduct , required experience operators, fuel and lubricants are to be arranged by the contractor at his cost.

3.2.5 CONSUMABLES

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

3.3.0 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 loadside 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 (monthwise) 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 Welder should be provided with one portable electrode drying oven at the work spot. Electrode drying oven and portable drying ovens shall be provided by 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.

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 supply 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 comtemplated 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 be provided 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, trailor 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.

3.9.6.1 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. The required paint and thinner shall be provided by BHEL free of cost. 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 clause 2.15 and its sub clauses of 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 available with them for verification by BHEL. A list of such instruments possessed by contractor at site with its calibration status is to be submitted to BHEL Engineer for control.

Contractors shall arrange for the inspection of the works at various stages as required by BHEL. Immediate corrective action shall be taken by the 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.

HSE SPECIFIC REQUIREMENT

OCCUPATIONAL HEALTH & SAFETY MANAGEMENT SYSTEM

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

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

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

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

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

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

SUB CONTRACTOR TO ENSURE COMPLIANCE OF THE FOLLOWING SAFETY RELATED POINTS

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

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

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

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

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

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

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

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

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

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

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

11. Contractor should 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 incharge, 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 remanant spilled oil disposed off to a safe place, identified for such disposal.

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

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

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

OTHER HSE REQUIREMENTS TO BE COMPLIED BY SUB CONTRACTOR

1. Sub contractor to clearly understand and accept the 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

1 X 20 MW CO-GEN CYCLE POWER PLANT, CPCL – CHENNAI (STAGE – II)

ELECTRICAL/ C&I PACKAGE

SCOPE OF WORK AND SPECIAL CONDITIONS

6.0.0 SCOPE OF WORK:

6.1.0.1 The scope of Electrical/C&I work consists of E&C of Electrical/C&I Package related to HRSG & Gas Turbine, Illumination system of HRSG area and supply of miscellaneous Erection materials as specified in the tender.

6.1.0.2 The scope of Electrical/C&I work covers, Identification of equipment at stores/storage yard, technical assistance for checking and making the shortage/damage reports, taking delivery at stores/storage yard, transportation to erection site and pre-assembly of equipment wherever required, checking, calibration, erection, testing, along with the supply of all consumables, tools and tackles and testing instruments as per BHEL Engineer's instructions/Supervision. and providing assistance for commissioning, trouble shooting, trial operation and maintenance of the complete equipment and materials till the completion of contract period .

6.1.0.3 It is not the intent to specify herein all details of equipment and material. Any C&I/ electrical item related to this work, that is necessary to complete the system shall be deemed to have been included in the scope of work, even if not covered by this.

6.1.0.4 All the work shall be carried out as per the 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.

6.1.0.5 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 will decide the sequence of erection/commissioning methodology. No claims for extra payment from the contractor will be entertained on the grounds of deviation from the methods of erection/commissioning adopted in erection/commissioning of similar job or for any reasons whatsoever.

6.1.0.6 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.

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

6.1.0.8 The contractor shall co-ordinate and provide assistance for satisfactory testing, pre-commissioning, commissioning to meet the system requirement and Customer satisfaction.

6.1.0.9 During the course of erection, testing and commissioning of Electrical/C&I works certain rework / modification / rectification / repairs / fabrication etc will be necessary on account of feed back from other power stations that are already commissioned or under erection or due to change in design or manufacturing defects or to meet operational/maintenance requirements. Contractor shall carryout above such rework promptly and expeditiously. Daily log sheets indicating the details of work carried out, man hours; consumables used etc. shall be maintained by the contractor and got signed by BHEL engineer every day. Claims of contractor, if any, for such works, will be dealt as per appropriate clause referred elsewhere.

6.1.0.10 All suitable material handling equipment required for C&I/ Electrical Works and other tools, measuring instruments, calibrating equipment etc shall be arranged by the contractor . He shall also have adequate trained, qualified and experienced C&I/Electrical engineers, supervisory staff and skilled personnel. The manpower deployed by contractor shall match with above scope of works.

6.1.0.11 If any C&I/Elect equipments or items not covered but requires to be erected/commissioned, same shall be carried out by the contractor. Equivalent unit rate for those item or equipment shall be considered from the rate schedule.

6.1.0.12 The contractor shall provide assistance to maintain all the equipments/ instruments erected and commissioned by them till the completion of contract period.

6.1.0.13 Contractor shall have valid ELECTRICAL LICENSE OR SHOULD ENGAGE AN AGENCY HAVING VALID LICENCE **to** carry out the Electrical works. All the necessary certificates and licenses required to specific to Elect/C&I works are to be arranged by the contractor expeditiously at his cost.

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

6.1.0.15 Manpower Requirement:: There shall be 2 separate area In-charges, each for Electrical and C&I under a residence manager. They shall work independently with required manpower, T&P etc., Each In-charge shall have minimum 1 erection engineers with adequate supervisors and Technicians. Similarly commissioning in charge and Engineers also shall be identified separately for each package and the minimum requirement shall be as indicated in the Tender Specification. Besides the above, there will be separate engineers for Planning, Safety and Quality. Each of the above In-charges will be provided with a PC and good communication facilities.

ELECTRICAL PACKAGE

6.2.0 SCOPE OF WORK FOR ELECTRICAL PACKAGE IN GENERAL

6.2.0.1 Installation of Generator Transformers, NGRs / Neutral & phase side cubicles, HT Busducts, LT Switchboards, Miscellaneous Distribution boards and Panels, Battery and Battery charger panels, GTG Control/ relay/ excitation panels.

6.2.0.2 Installation of epoxy painted/GI supporting structures for cable trays, cable racks, etc., using standard mild steel sections like channels, angles, flats etc.

6.2.0.3 Installation of cabling system.

6.2.0.4 Installation of cable termination and straight through joints (if applicable) for HT/LT power cables, control cables.

6.2.0.5 Supply & Installation of trefoil cable clamps for clamping single core HT power cables.

6.2.0.6 Installation of items for underground cable installation like cable markers, cable joint markers etc.

6.2.0.7 Installation of rigid/ flexible GI conduits, and RCC Hume pipes for cable installation, wherever required.

6.2.0.8 Installation of painted steel support structures for mounting push button stations for local starting of motors.

6.2.0.9 Supply of cable lugs, ferrules, cable identification tags, cable dressing materials etc.

6.2.0.10 Supply of paints for items covered in the scope of works

6.2.0.11 Supply as well as installation of material for sealing and making vermin/ dust proof unused openings, if any, in panels/ JBs

6.2.0.12 Supply and Installation of Danger Board

6.2.0.13 Installation of canopy for outdoor pushbutton stations/motors/panels/ instruments

6.2.0.14 Supply & installation of rubber floor mats for LT panels.

6.2.0.15 Supply of all consumables and hardwares like clamps, bolts, nuts, brackets, anchor fasteners etc. required for installation.

6.2.0.16 Arranging scaffolding and platforms for erection of cables, panels etc.

6.2.0.17 The following are the items/equipment which will be supplied by BHEL and the erection, testing and commissioning of which will be under the scope of work of this contract.

- 11KV / 6.6 KV grade HT power cables
- 1100 V grade PVC LT power cables.
- 1100 V grade PVC LT Control cables.
- Power transformer

- Neutral grounding resistors (NGRs).
- 415 V Motor Control Centres
- DC Distribution boards
- Segregated Phase Bus ducts
- Generator Control panels
- Generator relay panels
- Generator excitation panels
- 125 V DC battery sets and battery charger panel.
- Local push button stations
- Testing and commissioning of HT/LT drives and generator

6.2.1 SCOPE OF WORK FOR TRANSFORMER

6.2.1.1 Receipt of all Transformer and associated loose supplied accessories including oil drums from store/yard, inspection, transporting the above to the respective erection location up to plinth, storage, maintenance of N2 gas pressure in transformer tank, erection of Transformer and all the accessories, cabling from transformer accessories to marshalling box & OLTC panel, oil filling, testing of oil, dry out, pre-commissioning test, commissioning of equipment and final painting and handing over.

6.2.1.2 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 or by any other means of shifting and positioning transformer on the foundation. The necessary sleepers, winches, jacks etc. required for this operation will be arranged by the contractor at his cost. The components of the transformers will be sent to site in several packages which shall be assembled and erected.

6.2.1.3 Samples of each and every drum of transformer oil shall 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 in consultation with Engineer In Charge 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 for transformer winding and HV Bushing shall be arranged by the contractor.

6.2.1.4 Checking of protective system such as Buchholz relay, explosion vent, oil and winding temperature detectors etc. shall be checked under the guidance and supervision of BHEL Engineer.

6.2.1.5 Contractor shall carry out all tests with their own testing equipments and testing team.

6.2.1.6 All T&P, like material handling equipment like crane, Trailer, 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. Operator, fuel and other consumables shall also be arranged by the contractor. The transformers may have to be suitably lagged/ covered during the drying out operation by the contractor at no extra cost.

6.2.1.7 The contractor will engage his men on three-shift operation during drying out the transformers

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

6.2.1.9 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.

6.2.1.10 The scope of erection work **includes final painting**, 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. The scope of final painting involves supply of paints, thinner and other consumables at the cost of the contractor. No separate rate shall be paid for painting. Painting shall be as per details given in the painting clause.

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

6.2.1.12 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.

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

6.2.1.14 Preservative gas like N2 shall be supplied by BHEL free of cost to maintain the N2 pressure during preservation.

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

6.2.2 BUS DUCTS:

The segregated phase busducts is connected to the cable panel and generator. The cable panel is connected to the 11 kV side of transformer by HT cables. The bus consists of rectangular 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 will be mounted inside the busducts.

Each set of 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.

Tap-off busducts connect the potential transformer, surge protection equipment to the main bus. The protection equipment and potential transformers shall be housed in metal clad cubicles.

A sheet steel totally enclosed cubicle is provided to connect the Generator neutral point. The neutral side cubicle houses neutral grounding transformer & resistors.

The following equipment are covered in the scope of erection/commissioning of Segregated Phase Busducts:

A. MAIN BUSDUCT (PHASE SIDE):

Each set of 11 kV, 2000 A, segregated phase bus ducts for GTG connecting the generator line side terminals to the cable panel shall be complete with AL alloy enclosure and conductor with single epoxy bus support insulator arrangement, epoxy seal off bushing, make up pieces, inspection windows, copper flexibles etc. All bolted joint hardware shall be of high tensile steel Cadmium plated or Zinc plated and passivated. All conductor bolted joints shall be silver plated.

B. MAIN BUSDUCT (NEUTRAL SIDE):

11 KV busduct from the neutral side adopter box to the star point shall generally be in line with Main bus duct.

C. NG CUBICLE/NEUTRAL SIDE CUBICLE:

Each NG Cubicle shall be fabricated out of 3 mm thick steel sheet complete with illuminating lamps, space heater, busbars, mounting insulators, marshalling box, etc. Each set shall house the following:

i. Dry type epoxy cast NG transformer

ii. NG Resistor

D. TAP OFF BUSDUCT (PTSP Cubicle):

The tap off 11 kV busduct connecting the main busduct to PTSP cubicle shall generally be in line with Main bus duct.

E. PT SP CUBICLE:

PT&SP Cubicle shall be of draw out type fabricated out of 3 mm thick steel sheet, complete with PTs, Surge Protection equipment, illuminating lamps, space heater, busbars, mounting insulators, marshalling box, etc. The cubicle shall be self-supporting type.

F. BUSDUCT SUPPORTING STRUCTURE:

Each set of busduct supporting structure shall be fabricated from standard steel sections welded/bolted and hot dip galvanized.

G. SHORTING BARS:

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

6.2.3 SCOPE OF WORKS FOR ERECTION & COMMISSIONING OF BUSDUCTS

The general scope of works for Segregated Phase Busduct is as below.

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

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

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

6.2.3.4 Assembly and checking of busduct at ground level if necessary.

6.2.3.5 Minor civil work such as chipping and grouting of bus duct support structures including supply of grouting materials.

6.2.3.6 If any modification is required in the support structures due to site conditions, the same shall be carried out without any extra cost. Pockets will be provided during casting in which anchor bolts will be grouted for supporting the structures.

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

6.2.3.8 Conducting air-tightness test after erection to meet the BHEL Standards. Rectification of leakage, if any without any extra charges. For air tightness test, contractor shall arrange necessary pipe, PVC, hoses, fitting, valve, pressure regulator, Rota meter etc. at his cost. Contractors shall tap the air from nearest Instruments air tapping point available at site. The contractor shall prepare detailed test procedure for the above and get it approved by BHEL.

6.2.3.9 Conducting high voltage test and other tests as detailed in Section VII as per instruction of BHEL engineer after cleaning inside as well as outside of the busduct & arranging all testing equipment required.

6.2.3.10 Fixing of current transformers in busducts including wiring from CT terminal to local junction box, taking through rigid/flexible conduit pipe.

6.2.3.11 **Carrying out final painting as per the standard color codes recommended by BHEL for all the items covered in the scope including supply of paints, thinner and other consumables etc. as required as part of erection. (For more details, refer scope of painting**).

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

6.2.3.13 Fixing of neutral side flexible connections to generator and positioning of neutral CTs after testing.

6.2.3.14 Assembly, erection and commissioning of PTSP cubicles with its equipment such as lightning arrestors, voltage transformers, fuses, etc.

6.2.3.15 Erection and alignment of Tap off busducts for PTSP Cubicle & NG Cubicle, cable box.

6.2.3.16 Grouting of busduct support structures.

6.2.3.17 Running of earth flats and earthing of busducts, cubicles, Marshalling boxes and structures, as detailed in the relevant bus duct drawings.

6.2.3.18 Carrying out minor repair, rectification of enclosures/ conductors wherever required.

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

6.2.3.20 Arranging all Testing instruments, which have been calibrated

6.2.3.21 Furnishing copy of the calibration certificate to the concerned BHEL Engineer for verification and approval.

6.2.3.22 Submitting 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.

NOTES

1. Any minor modification required on the busducts to match with adaptor box, PTSP Cubicle and cable panel shall be carried out without additional cost. Any major modifications, if required, due to layout/ design changes, shall be carried out on extra work basis, as stipulated in relevant clauses.
2. The lengths as well as weights indicated in the specification are only approximate. 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.
3. Contractor shall carry out all tests with his own testing equipments and testing team.
4. Refer Section VII for general technical requirements for erection, testing and commissioning.

6.2.4 LT SWITCHGEARS, POWER DISTRIBUTION BOARDS, AVR AND OTHER CONTROL PANELS.

6.2.4.1 SCOPE OF LT SWITCHBOARD, AC/DC DB

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

b. The base frames shall normally be supplied along with the switchgear 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. All minor concrete chipping and finishing works are deemed to be included in the scope of the job. If base frame is to be fabricated/ erected, separate rate shall be paid on Tonnage basis. This is applicable for local start/stop push button box also. If any grouting bolts are required for the panel, the same shall be supplied within the quoted rate.

c. For the panels to be mounted on the trenches, channel supports have to 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 these support structures and separate rate shall be paid on Tonnage basis.

d. Panels will be delivered in different shipping sections. The contractor shall set each section of equipment on its foundation or supporting structures and assemble the panels as required. Skilled manpower shall be engaged for installation of panels with parallel, horizontal and vertical alignment.

e. Necessary interconnection of busbar, inter panel wiring, etc. will have to be done by the contractor as part of panel erection.

f. Normally the panels shall be supplied with complete instrument mounting and wiring. However, if necessary, dismantling of the existing components, making minor modifications in the wiring to suit operating conditions, mounting and rewiring of new components 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 cost. Mounting and wiring of any instruments, meters, relays, push buttons, indicating lamps, contactors etc. if supplied loose for safety in transit, will also be included in the scope of the job, within the quoted rate.

g. **The contractor shall carryout touch up painting for panels, including supply of paints, wherever required.**

h. For carrying out this work, the contractor shall make suitable stencils before the work is undertaken.

i. The commissioning of Switchgear shall involve the trial runs and commissioning of all connected equipment like servomotors and drives etc. The contractor will have to keep his personnel 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.

j. All T&P, Material handling equipment including cranes and Relay Testing/ HV Testing Calibration equipment/ Instruments shall be arranged by contractor.

k. The contractor shall calibrate and commission all switchgear/panel mounted instruments, protection relays, transducers, Recorders, Indicators, energy meters etc with experienced Engineers/ Technicians.

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

m. Contractor shall co-ordinate with other cable-laying agency for proper cable termination.

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

o. 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 no extra cost.

p. Any loose supplied items like lamps, lens, contactor, fuse/relays/instruments missed from the custody of the contractor shall be replaced by the contractor at his cost.

q. Contractor shall put his 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.

r. Rubber mats for switchgear shall be supplied by the contractor, as per rates quoted. Laying of rubber mats will be part of panel erection works and no separate rate shall be applicable for the same.

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

t. Closing unused opening at the panel bottom plate with suitable material shall be part of panel erection.

u. Contractor shall prepare log sheets, protocol sheets etc. and get approval from BHEL/ Customer. Contractor shall be responsible to get the protocol signed with customer, as per field quality plan.

v. 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.

w. Any variation in length within ±20% shall not be considered for payment. If the panels 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.

6.2.4.2 SCOPE OF AVR/ GEN. CONTROL/ RELAY PANELS/ VFD AND OTHER CONTROL PANELS

a. The panels shall be supplied with different type of protection relays, Instruments like Meters, Transducers, etc and these panels shall be installed in unit control room.

b. The scope of work will be generally in line with Electrical MCC panels as detailed under above clause.,.

c. Unit rate shall also include Testing, Calibration and adjustment of relays, electronic cards and instruments, transducers mounted on the panels.

d. If panels are supplied with monitor, printers, furniture, controller etc. or any loose items or equipments, the erection of above shall be part of respective panel. No separate rate shall be payable for loose supplied items.

e. Normally the panels shall be supplied with instruments / modules mounted and wired. No separate payment shall be made for commissioning of any instrument/ cards/ components. If dismantling of such instruments and rewiring are needed at site, the same shall be carried out at no extra cost. If any instruments/ cards/ components supplied as loose items for safe transit, the same shall be mounted and wired at no extra cost. However, if any major installation/modification/wiring are involved, the same may be carried out as extra work. The decision of BHEL engineer shall be final in respect of above extra works.

Note: - BHEL shall provide vendors' support for commissioning of proprietary type of microprocessor based instruments, protection relays which requires software loading and programmer etc. However overall responsibility lies with contractor and the contractor shall provide all support like manpower, standard T&P, instruments etc. for calibration and commissioning of above proprietary type instruments.

6.2.5 BATTERY AND BATTERY CHARGER

The batteries are of heavy duty type capable of providing normal and emergency DC loads. The cells will be mounted on insulators carried on suitable wooden 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.

6.2.5.1 SCOPE OF WORK FOR BATTERY

1. Collecting the batteries and all the accessories from stores and assembling on the wooden racks and fixing the all loose items supplied with the battery charger as per drawings and making any minor modifications or changes in wiring, if required, without any extra cost.
2. Filling the shells with loose supplied alkali/acid- if applicable.
3. Arranging for suitable load for charging and discharging during charging and discharging cycles.
4. Arranging manpower in shift during charging and discharging cycles which is to be carried out round the clock as per the code of practice and conducting other routine test as per the IS under the supervision of the BHEL engineer..
5. Arranging necessary tools, T&P, Testing & calibration instruments required for erection and commissioning of the above electrical equipment/panel.

6.2.5.2 SCOPE OF WORK FOR BATTERY CHARGER

The scope of work will be in line with Scope of work for Electrical Control Panels, as detailed above under Clause 6.2.4.2

C&I PACKAGE

6.3.0 SCOPE OF WORK FOR C&I PACKAGE IN GENERAL

6.3.0.1 The C&I works shall be covered for the total plant, which consists of Gas turbine, Generator, HRSG and other auxiliaries.

6.3.0.2 The Scope of C&I work covered in the above packages shall be as follows:

- Erection and commissioning of All Types of Field Instruments like Temperature, Pressure and Flow instruments (local & remote) and special instruments like EWLI, SWAS System, Gas analyser etc.
- Erection and commissioning of DCS/PLC system and its accessories like microprocessor based system panels, PC, printers, furniture etc.
- Commissioning of all Types of Pneumatic operated Valves/Actuators/ Controllers and Relief Valves.
- Erection of all types of Hardware like impulse pipes, trays & tray supports, instrument air line, etc.
- Erection & Testing of all types of control/instrumentation cables etc.
- Erection and commissioning of UPS, Battery, Battery Charger and DCDB
- Erection and commissioning of control panels etc.

6.3.1 SCOPE OF WORK FOR C&I CONTROL PANELS:

6.3.1.1 The erection of different types of Microprocessor based panels like PLC/DCS Panels, Instrument Panels, unit control desk etc. are covered in the scope of work.

6.3.1.2 The unit rate quoted for Installation of control panels, shall include fixing of anti-vibration pads, leveling and alignment, welding, grouting, drilling of bottom gland plates for cable entry as required, closing control panels bottoms with suitable flame proof compounds wherever required and checking of internal wiring, instruments, components etc. Unit rate shall also include Testing, Calibration and adjustment of relays, electronic cards and instruments mounted on the panels except the Instruments identified in the BOQ.

6.3.1.3 Panels are normally supplied in suite of one / two / three/ four cubicles with bottom base frame and these panels are to be mounted on separate site fabricated base frames as per site condition and if necessary base frame to be properly grouted to the concrete floor or to be tag welded to the embedded insert plates.

6.3.1.4 The panels which are supplied for various control systems have to be erected at different places like unit control room/ near the equipment/ various operating floors as per site layout. The contractor shall take the panels to the desired locations either through floor openings or temporary openings. No claims will be entertained for taking the panels to the location owing to change of route or non-availability of openings as per nearest route.

6.3.1.5 The base frames will be supplied normally along with the boards. Wherever the base channels are not available, the same shall be fabricated installed and painted at site. The material for the above will be supplied by BHEL. For fabrication and erection of frame, unit rate shall be paid on tonnage basis. Minor concrete chipping and grouting works, including supply of grouting material is included in the scope of works.

6.3.1.6 For panels to be mounted on trenches, if any channel supports are required, the same shall be provided across the cable trenches over which the base frames of the panels shall be mounted. Similarly for the panels to be mounted on false flooring, if mounting frames are not provided, same shall be fabricated at site. The contractor shall carry out fabrication and erection of these support structures on tonnage rate basis. Materials will be provided by BHEL.

6.3.1.7 If any minor grinding is to be carried out on the cut-outs provided in the panels for mounting instruments like recorders, indicators, console etc., the same shall be carried out by the contractor at no extra cost.

6.3.1.8 All the panels shall be earthed to the nearest Electronic earth grid by means of copper flat /wire as per standard .

6.3.1.9 Painting of fabricated parts and earthing conductors of panels shall be part of the work. Touch up paints for panels if required shall be carried out by the contractor at no extra cost.

6.3.1.10 Closing the Panel openings and unused drilled holes with non-flammable sealant materials, including supply of above material, shall be part of erection work.

6.3.1.11 For panels/ equipment erected by other agencies, commissioning work and troubleshooting are to be carried out by the contractor as per the rate quoted in the schedule.

6.3.1.12 Normally the panels shall be supplied with instruments / modules mounted and wired. No separate payment shall be made for commissioning of any instrument/ cards/ components. If dismantling of the above such instruments and rewiring are needed at site, the same shall be carried out at no extra cost. If any instruments/ cards/ components supplied as loose items for safe transit, the same shall be mounted and wired at no extra cost unless otherwise specified in the BOM. Similarly, if any loose supplied instruments /modules are to be mounted and wired on customer panels or any other panels not erected by contractor, the same shall be carried out at no extra cost unless otherwise specified in the BOM. However, if any major installation/modification/wiring are involved, the same may be carried out as extra work. The decision of BHEL engineer shall be final in respect of above extra works.

6.3.1.13 Dimensions & weights indicated in the BOQ against various panels are approximate only. There may be variations in the weight and dimensions. Any variation within ± 20% shall not be considered for payment. However, for variations beyond ± 20%, price adjustment shall be considered proportional to the length of the panel. Variations in depth, height or weight of the panel shall not be considered for payment.

6.3.2 SCOPE OF WORK FOR DCS/PLC AND MARK VI SYSTEMS WITH RELATED FIELD INSTRUMENTS:

6.3.2.1 The scope includes erection of all DCS/PLC and Turbine Control Panels(Mark VI) as well as erection of HMI Stations consisting of computer, CRTs, printers, with respective interconnecting cables, power supply, furniture etc. The scope covers integration of all the above said equipments and erection & commissioning. The unit rate shall be quoted for the above packages on lump sum basis as indicated in the BOQ.

6.3.2.2 As these are microprocessor based system panels, experienced personnel shall be deployed in erection and commissioning of these panels and laying and termination of ether net (Intra-Plant Bus -IPB) cable i.e. Data Highway between DCS and PLC and Mark VI systems by skilled personnel

6.3.2.3 The instrumentation part includes transmitters, gauges, switches, valves and erection materials like pipes, cables, trays, junction boxes etc. and the erection of these shall be carried out by the contractor as described elsewhere in this section.

6.3.2.4 If any instruments/ hardware including furniture supplied as loose item as a part of above packages, but not explicitly mentioned in the description, the same shall be installed at no extra cost.

6.3.3 SCOPE OF WORK FOR INSTRUMENTS:

6.3.3.1 The type of instruments to be erected and commissioned shall be as detailed below:

i) All types of transmitters like temperature, pressure, flow, level transmitters etc.

ii) Local mounted pressure gauges, DP gauges, thermocouples, RTDs, temperature gauges, temperature switches, pressure switches, DP switches, flow switches and limit switches and flow indicator level switches etc.

iii) Air filter regulators, Air lock off valve, Power cylinders s etc.

iv) Panels / Control desk mounted Instruments like indicators, recorder, console and electronic modules etc.

v) I / P converters and local controllers

vi) Special instruments like vibration sensors, electronic water level indicator, Gas analyser, PC based instruments, etc.

vii) Pneumatic operated control valves, trip valves, solenoid valves, and electrically operated valves. (Commissioning only)

6.3.3.2 The contractor shall set up his own instrument laboratory. The calibration equipment shall cover complete range and shall have the desired accuracy of not less than 0.1 %. All the calibration equipment shall have the certification from National Physical Laboratory (NPL) or 'IDEMI' for the duration of Contract Period.

6.3.3.3 The contractor shall follow the standard procedures for calibration of various instruments and as set by the manufacturer of instruments and as instructed by the Customer including any requirements of field calibration. First, the calibrations shall be carried out independently by the contractor and later in the presence of Customer who shall certify the same. Proper documentation in this regard shall be maintained and handed over to the Customer.

6.3.3.4 All the instruments shall be calibrated for the entire range of the instrument for which it is designed. Calibration shall include test for repeatability. After first commissioning, the instruments shall be tested for calibration again to check whether the instrument maintains its zero and maximum of the range.

6.3.3.5 All instruments and control equipment shall be calibrated to read correctly to the satisfaction of equipment supplier/ customer.

6.3.3.6 Prior to installation, all the local & remote Instruments, thermocouples/RTDs, I/P converters, etc. shall be calibrated. Similarly, limit switches, flow switches, level switches, solenoid valves, air filter regulator, purge meters, etc. shall be checked for proper operation.

6.3.3.7 All switches shall be tested for the actuation of both normally open and normally closed contacts at the desired set points and also for the fixed/ differential settings

6.3.3.8 All the float operated level switches shall be tested for the movement of the float and linkages to make to break the switch contacts by filling up with water before installation.

6.3.3.9 All the conductivity type probes and switches shall be tested for performance before installation

6.3.3.10 Unit rate quoted for each instrument shall include calibration, installation, loop checking, commissioning and trouble shooting until satisfactory performance as per operational and system requirement and maintenance till the end of contract period. In case any instrument requires recalibration to achieve the expected performance, the same shall be carried out at no extra cost. If any re-calibration or replacement of instruments and rechecking of cable termination is found necessary during commissioning, the same shall be done within the quoted rate. The unit rate shall also cover marking Tag numbers on the instruments or racks, either by paint or a separate tag plate as per BHEL Engineer's directive

6.3.3.11 Unit rates have been asked item-wise for instruments, gauges, switches, indicators, recorders etc. as indicated in BOQ. The rates quoted by the contractor shall be uniform as far as possible for similar items of work of the rate schedule

6.3.3.12 If any instrument is to be relocated for reasons not attributable to the contractor, but required for satisfactory performance, the same shall be carried out on extra works basis. This activity is to be coordinated by contractor separately and the manpower for the above activities shall not be availed from commissioning manpower.

6.3.3.13 Unit rate quoted for erection of pressure/differential pressure transmitters, gauges, switches, shall include fixing the instruments on the racks / supports along with manifolds, and associated fittings and clamps. No separate rate shall be paid for each item. However, for fabrication and installation of racks and supports, rates shall be paid on tonnage basis. Steel materials required for fabrication of Racks and supports shall be supplied by BHEL.

6.3.3.14 Unit rate quoted for Temperature transmitters, I/P converters, Air filter/Air lock off valves, Purge meters, Rotameters, position transmitter, probes etc shall include fixing the instruments on the racks / supports along with associated fittings and clamps. No separate rate shall be paid for each item. However, for fabrication and installation of racks and supports, rates shall be paid on tonnage basis.

6.3.3.15 Unit rate quoted for control room mounted instruments shall cover mounting of instruments on panels / desk wiring, minor grinding on the cut out of panels for proper fixing.

6.3.3.16 Unit rate quoted for erection of Casing temperature thermocouple of turbine/ metal temperature thermocouple (MTM) shall cover laying, dressing and clamping, supply and fixing of tag plates, etc. Necessary tray supports for routing of MTM thermocouples shall be erected as part of tray erection covered in the tender.

6.3.3.17 Unit rate quoted for erection and checking of thermocouple, RTD etc. shall include cleaning of thermowell threads using tap sets, fixing of thermowells, wherever required.

6.3.3.18 Unit rate quoted for Erection and commissioning of temperature switches, gauges besides the works covered above (RTD & T/C) suitable support shall be provided for capillary type temperature Gauges/switches that shall be fabricated at site using steel plates and angles. The rate for fabrication and installation shall be on tonnage basis.

6.3.3.19 Unit rate quoted for erection and commissioning of float type Level switches includes fixing of switches on float chambers and fixing of float chambers on stand pipe, providing supports wherever required etc. Any minor modification requires matching Float chamber with tapping point same shall be carried out at no extra cost.

6.3.3.20 Unit rate quoted for erection and commissioning of Electronic type Level switches includes fixing of Electrode standpipe, Electrodes, Electronic unit, integration of all loose supplied items etc Any minor modification require to match Float chamber/ Electrode standpipe with tapping point same shall be carried out at no extra cost.

6.3.3.21 Unit rate quoted on lump sum basis for erection/commissioning of special instruments like, Electronic water level indicator, Gas analysers, SWAS Analyser, etc. 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 including furniture. 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.

6.3.3.22 For Special Instruments like, Gas Analysers, SWAS System, DCS/PLC vendor support shall be provided by BHEL for commissioning. The contractor shall provide necessary assistance for commissioning activities.

6.3.3.23 All instruments are generally covered in rate schedule. However, if any instruments not covered, but requires being erected/commissioned, same shall be carried out by the contractor. Equivalent unit rate for those instruments shall be considered wherever possible from the BOQ.

6.3.3.24 For field mounted instruments, pre-fabricated canopies shall be provided by BHEL. The mounting of canopies shall be done at no extra cost.

6.3.3.25 In case the Instruments are mounted and supplied along with main equipment and the BOQ calls for Erection & Commissioning, the contractor shall carry out removal, calibration, re-fixing and commissioning of same. Payment shall be made only for removal, calibration, re-fixing and commissioning, in line with rate quoted for removal, calibration and re-fixing of Instrument of similar type.

6.3.3.26 In case the Instruments are supplied as loose items, and the BOQ calls for removal, calibration, re-fixing and commissioning, the contractor shall carry out erection and commissioning of the same. Payment shall be made only for Erection and commissioning in line with rate quoted for Erection and Commissioning of Instruments of similar type.

6.3.4 SCOPE OF WORK FOR IMPULSE PIPES:

6.3.4.1 Different types of impulse pipes, like alloy steel, carbon steel, stainless steel of different sizes and thickness shall be supplied with suitable fittings like coupling, sockets, root valves, drain valves, manifold, condensing pots, syphons, tees, bends, nut and tail piece.

6.3.4.2 Unit rate quoted for impulse piping shall include site routing, cold bending, tig / arc welding of unions, connector Nuts and tail pieces, sockets, nipples, equal tees, couplings, condensing pots, syphons, root valves, isolation valves etc., fixing of manifolds and supporting with suitable fixtures and 'U' clamps at a interval of 200-300 mm gap and painting as per BHEL/CPCL specification and site engineers instructions. No separate rate shall be paid for fixing /welding of Impulse pipe fittings. The unit rate also includes supply of U clamps, fasteners, paints, etc. For impulse pipe support materials viz. Angles/ Channels, the rate shall be paid on tonnage basis. The above support materials shall be supplied by BHEL. For scope of painting, refer Scope of Painting clause. Welding of impulse pipe for High Pressure Lines shall be carried out by High Pressure welder.

6.3.4.3 Suitable root valves will be provided by BHEL on the tapping point wherever required. Wherever the dia of the impulse piping is not matching with valve outlet dia., reducers to be provided and necessary welding to the same to be done at site as part of impulse pipe erection. The reducers will be supplied by BHEL and the contractor shall carry out the welding. No separate rate will be paid for welding of the reducers.

6.3.4.4 TIG-welding sets, welding transformer/generator rectifier, Hydraulic bending machines, DPT kits, Hydraulic testing pumps required for pressure testing of impulse pipes shall be arranged by the contractor. Similarly, consumables such as welding electrodes, gas, Tungsten rods etc., filler wire shall be arranged by the contractor at his cost.

6.3.4.5 The contractor shall obtain necessary approval for welding electrodes, filler wire from BHEL welding engineer at site.

6.3.4.6 Impulse pipes Welder shall undergo test and get approval from BHEL welding engineer according to the nature of welding.

6.3.4.7 For longer route lengths of impulse pipes, the contractor shall provide Tag numbers at appropriate locations as directed by BHEL site engineer at no extra cost.

6.3.4.8 Air leak tests shall be performed on all flue gas impulse/ sample lines, air supply and pneumatic lines. Necessary equipment such as portable compressor, connecting pipes, materials, cables and test gauges shall be provided by the contractor as part of erection.

6.3.4.9 Hydro test shall be performed for all other impulse lines/ sampling lines. Necessary equipment such as hydro test pumps and temporary piping to the required point, fill pump etc., materials such as temporary gaskets, miscellaneous fasteners etc., tools and tackles including test pressure gauges etc. are to be provided by the contractor as part of impulse line works.

6.3.5 SCOPE OF WORK FOR COPPER/ SS TUBES:

6.3.5.1 Different sizes of copper tubes of different thickness with or without PVC coating shall be supplied in standard lengths of 15 Mtr Coils and SS tube shall be supplied in standard length of 6 meter. The connectors and tees will be of brass/SS of different sizes as per site requirement.

6.3.5.2 The unit rate quoted on meter basis includes site routing, bending, providing supports, fixing of connectors, unions, valves, tees, etc. and connecting to the instrument air line instruments. The unit rate also includes providing tag plates on instruments / power cylinders.

6.3.5.3 If copper/SS tube length is more than ½ mtr, suitable support shall be provided either by angle or trays. Protective angles to be used for copper tube routing. The support materials shall be supplied by BHEL. Separate Rate shall be paid for fabrication and erection of supports as per rate quoted in the BOQ.

6.3.5.4 Copper/SS tubes shall be clamped with suitable clamping materials. Supply of suitable Aluminium clamps and tag plates are under contractor's scope. The unit rate quoted for laying of copper tube shall cover the supply of clamping materials also.Leak test shall be carried out after completion of tubing works as per guidelines.

6.3.6 SCOPE OF WORK FOR INSTRUMENT AIR LINES:

6.3.6.1 Different type of GI pipes of different thickness/ class shall be supplied along with GI fittings like union, coupling, tee, reducers, elbow, valves, etc

6.3.6.2 Unit rates on length basis for erection of instrument air lines includes site routing, providing supports, fixing "U" clamps, fixing of loose supplied GI accessories mentioned as above as per the drawings, providing fresh threading as required for jointing with unions, valves and all type of other fittings as required in the system. Unit rate also shall include supply of U clamps, Teflon tapes and bolts, etc.

6.3.6.3 Teflon tapes shall be used for tightening all the joints. No bending, welding etc. is allowed. No separate rate shall be paid for erection of GI fittings / accessories and U clamps.

6.3.6.4 After installation of instrument airlines, the line shall be blown and leak test shall be conducted for all the joints as per the guidelines given in section VII at no extra cost.

6.3.7 SCOPE OF WORK FOR ELECTRIC & PNEUMATIC ACTUATORS:

6.3.7.1 Different types of pneumatic actuators like regulating type, on-off type, of different stroke length shall be supplied. Some of them may be fitted and supplied with main equipment.

6.3.7.2 The unit rate quoted for erection & commissioning scope of electrical and pneumatic actuators includes modification of linkage mechanism wherever required and connecting the same with driven equipment, fixing of all accessories like air sets, Solenoid valves, air lock off valves, limit switches, if supplied loose item as part of power cylinders, replacing the damage copper tubes or any other accessories like gauges, solenoid valves, limit switches, etc. connecting to air line, and adjusting the stroke length. No separate rate shall be paid for the above works. For all pneumatic and electrical actuators, the necessary LINKAGE MECHANISM shall be supplied by BHEL as part of actuators. No separate rate shall be paid for erection of linkage mechanism. For fabrication and erection of steel supports and frames, the rate shall be paid on Tonnage basis.

6.3.7.3 The link rods have to be adjusted to suit the opening and closing position. This adjustment has to be repeated number of times till proper operation is obtained. If BHEL site engineer desires to remove the accessories like position transmitters, air locks, positioners, limit switches, solenoids etc. prior to erection either at BHEL stores or at site to avoid damages/pilferage, keep in safe custody and remount the same prior to commissioning, this shall be part of scope of work for power cylinders.

6.3.7.4 For calibration of any Pneumatic Actuator at field, temporary air supply, if required, shall be arranged by the contractor.

6.3.7.5 In case the actuator is supplied in assembled condition along with main equipment and the BOQ calls for Erection & Commissioning of the same, payment shall be made only for commissioning, in line with rate quoted for commissioning of actuator of similar type.

6.3.7.6 In case the actuator is supplied as loose item, and the BOQ calls only for commissioning, the contractor shall carry out erection and commissioning of the same. Payment shall be made in line with rate quoted for Erection and Commissioning of actuator of similar type.

6.3.8 SCOPE OF WORK FOR THE INSTRUMENTS MOUNTED AND SUPPLIED ALONG WITH EQUIPMENT/ SKIDS

6.3.8.1 Scope of work covers removal, re-calibration, re-fixing, re-termination of cables, checking the continuity, replacing any defective parts or replacing the total instrument, if required.

6.3.8.2 The scope also covers collecting the replacement instruments/parts from BHEL/customer stores, stockyard etc.

6.3.8.3 In case skid mounted/ equipment mounted instruments have been removed and supplied as loose for safety in transit, the Erection rate will be considered in line with other loose supplied instruments.

6.3.9 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- Dryout all the motors if required to improve IR value.

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

e- Checking the bushing and HV test/Tan delta test.

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

2 ALL TYPES OF LT DRIVES.

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 setting

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

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

g- Replacing defective components like limit switches

3 HOIST:(if applicable)

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, and limit switch etc., fixing of Trailing cables, and making ready for load test by mechanical agency.

4 PNEUMATIC (ALL TYPES OF VALVES AND POWER CYLINDERS)

a) Calibration and checking of instruments mounted on the actuators and setting stroke length of the actuator.

b) Servicing of positioners, position transmitters, limit switches, solenoid valves, air lock-off valves, removing/replacement of defective components, copper tubes etc., if necessary.

c) If the actuator is to be removed for attending to any mechanical problems, removing of copper tubes, cables etc. reconnecting and re-commissioning of the actuators is to be done.

d) Testing and checking the remote/local operation in Auto as well as Manual mode.

e) Fixing of instruments if supplied as loose items. (As referred in Sl.no. 6.3.9.1 b above)

f) Attending to any defects till the contract period.

5 FLOW METERS/ SWITCHES

a) Checking the calibration and servicing if required.

b) Setting the alarm value

c) Replacement of defective components if any

6 LIMIT SWITCHES & LEVEL SWITCHES

a) Checking the operation

b) Replacing defective components if required

7 SOLENOID VALVES

a) Checking the healthiness of coil

b) Checking the operation

c) Replacement of defective components if required.

8 TEMPERATURE ELEMENTS (MOTORS' AND GENERATORS' WINDING AND BEARING)

a) Checking the healthiness

b) Replacement of defective element (only for bearing)

9 DIRECT WATER LEVEL GAUGES (REMOTE & LOCAL)

a) Checking the calibration

b) Fixing of bulbs and extending Power supply

c) Replacing defective components

NOTE:

1. The scope of work covered in 6.3.9.0 also includes collecting the replacement instruments/parts from BHEL/customer stores, stockyard etc

2. Separate group shall be identified for commissioning. The above group shall be available right from Trial run of individual equipment to full load operation including shift operation.

ILLUMINATION

6.4 SCOPE OF WORKS FOR ILLUMINATION PACKAGE

6.4.0.1 The scope of works of illumination covers mainly in HRSG area. The scope of items to be supplied by the contractor is indicated in the BOQ. If any conduit accessories other than those supplied by BHEL is required for completion of illumination system, the same shall be arranged by the contractor within the quoted rate.

6.4.0.2 The following shall be part of the illumination work.

- Installation of main lighting panels with switch controls.
- Installation of GI conduits
- Installation of wiring materials and junction boxes for lighting system.
- Supply and installation of cable lugs, ferrules, cable identification tags, cable dressing materials etc. as required.
- Supply of complete erection hardware for installation of lighting system like clamps, bolts, nuts, brackets, anchor fasteners, grouting bolts, connectors, flexible GI conduits –PLICA type etc. required for lighting system.
- Supply of paints.
- Supply and installation of other accessories which have not been specifically indicated but may be required for complete of installation.
- Arranging all scaffolding and platforms for erection of cables, light fittings, DBs etc.

6.4.1 GENERAL INSTALLATION REQUIREMENTS FOR ILLUMINATION PACKAGE

6.4.1.1 Installation work shall be carried out in accordance with good engineering practices and also as per manufacturer's instruction/recommendations where the same are available.

6.4.1.2 Equipment shall be installed with neat workmanship so that level, plumb, square are properly aligned and oriented.

6.4.1.3 Cable installation work shall mean laying of cables either in ground or on trays, inside trenches, overhead trays, in conduits etc., dressing and clamping, jointing and termination inclusive of supply of necessary ferrules, tapes etc. and other accessories, grounding of cable armour/cable screen.

6.4.1.4 Lighting fixtures of appropriate type as per the lighting layout drawings shall be installed by the sub contractor. The exact mounting will be decided at site depending upon the actual space/other facilities available at site. All materials required for mounting the fixture shall be supplied and installed by the contractor.

6.4.1.5 The bracket for mounting the lighting fixtures on boiler platforms shall be fabricated at site using 40 mm GI conduit with a reducing socket to suit the fixture and clamped to the handrails. However, the clamping of these conduits at points of large vibrations should be avoided. The fixing shall be strong enough to withstand vibrations and wind velocity.

6.4.1.6 The location of the lighting panels and lighting fixtures with circuit designation shall be as shown in lighting drawings. The various receptacles, switches etc. at various places shall be installed as shown in the drawings. The lighting layouts furnished by purchaser shall indicate the approximate location of fixtures. The contractor shall determine the exact location in order to avoid interference with piping/cable trays or other equipment and to avoid objectionable shadows.

6.4.1.7 Before installation, light fittings, switches, receptacles etc. shall be checked for tightness of internal connection and insulation value. Fixtures shall be firmly supported from structures. Clamps may be bolted or welded to the existing steelworks. In case of concrete structures, fixtures will be fixed with the help of anchor fasteners. In false ceiling areas fixtures shall be supported from the true ceiling.

6.4.1.8 Main Lighting DB's shall be mounted on floor and LPs shall be mounted on floor or on the walls/columns/steel structures at the locations as indicated in the drawings. Suitable fixing provision for mounting LDB on floor would be made by the contractor. The sub contractor will supply necessary foundation bolts and do the grouting to fix up the LDBs.

6.4.1.9 DBs shall be installed by fastening to studs of not less than 12 mm dia. which will be suitably grouted/ welded to the wall/column by the sub contractor. All the required accessories including studs for the erection of the panel shall be supplied by the sub contractor.

6.4.1.10 If mounting channels are required for LDBs/ DBs, the same will be fabricated and erected by the contractor on tonnage basis.

6.4.1.11 Unless specified otherwise in the drawings, the height of the centre line of lighting panels from the floor shall be 1200 mm.

6.4.1.12 All lighting wires shall be run in separate conduits. Not more than two circuits shall be run in each. Each phase shall be run in separate conduits only. Size of conduit shall be selected as per the table given below:

Size of Wire	Max. Number of wires in
7/20 Copper	25 mm conduit - 4 wires

6.4.1.13 Lighting wires from lighting panels to junction boxes and junction boxes to lighting fixtures, switch boxes and receptacle boxes shall run in conduits (Rigid/flexible).

6.4.1.14 All wires in a conduit shall be drawn simultaneously. No subsequent drawing is permissible.

6.4.1.15 Wires shall not be pulled through more than two equivalent 90 deg. Bends in a single conduit run. Wherever required, suitable conduit junction boxes/pull boxes shall be provided. All types of wiring, concealed or unconcealed shall be capable of easy inspection.

6.4.1.16 Receptacles and lighting circuits shall be fed from different circuits. The switch controlling these circuits shall be on the live side (phase wire) of the circuits.

6.4.1.17 All lighting wires shall be crimped using suitable type of solderless, crimping, tinned fork type copper lugs. Cost of the lugs shall be included in the erection price of wire.

6.4.1.18 All cables from MCC to Main DB and Sub-DBs shall be laid in cable trenches, cable trays along with the power cables and shall be clamped properly.

6.4.1.19 All cables from sub-DBs to the lighting fixtures shall be run along the column or structures with suitable clamps and dressed neatly.

6.4.1.20 Wherever necessary, GI pipes may be used for running the cable for mechanical protection. Proper lugs should be used for terminating the cables.

6.4.1.21 For HRSG light fittings, outgoing cable from each circuit of lighting panel shall be 1 run of 3 C x 2.5 sq. mm PVC, Al or Cu cable.

6.4.1.22 Lighting fixtures, receptacles, switches, conduits and junction boxes etc., shall be properly earthed in compliance with the provision of I.E. rules and applicable Indian standard amended upto date.

6.4.1.23 A continuous earth conductor of 8 SWG GI wire shall be run all along the entire length of the conduit between the fixture and the corresponding lighting panel where it will be connected to the station earth. This will be treated as part of conduit erection and no separate rate shall be payable for the earth conductor.

6.4.1.24 For fixtures in hazardous areas, the third core of each single-phase armoured cable circuit shall be used as earthing conductor.

6.4.1.25 Wherever necessary, GI wire shall be run along with cable as instructed by engineer in- charge.

6.4.1.26 The grounding shall be done by conductors of suitable size and the same shall be connected to the risers of Owner's main ground mat.

Lighting distribution panels, 25 x 6 mm GI flat or 50x 6mm G.I. flat.

6.4.1.27 Equipment will generally be furnished with two separate ground pads with tapped holes, bolts, nuts and spring washers etc. If however the same are not furnished, contractor shall drill and tap holes and provide bolts, nuts, spring washer etc. for connection.

6.4.1.28 Equipment ground connections, after being checked and tested by the engineer, shall be coated with anti-corrosive paint.

6.4.1.29 Whether specifically shown or not, all conduits, trays, cable armour and cable end box, electrical equipment such switchboards, panels, cabinets, junction boxes, fittings, fixtures, etc. shall be effectively grounded.

6.4.1.30 Earthing conductors along their run on walls and columns shall be supported by cleating with approved materials/welding at intervals of 750 mm.

6.5 SCOPE OF WORKS COMMON FOR ELECTRICAL/C&I/ILLUMINATION

6.5.1 SCOPE OF WORK FOR CABLES

BHEL will supply HT and LT cables (11kV/ 1.1 kV, Armoured/ Unarmoured, Aluminium/Copper PVC FRLS 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, 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 laying 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 duct bank, cable shaft etc., the same . rate shall be applicable.
4. Separate rate shall be paid for LT Power cable termination only.
5. For single core Power cable **Trefoil clamps shall be fixed as part of laying and termination rate.**
6. If the cables are to be routed on steel angles as per site condition, steel angles will be supplied by BHEL.
7. **All the dressing material such as Aluminium/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 other cables of lesser quantity for which no separate trays have been allotted and are to be laid on the same trays, the contractor shall do clamping such those cables also along with the cables laid by him.
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) 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.

d) 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

e) 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 to be for control and pair cable shall be assumed as follows: The average RUN length shall be considered as 150 mtrs. However, 10% of the cable the average length shall be considered as 30 mtrs.**

CABLE TERMINATION

11. For LT control cable terminations, no. separate rate shall be paid.
12. The scope of termination shall include, termination of cables on various panels/ JBs/ Pushbuttons etc. installed by other agencies. The contractor shall co-ordinate with such agencies and do the termination, including drilling of gland plates for fixing cable glands, if required.
13. The insulating sleeves shall be of fire resistant and be long enough to over pass conductor insulation and shall be properly sized.
14. The contractor shall provide Tools/ equipment required for the connections and termination of cable wherever necessary.
15. Necessary lugs above 2.5 sq. mm shall be supplied by BHEL.
16. After cable terminations, the debris shall be removed then & there
17. 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 cost shall be paid for HT termination
18. Only printed ferrules should be used and necessary ferrules printer shall be brought and used by contractor at site.

6.5.2 SCOPE OF WORK FOR CABLE TRAYS/ SUPPORTS/ CONDUITS/ FLEXIBLE CONDUITS:

6.5.2.1 CABLE TRAYS

1. Scope of cable tray works covers erection of various sizes of ladder & perforated trays with tray accessories such as bends(vertical and Horizontal), tees, cross, reducers, coupler plates, fasteners etc.
2. If accessories such as Tees, Reducers, Bends (vertical and Horizontal), cross not supplied, same shall be fabricated wherever required, from the straight Trays. The accessories supplied may be modified to suit site routing as part of work.
3. The scope also covers making offsets by means of cutting standard tray sections and inserting suitable size of trays to match with the existing arrangement.
4. The unit rate for erection of trays shall be on meter basis which includes erection of trays and accessories, fabrication of trays 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 trays covers are supplied same shall be erected after completion of cable laying 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.

6.5.2.2 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 as required by BHEL. 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.

6.5.3 SCOPE OF WORK FOR JUNCTION BOXES/ PUSH BUTTON BOXES

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

1. The unit rate quoted for erection of junction boxes/push button boxes shall include providing necessary supports, drilling of bottom gland plates for cable glands as required, Painting the tag No of JB or fixing a separate tag plate as required on junction boxes/push button boxes, minor chipping, grouting as required for mounting the JBs/PB and supply of all bolts and nuts (Fasteners) including grouting bolts as required for mounting the junction box/push button.
2. Fabrication and fixing of supports shall be on tonnage basis.
3. The contractor shall close all unused holes on the gland plates using grommet or other suitable material issued by BHEL, at no extra cost.
4. All bolts and nuts (Fasteners) required for mounting the junction box shall be arranged by the contractor.
5. If any intermediate JBs are required to terminate power cables for drives, the same shall be installed and also any modification like replacement of terminals, enlarging gland holes etc. required to accommodate power cables shall be carried out as part of this works. Equivalent Unit rate shall be paid for installation of such JBs. Decision of site engineer will be final regarding the equivalent rate.
6. For flame proof JBs, if any gland holes are to be modified, the same shall be carried out as per rates in Rate Schedule.

7. The contractor shall prepare JB terminal drawing for each JB, indicating tag nos. for instruments, JB TB & TE no, core/ pair no of all incoming/outgoing cables. Such drawing shall be laminated and pasted inside the respective field JB. 2 Nos. of the laminated drawing per JB are to be supplied.

6.5.4 SCOPE OF WORK FOR 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, JB, Control Box/Panel, local push Buttons, busducts etc. with angles and channels of different size
2. The fabrication steel materials such as angles, channels, plates, etc shall be supplied in standard lengths by BHEL.
3. Fabrication shall be carried out as per schemes in consultation with site engineers.
4. **All site fabricated items, all supports or brackets needed for installation shall be fabricated and painted by the contractors with two coats of red chromate Zinc 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.

6.5.5 SCOPE OF ABOVE GROUND EARTHING

1. The scope of work shall includes installation of earthing and lightning protection system materials and associated fittings. Others will provide earthing system comprising of main earthing conductor buried in soil, embedded in concrete inside the building. Installation of earthing conductors for connecting equipment pertaining to BOILER/TG/BOP area to the plant main earth grid shall be carried out by the contractor.
2. Different type of earthing materials shall be supplied by BHEL and the contractor shall lay and connect the earthing materials as per site requirement. Unit rate for earthing flats/ wires shall be on running meter basis. The unit rate quoted for earthing shall cover supply of fasteners, Saddles, Spacers, lugs, minor civil works etc.
3. Drawings of main earth grid to be provided by others would be made available to the contractor to enable them to carry out rest of the earthing system work.

4. Earthing System Installation scope covers, earthing of all cable trays in inside/outside plant building as well as inside the trenches at an interval as detailed in section VII metallic frames of all current carrying equipment, supporting structures adjacent to current carrying conductors, lightning protection system conductors and neutral points of various systems/equipment, panels, motors, JB, push button boxes etc. as listed in various drawings
5. The connection between earthing pads/ terminal to the earth grid shall be made short and direct and shall be free from kinks and splices.
6. 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.
7. Equipment bolted connection after checking and testing shall be painted with anti- corrosive paint/ compound. 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.
8. Supply of anti corrosive paint is in the scope of contractor.
9. 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.
10. Generator transformer neutral shall be earthed using 2 dedicated rod electrodes.
11. All electrical equipment operating above 250V shall have two separate and distinct connections to the earth pit.
12. 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.
13. 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.
14. 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
15. A minimum of two spare earth rings will be provided in each floor of the building for earthing future building.
16. Each RCC steel column of the building will be interconnected to the floor-earthing grid in basement/ground floor.
17. **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.**

6.5.6 SCOPE OF PAINTING

1. The scope of painting generally includes painting of all steel items such as supports, racks, frames, canopy, impulse pipes, Transformer, Bus ducts, as detailed in Scope of work of respective equipment 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. Full painting shall be required for specific equipments as per the scope of erection.
4. For any bare copper material requirement, painting as desired by the site shall be carried out by the contractor at no extra cost.
5. All damaged painted surfaces shall be cleaned and as detailed above.
6. All damaged galvanized surfaces including cable trays shall be coated with cold galvanizing paint.
7. 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.

6.5.7 SCOPE OF CIVIL WORKS

1. Minor civil works like chipping, drilling and punching in concrete floors/ slabs/ brick walls, grouting of bus duct /Transformer supports in foundation, base frame of panels/ push button stations/ Junction Boxes, etc. are covered in the scope of this contract.
2. Scope of civil works includes supply of grouting materials like grouting cement, sand, etc., and cleaning of all debris.
3. More details regarding scope of civil works are given in the respective equipment erection.
4. No separate payment will be applicable for above civil works.

CIVIL WORK FOR CABLE TRENCH : (Wherever Required)

5. Excavation & back filling of trenches for cables and earth strips in all types of soil except in hard rock for a maximum of 1.2 m depth, 0.6 m wide, shoring, shuttering, and dewatering of surface/ sub soil water if required, disposal of surplus earth etc.
6. Spreading of approved fine river sand in cable trenches on cubic metre basis including supply of river sand.
7. Laying of approved class bricks of thickness 3” in cable trenches for cable protection etc. including supply of bricks

6.5.8 SCOPE OF CALIBRATION

1. Contractor shall calibrate all the local instruments, panel mounted instruments including transducers, protective relays, Recorders, Indicators etc. that will be supplied along with equipments mounted in or in 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, protective 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 is unable to 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 reimbursed by BHEL. However if above such calibrator is available with BHEL at site the calibration shall be carried out by the contractor within the quoted rate.**

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

1. The scope of commissioning works covers arranging suitable skilled manpower – technician,supervisor and engineer as required for commissioning of all instruments/equipments/systems covered in the BOQ including loop checking and establishing the operation of instruments/equipments/systems to meet plant commissioning/operation. BHEL will provide vendor supports for special or proprietary type instruments/systems and contractor engineers/supervisors shall associate with the vendors and provide necessary manpower, T&P etc.
2. Scope of commissioning starts with the commissioning of various equipment/ instruments/ systems erected by the contractor and making them available, as required, for the various commissioning activities of the main plants. The commissioning activities of the main plant shall be as below:

   GAS TURBINE:

   i) Trial run of various equipment.

   ii) Cranking of GT

   iii) FSNL

   iv) Synchronisation

   v) Full load operation

FOR HRSG:

i) Gas admission

ii) Boiler acid cleaning.

iii) Boiler alkali boil out.

iv) Steam blowing.

v) Safety valve floating.

vi) Admission of steam to process line.

The above commissioning activities, tests, trial runs may have to be repeated till satisfactory results are obtained to the satisfaction of customer / consultant.

The contractor shall co-ordinate with other contractors during the above main plant commissioning activities to ensure proper commissioning of total plant.

3. The pre commissioning activities of the main power plant will start with run of various equipments prior to commissioning of main equipment. The contractor shall simultaneously start commissioning activities for the equipment erected to match with the various milestone activities of commissioning programme of the project.

4. Contractor shall arrange commissioning engineers, supervisors, electricians, instrument mechanics in each area to be associated with BHEL commissioning staff. Contractor shall earmark separate manpower for various commissioning activities. The manpower shall not be disturbed or diverted. It shall be specifically noted that above employees of the contractor may have to work round the clock along with BHEL commissioning engineers involving considerable payment of overtime, which forms part of Contractors Scope

5. The mobilization of these commissioning groups shall be such that planned activities are taken up in time and also completed as per schedule and the work undertaken round the clock if required. It is the responsibility of contractor to discuss on day to day / weekly / monthly basis the requirement of manpower, consumables, tools and tackles with BHEL engineer and arrange for the same.

6. If the contractor fails to arrange the requisite manpower, consumables, T&P to meet the schedule, BHEL shall make alternate arrangements and recover the cost with overhead from the running bills of the contractor.

7. The contractor shall make necessary protocols with BHEL/ customer after erection as well as testing/ commissioning of various equipments/ instruments. The contractor shall prepare the formats and obtain approval from BHEL. The approved formats shall be printed by the contractor in adequate numbers.

8. In case any rework/repair/rectification/modification/fabrication etc. is required 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. If during commissioning, any improvement / repair / rework / rectification / fabrication / modification due to design improvement / requirement is involved, the same shall be carried out by the contractor promptly and expeditiously. Claims if any, for such works from the contractor shall be governed by clauses covered elsewhere.

9. During commissioning activities and carrying out various tests, if any of the instruments has to be temporarily erected and commissioned to suit the commissioning activities, the contractor have to carry out the erection of the same. After completion of activities the temporary systems have to be removed and returned to stores and no extra rate shall be paid for this.

10. Minimum requirement of Man Power for commissioning works shall be as follows:

Engineer (Electrical)	–	1
Supervisor (Electrical)	–	2
Technician (Electrical)	–	5
Engineer (C&I)	–	1
Supervisor C&I)	–	2
Technician (C&I)	–	5

The above commissioning group shall be identified at the Pre-commissioning and commissioning time. The above commissioning group shall have the knowledge of various systems referred in the tender and also should have adequate experience. The above manpower for commissioning is only tentative and for any additional manpower as per site requirement the same shall be arranged by the contractor.

If the contractor fails to deploy the above Engineer/Supervisor/ Technician at appropriate time of commissioning, no payment shall be made against commissioning activities as per terms of payment.

11. All the T&P instruments required for commissioning are to be arranged by the contractor. (However, any special instruments, which are of proprietary nature, shall be arranged by BHEL.)

12. It shall be the responsibility of the contractor to arrange and complete all the testing, pre-commissioning and commissioning activities for the particular equipment as per relevant standard, code of practice, manufacturer's instructions and BHEL norms. All the above will be witnessed by BHEL engineers and reports signed jointly. Contractor shall follow checklist of BHEL and testing & commissioning activities shall be carried out in accordance with the checklist.

6.6 TIME SCHEDULE

1. The contractor has to mobilize his resources and work force in such a manner that the entire electrical /C&I work shall be completed with in 7 Months from start of works . The contractor shall complete all the works in the scope of this contract within this period. The date of start of erection work at site shall only be considered as commencement of contract period and shall be certified by BHEL.

2. 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.

3. 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.

4. 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.

5. 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. CONTRACT PERIOD

   The total contract period for completion of entire work shall be 7 months from the start of erection activity. The contractor shall complete all the work in the scope of this contract within this period. The date of start of erection work at site shall only be considered as commencement of contract period and shall be certified by BHEL.

7. CONTRACT EXTENSION

   If the completion of work as detailed in these specification gets delayed beyond the end of contract period , then depending on the balance work left out, BHEL at its discretion may extend the contract.

8. A joint programme shall be drawn for the work to be completed during the extended contract period.

9. During the normal tenure of contract period, 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 through other agency at the risk & cost of the Contractor. The contractor shall not be entitled for any compensation whatsoever in this regard.

6.7 OVER RUN CHARGES

1. In case due to reasons not attributable to the contractor, the work gets delayed and completion time gets extended beyond 7 (Seven) months from the date of commencement of work, the contractor , if eligible for ORC , will be paid ORC of Rs.40,000/- (Rupees forty thousand only) per month for the extended period, duly taking into account the balance work at the end of 7 months period.
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.
3. The period of over run compensation will have to be ascertained before commencement of the ORC period.

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6.8 MEASUREMENTS & WASTAGE & CUTTING ALLOWANCES:

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.
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.
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.
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.
5. While carrying out material appropriation 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. For all site-fabricated steel items such as supports, racks, frames 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.
7. Every month the contractor shall submit an account for all the materials issued to him by BHEL in the standard proforma prescribed for this purpose by the site in charge/ Engineer.

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
01.	Fabrication steel	2
02.	Each size of power cables	1
03.	Each size of control cables	2
04.	Impulse pipe/ tubes/GI pipes/ Cu tube	1

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

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 BHEL Stores for accounting towards wastage. The cables damaged by the contractor shall have to be replaced by the contractor at his own cost.

NOTE:

Salvageable scrap shall mean lengths of pipes, multicables, other cables etc., that can be used one time or other at a later date and normally they are recovered from the cut-pieces of tubes, pipes, multicore cables, cables etc.

Non - Salvageable scrap means the lengths of tubes, pipes, multicore cables, cables etc., and they are from cut-pieces of tubes, pipes, multicore cables, cables etc., that cannot be used at all.

6.9 COLLECTION OF BHEL SCOPE OF SUPPLY MATERIALS

1. BHEL shall issue materials covered in BHEL scope from their stores/ storage yard at site. The contractor shall collect such materials from BHEL stores/ storage yard and transport to his worksite at the contractor’s cost.

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.

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

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

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

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

6.10 STORAGE

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

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 will also help in lifting the packing with fork lift.

3. Periodic inspection of silica gel placed inside the equipment is necessary. It has to be replaced when decolorisation takes place or regenerated. BHEL shall supply the material and contractor shall replace the same.

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.

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. Contractor shall keep BHEL informed about such problem and try to rectify the problem at his risk and cost.

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.

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

8. Sub-Assemblies

   - All sub-assemblies should be kept in a separate place where it is easily accessible.
   - 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.
   - Sub-assemblies should not be stacked one above the other.

9. Loose items (wherever applicable)

   The loose items supplied for the main equipment fall into various categories like tools, cables, prefabricated cables, console inserts, recorders, modules and display units, printers, sensors and transducers, cable glands, cable ducts, frames etc. are to be categorised and stored separately.

6.11 MATERIALS TO BE ARRANGED BY CONTRACTOR

The following items shall be supplied as detailed in the BOQ.

a) Danger boards(as per IS 2713: 1900), hand gloves and
b) Rubber Mats (as per IS5424)
c) Trefoil clamps, made of die cast Aluminium, as per sketch enclosed.

The materials to be supplied shall be procured from reputed manufacturers. Necessary test certificates, guarantee certificate etc. as applicable shall be submitted to BHEL before proceeding with installation.

The above supplies shall be effected in consultation with Engineer-In-Charge. The contractor shall get all the supply items inspected by BHEL Engineers at BHEL stores. Contractor shall hand over all the materials to BHEL stores along with the test / guarantee certificates, if any. and get necessary endorsement from BHEL Stores. BHEL's endorsement or Stores Receipt Voucher shall be submitted along with bills for payment of Supply Items.

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Contractor shall make his own arrangement for transporting these materials to BHEL stores and the materials should be stacked in the area allotted for contractor supplied items.

6.12 MATERIALS/CONSUMABLES TO BE ARRANGED BY THE CONTRACTOR WITHIN THE RATE QUOTED FOR E&C OF RESPECTIVE EQUIPMENT/ITEMS.

01 Welding electrodes and gas.

02 Provision for Temporary Scaffoldings.

03 "U" Clamps with nuts and washers for impulse pipes and GI pipe clamping(if applicable).

04 Tag Plates.

05 Insulation tape.

06 Teflon tape for GI pipe coupling(if applicable).

07 Paints required for primer coating and final coating of synthetic enamel paint of approved colour and consumables like thinner, brushes, emery paper etc.

08 Solder wire (Lead) -(60/40)

09 Protocol/Calibration report sheets as per BHEL Format.

10 Panel/JB Sealing compound material (for cable entry from bottom/Top of Panel).

11 PVC cable tie, Aluminium or GI strips and fasteners for clamping of cables and other dressing materials required for cable dressing Crow mat

12 Ferrules, sleeves for cables

13 PVC cable tie, or Aluminium strip and fasteners (for clamping of cables), lugs upto 2.5 sq.mm

14 Fasteners required for fixing JBs and Push button Stations etc.

6.13 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

6.14 TERMS OF PAYMENT

The contractor should submit his monthly on account monthly bill with all details 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.

a) For transformers :

a.	Receipt, transport to the placement of erection	10%
b.	Placement, assembly, alignment, grouting mounting and wiring loose parts	40%
c.	Oil filling (gas filling) filtration, mechanical operation checking	20%
d.	Pre commissioning checks, tests, calibration and energisation and commissioning	20%
e.	Painting	3%
f.	On submission /acceptance of final bills	2%
g.	After guarantee period	5%

b) For LT Switchgear / DCDB / All types of control and protection panels

a.	Receipt, transport to erection site Placement, assembly fixing and clamping Adjustment, Alignment, grouting and electrical interconnections	70%
b.	Pre-commissioning tests, checks, and making ready for energisation	20%
c.	Completion of pending points/ as built drawings	3%
d.	On submission/acceptance of final bills	2%
e.	After guarantee period	5%

c) For busducts with associated equipments

a.	Receipt, transport to erection site, checking, erection of Supporting structures, Placement, assembly, grouting, Mounting and wiring of loose components	70%
b.	Precommissioning checks, and making ready for energisation	20%
c.	Painting	3%
d.	On submission /acceptance of final bills	2%
e.	After guarantee period	5%

d) For Battery Sets, Charger/UPS:

a.	Receipt, transport to erection site, checking, Placement, assembly, grouting, Mounting and wiring of loose components	50%
b.	Adjustment, alignment, inter connections and pouring of Electrolyte	20%
c.	Pre commissioning checks, and making ready for Energisation	20%
d.	Completion of pending points	3%
e.	On submission/acceptance of final bills	2%
f.	After guarantee period	5%

e) For HT / LT power cables

a.	Laying and tagging, ferruling, meggering/ hipot test as applicable on pro rata basis	70%
b.	Checking/ Dressing on pro rata basis	20%
c.	On submission of as built drawings	3%
d.	On submission /acceptance of final bills	2%
e.	After guarantee period	5%

f) For LT control & instrumentation cables (all types)

a.	Laying and tagging, ferruling, meggering & termination on pro rata basis	70%
b.	Checking/ Dressing on pro rata basis	20%
c.	On submission of as built drawings	3%
d.	On submission/ acceptance of final bills	2%
e.	After guarantee period	5%

g) For Impulse Pipes

a.	On Laying and welding on pro rata basis	75%
b.	On Clamping and Painting on pro rata basis	20%
c.	After guarantee period	5%

h) For Supply Items

a.	On submission of running bill along with the Stores Receipt Voucher/ Stores' Endorsement issued by BHEL , on pro rata basis	95%
b.	After guarantee period	5%

i) For all other items which are not covered in the above Terms of Payment, the payment shall be made as under.

a. 70% of the accepted rate for the respective item of work on prorata basis on satisfactory completion of work.

b. 23% of the accepted rate on completion of the commissioning of the system on prorata basis.

c. 2% shall be paid on submission and passing of final bill.

d. 5% after Guarantee period.

6.15 GUARANTEE

The Balance 5 % of the amount will be paid after completion of 12 months guarantee period. .. The guarantee period of 12 months will commence from the date of handing over of the plant to Customer or 3 months from the date of first synchronization of GT , whichever is earlier.

However, the above 5 % guarantee amount may be released against submission of bank guarantee, from a nationalized/scheduled bank for an equivalent amount ,valid for the entire guarantee period, in the prescribed proforma of BHEL.

The contractor shall be responsible for the quality of workmanship and shall guarantee the work done, shall rectify/replace at free; of cost all defects due to faulty supply/erection and commissioning during the guarantee period.

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/rights.

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

Nil

6.17 TOOLS AND PLANT TO BE ARRANGED BY THE CONTRACTOR

1. Equipment, vehicles, tools and plants and materials brought to site by the contractor from his resources shall have distinctive identification marks and the contractor shall intimate the description and quantity to BHEL in writing.
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.
3. No material or equipment or tools etc. shall be taken out of the work-site without the written consent of BHEL.
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.
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.

6.18 ELECTRICAL INSPECTORATE'S APPROVAL:

1. Contractor is responsible for getting Electrical Inspector/statutory authority's approval for all electrical installation covered in his scope. This also includes the Electrical equipments that are erected by mechanical contractor for which commissioning assistance is to be provided by the Electrical contractor.
2. For getting electrical inspector approval, contractor shall arrange the following:
    a. Erection Completion certificate.
    b. Details of Equipments (specification)
    c. Test results conducted at site.
    d. Any other documents as required by statutory authority.

3. Contractor shall carry out the modifications/rectifications as suggested by the authority at his cost. However, it is not applicable for equipment erected by Mechanical contractor.
4. Contractor shall also conduct re-test if required as suggested by the authority at his cost.
5. Contractor shall also have valid electrical installation license on his company or engage such agency holding valid electrical inspectorate licence as well as for individuals acceptable to respective state electrical inspectorate requirement.
6. 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.

6.19 PROGRESS AND MONITORING OF WORK

1. The responsibility of the contractor to provide all the relevant information on a regular basis regarding erection progress, welding progress, labour availability, equipment deployment, consumption of electrodes, gases, etc.
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 planned with reasons indicating the delays, if any. The report shall also give the remedial actions 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.
3. Contractor shall monitor and submit the progress report on day to day basis as per the format furnished by BHEL.

6.20 CONTRACT VARIATION

The quantities shown in rate schedule are only estimated and the payment will be made on the actual quantity executed on unit rate basis and no compensation or revision of rates is envisaged for any variation in quantities

6.21 EXTRA WORK CHARGES FOR MODIFICATION AND RECTIFICATION WORK

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 fault.
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.

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 will be considered for payment.

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

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

6. 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 .

7. 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.

8. Extra works are broadly defined as below:

   - Design changes which will be intimated 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 will be identified as major and warrant extra, payment, certified as such by the Project Manager and accepted by the designers/competent authority of BHEL.

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

6.22 REPORTING DAMAGES AND CARRYING OUT REPAIRS.

1. Contractor shall render all help to BHEL in assessing and preparing estimates for repairs of components damaged during transit, storage and erection and preparing estimates for fabrication of materials lost during transit, storage and erection. Contractor shall help BHEL to furnish all the data required by railways, insurance company or their surveyors.

2. Contractor on drawing the C&I components from BHEL stores, shall report to BHEL in writing any damages to instrument and contractor shall also report damages while in transit to site and unloading at place of work and any damages during storage and erection and commissioning to BHEL in writing. The above report shall be in as many number of copies as required and in the proforma prescribed by BHEL site management. Any consequential loss arising out of non-compliance of this stipulation will be borne by contractor.

3. Contractor shall carry out fabrication of any material lost for which insurance claim has been made only after getting written instructions from BHEL engineer.

4. 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.

5. All the Repairs/Rectification/Rework of damages and fabrication of materials lost, if any, carried out shall be by a separate gang which could be identified 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 extra works for repair/Rectification/Rework of damages or fabrication of materials lost.

6. Insurance cover under this policy will be as per clauses 2.10.1 to 2.10.4 of general conditions of contract..

6.23 TAXES

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

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

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

6.24 IMPORTANT CONDITIONS FOR PAYMENT

It may be noted that the first running bill will be released only on production of the following.(Please also ref clause 6.25.)

- PF Regn. No.
- Labour License No.
- Workmen Insurance Policy No.
- Unqualified acceptance for detailed LOI
- Initial 50 % Security deposit
- Rs. 100/- Stamp paper for preparation of contract agreement

6.25 PROVIDENT FUND & MINIMUM WAGES

1. Contractor is required to extent the benefit of Provident Fund to the labour employed by him 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 BHEL the code number allotted to him by the Provident Fund authorities within one month from the date of issue of this letter of intent. In case the contractor is e exempted from such remittance an attested copy of authority for such exemption is to be furnished. It may be noted that in the event of failure to comply with the provisions of said Act, if recoveries therefore are enforced from payments due to BHEL by the customer or paid to statutory authorities by us, such amount will be recovered from payments due to the contractor.
2. The contractor shall ensure the payments of minimum labour wages to the workmen under him as per the rules applicable from time to time in the state.
3. **The final bill amount would be released only on production of clearance certificate from PF/ESI and labour authorities as applicable.**

6.26 OTHER STATUTORY REQUIREMENT

1 The contractor shall submit a copy of Labour Licence obtained from the Licensing Officer (Form VI) u/s 25 read with u/r 12 of Contract Labour (R&A) Act 1970 & rules and valid WC Insurance cover or ESI Code (if applicable) and PF Code No. along with the fiirst running bill.

2 The contractor shall submit first running bill along with copies of monthly wages (of the preceding month) u/r 78(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 workmen engaged by him.

3 The contractor should ensure compliance of Section 21 of Contract Labour (R&A) Act 1970 regarding responsibility for payment of Wages. Incase of “Non-Compliance of section 21 or non-payment of wages” to the workmen before the expiry of wage period by the contractor ,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 of disbursal of retrenchment benefits on retrenchment of each workmen under ID 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 andcopies of monthly return on ESI contribution-Dorm 6 under ESI act 1948 (if applicable) to BHEL along with Final Bill.

5 In case of any dispute pending before the appropriate authority under ID act 1948, WC Act 1948 and PF Act 1952, BHEL reserves the right to hold such amounts from the final bills of the contractor , which will be released on submission of proof of settlement of such 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 calims that may arise at a later date without prejudice to the right of BHEL.

6.27.0 TAXES, DUTIES, LEVIES

1 Refer to caluse 2.8.4 of General Conditions of Contract in this regard

2 **SERVICE TAX** : :

Service Tax as applicable for this contract will be paid by BHEl.

The contractor amy calim the Service tax min their first running bill and the same will be paid by BHEL, on production of registration certificate .showing the category of services for doing this work.

3 **NEW LEVIES /TAXES**

In case the government impose any new levy/Tax after award of the work, 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. **No such reimbursement on account of increase in the rate of existing levies shall be made**.

6.28 DETAILS TO BE FURNISHED BY THE TENDERERS

1. Apart from other details called for in the tender document under the various other provisions, the tenderers along with their offers shall submit the following details. Please also refer the checklist.

   Tenderers shall go through very carefully all the provisions under section VI and shall submit manpower deployment plan as per appendix VI A. The contractor along with his offer shall, also submit the list of T&P and instruments that are available with him for mobilisation for the work as specified in Appendix VI B. 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.

   Apart from other details called for in the tender document under the various other provisions, the tenderers along with technical bid shall submit the following details.

   a. HQ Organisation chart
   b. Site Organisation Chart Covering various function
   c. Month wise Manpower deployment plan
   d. T&P deployment plan

6.29 DOCUMENTATION

1. The following information shall be furnished within two weeks of award of contract for approval:
   a. Detailed organization chart
   b. Erection Schedule./ Bar chart covering planned activities at site
   c. Experience details of site staff
   d. Details of calibration instruments

2. The following information shall be furnished during the progress of work.
   a) Calibration certificates for the Instruments calibrated at site.
   b) Test certificates of various tests conducted at site.
   c) Erection and commissioning protocols signed by customer& BHEL

3. As built drawings:

   After successful completion, testing and commissioning of installation work, all the E&C 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.

6.30 RECOMMENDED LIST OF TOOLS AND TACKLES / INSTRUMENTS FOR C&I WORKS

S. NO	DESCRIPTION	QUANTITY
01	Dead Weight tester rated 400 Kg/Sq.cm with weights & test gauges facility	02 No.
02	Oil temperature bath suitable to calibrate upto 300 Deg C	02 No.
03	Furnace range 600 Deg C	01 No.
04	Standard Pressure Gauges as below :	
	0 to 1 Kg/Sq.cm	02 No.
	0 to 5/6 Kg/Sq.cm	02 No.
	0 to 10 Kg/Sq.cm	02 No.
	0 to 16 Kg/Sq.cm	02 No.
	0 to 25 Kg/Sq.cm	02 No.
	0 to 60 Kg/Sq.cm	02 No.
	0 to 100 Kg/Sq.cm	02 No.
	0 to 250 Kg/Sq.cm	02 No.
05	Standard Temperature Gauges as below :	
	0 to 100 Deg C	02 No.
	0 to 200 Deg C	02 No.
	0 to 600 Deg C	02 No.
06	Standard compound pressure gauge -1 to +3 kg/Sq.cm	01 No.
07	Standard Vacuum Gauge -760 mm Hg to 0 Kg/Sq.cm	01 No.
08	Manometer 0 to 1000 mm WC with hand bulb	04 Nos.
09	Portable air compressor with drier and regulator rated for 10 Kg/Sq.cm	02 No.
10	Vacuum pump with standard vacuum gauge	02 No.
11	Standard Milliamps Source (Digital)	10 Nos.
12	Standard Millivolts Source (Digital)	05 Nos.
13	Mercury Manometer different range	04 Nos.

6.31 RECOMMENDED LIST OF TOOLS AND TACKLES / INSTRUMENTS FOR ELECTRICAL WORKS.

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 LPH for transformer dryout.

j) Variac - 1 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) Oil. Tank for transformer oil.

q) Air compressor.

r) Vacuum pump.

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

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

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

v) Tachometer etc.

x) mA Source

y) Standard temperature gauges

z) Temperature oil bath

aa) Micro Ohm Meter for contact resistance measurement of circuit breakers.

bb) Event recorder for measurement of closing and opening time (with micro second accuracy)

cc) DC Power Supply , 24 V ; 5A

dd) Single Phase Variac 250V; 10A

ee) Three Phase Variac 415V

ff) Function Generator

gg) Soldering irons, soldering pump, Vacuum cleaner, Air blower etc.

6.32 RECOMMENDED LIST OF TOOLS & PLANTS REQUIRED FOR ELECTRICAL/ C&I WORKS

S.NO	DESCRIPTION
01	Steel wire ropes
02	Chain pulley block/turfer
03	2 " size pipe bending machine
04	Grinding machine
05	Drilling machines : 1/4" , ½" , 3/4" , 1 "
06	Copper tube bender and cutter sizes 6 mm ;8 mm ;1/2",1/4"
07	Dye sets for threading upto 2 " pipe
08	Set of spanners
09	Allenkey sets
10	Bench vice
11.	Spirit level
12	Tap sets for both BSP & NPT threads upto 1 "
13	Measuring instruments like micrometers, calipers etc.
14	Welding generator
15	Welding transformer
16	TIG Welding set
17	Mechanical tool kit for fitters
18	Electrician tool kit
19	Crimping tool
20	Flood light fittings
21	Fire extinguishers
22	Distribution boards with power cable complete as required
23	Hydraulic test pump rating as per requirement
24	Painting brush
25	Fire proof tarpaulin
26	Safety belts & safety helmets
27	Telephone sets

6.33 CCURACY REQUIREMENT OF CALIBRATION INSTRUMENTS

Sl. No	INSTRUMENT / TOOL	RANGE	ACCURACY
01	Digital Multimeter	Voltage 200 mV to 1000 V DC	± 1% + 1 digit
		Philips Voltage 200mV to 1000 V AC	± 1% + 1 digit
		Hcl Current 200 mA to 10 A AC	± 0.8% + 1 digit
		Philips Current 20 mA to 20 A AC	± 0.8% + 1 digit
		Resistance (Hcl) 2120 200* to 20M*	± 0.5% + 1 digit
		Resistance (Hcl) 2105 200* to 200M*	± 0.25% + 3digits
		Hcl Voltage 200 mV to 750 V	± 0.8% + 1 digit
		Philips Current 20 mA to 20 A DC	± 0.5% + digit
		Hcl Current 200 mA to 010 A AC	± 1% + digit
02	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%
03	MV/mV Source	0 to 200 mA/200mV	0.2%
04	Hand operated Megger 500V/1000V	Upto 200 m Ohms	± 5% at Centre scale
05	Standard Pressure Gauges	0 to 1 kg/Cm^2	±0.25% Lc–0.02 kg/cm^2 10”
		0 to 10 kg/Cm^2	±0.25% Lc–0.02 kg/cm^2 10”
		0 to 25 kg/Cm^2	±0.25% Lc–0.25 kg/cm^2 10”
		0 to 60 kg/Cm^2	±0.25% Lc–0.1 kg/cm^2 10”
		0 to 250 kg/Cm^2	±0.25% Lc–2.5 kg/cm^2 10”
		0 to 6 kg/Cm^2	±0.25% Lc–0.1 kg/cm^2 10”

06	Dead Weight Tester	0 to 400	Lc – 5 kg/cm^2
		0 to 600	Lc – 5 kg/cm^2
07	Standard Hg in glass Thermometer	0 to 100^0C	Lc - 1^0C
		0 to 110^0C	Lc - 1^0C
		0 to 250^0C	Lc - 1^0C
		0 to 150^0C	Lc - 1^0C
		0 to 360^0C	Lc - 1^0C
08	Single Phase Variac	15A Capacity	N/A
09	Power Pack	0 to 50V DC, 3A	$\pm$ 2%
10	Vibration Measuring Equipments	Velocity upto 50 mm/sec.	$\pm$ 0.5% mm/sec
		Displacement upto 300 microns	$\pm$ 2 microns
11	a) Tong tester	0/300/600A AC	$\pm$ 5%
	b) Tong tester	0 to 300A DC	$\pm$ 5%
12	Tacho Meter (Hand held	0 to 4000 rpm	$\pm$ 5%
13	Phase Sequence Meter		N/A
14	Earth Megger (Tester)	0 to 1, 10, 100 Ohms	$\pm$ 5% at Centre Scale range
15	DC Ammeter	0 to 300 A	$\pm$ 10%
16	DC Voltmeter	0 to 500 V	$\pm$ 10%

Note for Contractors' Instruments

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

b. 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 cranes of heavy lift, the 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 will have to be arranged by the contractor at his cost except proprietary type equipment.

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

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

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

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

h. Contractor shall maintain calibration records as per the format CP: PEX:FOX enclosed in the Tender Specification and produce them whenever called for by BHEL Engineers.

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

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

APPENDIX - VI A

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

S.NO	CATEGORY	MONTHS
		1 2 3 4 5 6 7 8 AND SO ON .....
01	C&I/ Elec In-charge	
02	Engineers	
03	Supervisors	
	a. Mechanical	
	b. Electrical	
	c. Industrial Relations/ Safety	
04	Riggers	
05	Fitters	
06	a) HP Welders	
	b) Structure Welders	
07	a) Electricians	
	b) Cable jointer	
08	Store Keeper	
09	Semi skilled and unskilled workers	
10	Watchman/Security	

N O T E

01. Minimum Number of persons to be indicated monthwise.

02. Above deployment plan will be discussed with BHEL Site Engineer and necessary changes will have to be made by the contractor as per discussion. If required, any additional deployment during execution of the work will 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.

APPENDIX - VI B

DEPLOYMENT PLAN FOR MAJOR TOOLS AND PLANTS / INSTRUMENTS

(MONTH WISE QUANTITY TO BE INDICATED CATEGORYWISE BY THE CONTRACTOR

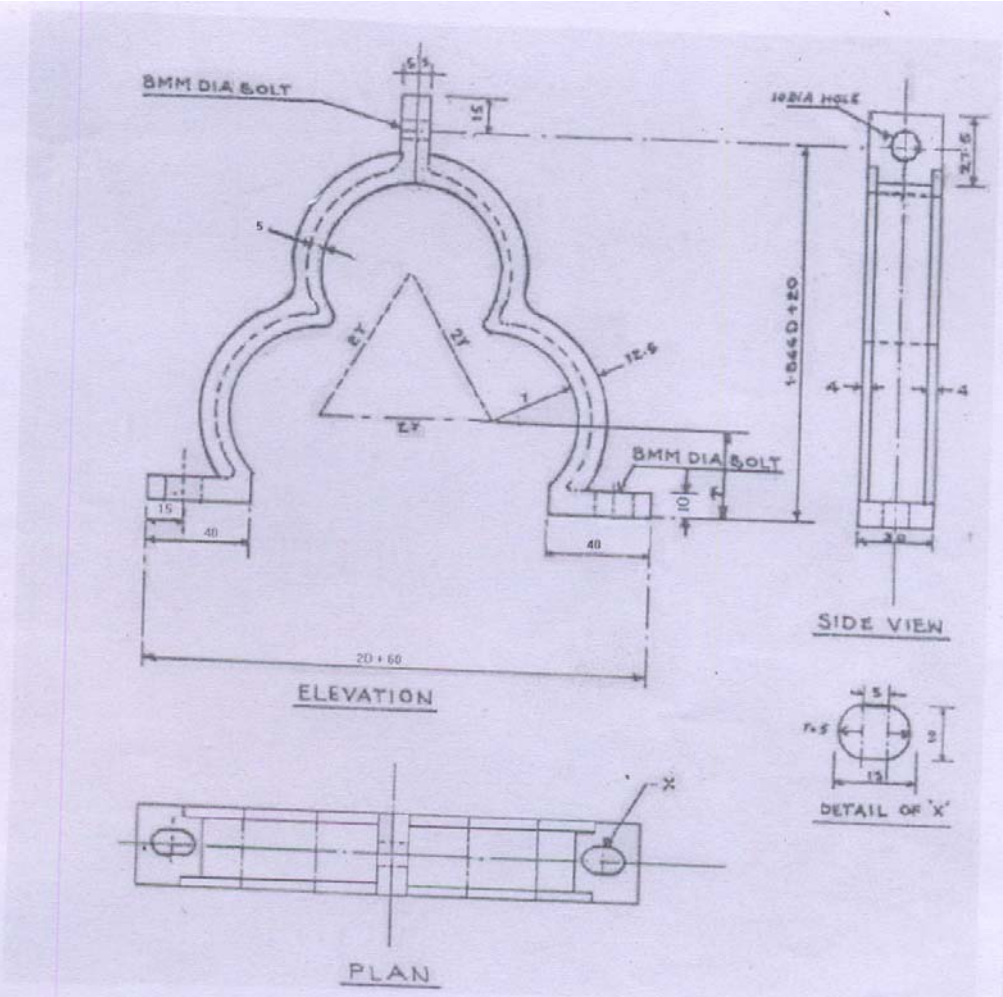
S.NO	CATEGORY	MONTHS	PRESENT
		1 2 3 4 5 6 & SO ON	LOCATION
01	Welding Generators		
02	Welding Transformer		
03	TIG Welding sets(air cooled)		
04	Insulation Tester		
	a. Motorised Megger		
	1000 & 5000 V Grade		
	b. Hand operated Megger		
	500 & 1000 V Grade		
05	Earth resistance Megger		
06	Transformer 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 LPH and 2000 LPH for transformer dryout		
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 dies.		
18	Instrument Air compressor Deadweight Tester		
19	mAmp source		

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



Notes:

1. Trefoil clamp parts will be cast from Commercial Grade Aluminium.
2. All sharp edges, corners and ends shall be rounded smooth.
3. Each clamp will be provided with 3 Nos. M.S. Zinc passivated fasteners. The fasteners will be completed with nut, bolt, 2 Nos. plain washer and 1 No. spring washer.
4. The above drawing is only indicative, the clamps supplied shall suit the cable supplied. Casting tolerance of trefoil clamps shall be limited to ± 1 mm.

BHEL PS:SR **Format No. CP: PEX:FOX**

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

7.1.0 INSPECTION & TESTING IN GENERAL:

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

- Equipment shall be considered to be completely erected when the following activities have been completed.
- Moving of all equipments to the respective foundations.
- Fixing of anchor bolts or tack welding as required.
- Levelling and alignment of equipment.
- Assembling of all accessories such as relays, CTs, PTs, meters, instruments etc. as described in the job specification.
- Drying of equipment as required and testing of oil for di-electric strength.
- Filtration and filling of oil as required.
- Cable laying, termination with continuity check.
- Applying of finishing coat of paint.
- Mounting of lighting fixtures and connections.
- Completion of earthing system.

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.

7.1.1 SITE TESTS AND CHECKS

a) General

All the equipments 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 finalised 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 engineer in-charge system/ equipment Completion 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 chargings 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.

7.1.2 TRANSFORMER

7.1.2.1 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 knows the various working operations very well.

7.1.2.2 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 pressure indicates that the tank and the transformer components respectively are tight, and that the active part including the insulation materials are dry.

If there is no positive gas-pressure, transformer should be immediately filled with dry Nitrogen gas at a pressure of 0.17 kg/Cm^2 (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 .

7.1.2.3 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.

7.1.2.4 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.

7.1.2.5 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.

7.1.2.6 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. Tapchanger 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:

1. Fire-fighting equipment shall be available at the oil-treatment equipment as well as at work on and adjacent to the transformer.

2. 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.

3. Smoking on or near the transformer shall not be allowed.

4. Transformer tank, control cabinet etc, as well as assembling and oil-treatment equipment shall be connected with the permanent earthing system of the station

5. Check that there is no overpressure in the transformer when blanking plates or connection lids are to be opened.

6. All loose objects, tools, screws, nuts etc.. shall be removed from the transformer cover before opening the connection and blanking lids.

7. All loose objects (tools, pencils, spectacles etc..) shall be removed from the boiler- suit pockets etc. before starting the work through man holes.

8. 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.

9. Tools with loose sleeves and tools with catches must not be used at work inside the transformer.

10. Greatest possible cleanliness shall be observed at work inside the transformer, and at handling of part to be mounted inside the transformer.

11. Fibrous cleaning materials should not be used as it can deteriorate oil when mixed with it.

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

13. 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 oil to the interior of the tank. The warm oil should be circulated all the time transformer is open to atmosphere.

14. Oil pump & all joints in the oil pipe work should be air tight to avoid entrance of air through leakage joints.

15. 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.

16. Objects which-despite all precaution are dropped inside the transformer, must absolutely be brought out from the equipment.

17. Check that the oxygen content inside the transformer tank is minimum 20% if a person is to enter the tank.

7.1.2.7 ASSEMBLY

Assembly of wheels Bushing Valves, cooling device, Oil conservator, Pipe Flanges, Blanking plates and accessories like cooling fans, pumps, OLTC and components for supervision and control oil level indicator, flow indicators, gauges, Bucholz relay, PRV, thermometers etc. are assembled according to leaflet/ description valid for the components.

7.1.2.8 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 Bucholz 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 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 cell 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 o.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 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) Conservator tank shall be filled up with oil as per the supplier's instructions.

(x) The system is now properly filled. Air release plugs are fitted in normal operation.

7.1.2.9 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.

(viii) Valves, fitting, gaskets etc.

(ix) Dry nitrogen cylinders.

7.1.2.10 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 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. Local and remote operation of tap changer
25. TAN-DELTA test if quality check list calls for.

INSULATION RESISTANCE TEST

Sl.No	Description	Date	Time 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 than 1000 V megger)						
	c) LV/E+HV+LV						
	d) HV/IV						
	e) IV/LV						
	f) 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 wthdrawing 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.

7.2.0 BUSDUCTS - SEGREGATED PHASE

HANDLING AND STORAGE

7.2.1 General

Busduct form the main electrical connections between the Generator and associated generator transformer and tap-off to PTSP cubicle. 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.

7.2.3 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

DOs

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.
8. 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 :

DOs

1. Carry out pre-lay survey to verify the position of various equipments to be connected, levels of floors and positions of cut-outs.
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. Take care for proper sealing while joining the enclosure.
8. Ensure proper earthing of enclosure and structure as specified.
9. Check wiring as per relevant wiring diagram.
10. Ensure that CT secondaries are shorted and grounded before HV test 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 subject IAS, capacitors, and PTs to HT test as these are pretested and test at site is not required.
6. Don't subject NG transformers to over voltage as these are pretested.
7. 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 :

1. Project name and unit number
2. Item no of main BOM this is encircled
3. Phase marking R, Y or B
4. Work order number
5. Drawing number and item/variant number
6. Arrow indicating direction towards switchgears. 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 equipments such as switchgear, unit auxiliary transformer, LA & VT 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) along with CTs and wiring as per drawing at the working floor and match with the top chamber (if applicable). Now fix the supporting structure.

Assemble N.G. Transformer and N.G. Reactor and complete the terminal connections.

Note : Before fixing top chamber / bottom chamber, care should be taken that shunts are welded on line side busduct as shown in lay out drawing :

(b) Line 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.

(c) 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.

(c) 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.

(e) 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 (Unplated)

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 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 and 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.

7.2.15 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 10 mm 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 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 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, oil, grease and any other 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 cloth. 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 arrestors

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. Megger-Checks :

Before the application of high voltage, check the insulation of each bus, conductors by means of 2.5 KV megger. A value e. 100 mega ohms is expected under normal conditions. However, during mainly season this value may fall down considerably and drying up by hot air may be necessary before the test. Minimum acceptable value is around 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 section including tap-off must withstand the above test voltage.

7.2.20 Site Test Records on Segregated Phase Busducts :

Test conducted on date..... Site .....

Power Frequency high voltage test :

Instrument .....

Phase	Megger Reading before after HV test HV test	HV applied & duration A.C./D.C.	Leakage current	Remarks
R				
Y				
B				

7.3.0 SWITCHGEAR / CONTROL PANELS :

The following points shall be checked up during erection.

7.3.1 Layout of foundation channels.

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

7.3.3 Location and serial no. of panels.

7.3.4 Positioning of panels.

7.3.5 Verticality of switchgear panels within the limit specified.

7.3.6 Franes of Breaker Truck and modules in housing and its manual operation.

7.3.7 Earthing of panels and breaker truck to station earth.

7.3.8 Lugs for termination of HT and LT cables.

7.3.9 Mounting and fixing arrangements of Bus bars.

7.3.10 Tightening of Busbar jointing bolts as specified.

7.3.11 Clearance between :

i. Phase to Phase

ii. Phase to earth

7.3.12 Minimum clearance for :

i. Breaker, Truck and modules withdrawal

ii. Distance required for maintenance work

7.313 Check the operation of :

i. Remote control

ii. Various required - closing / tripping / alarm / indications / interlocks

7.3.14 Installation position of instruments and relays

Operation of relays and meters by secondary injection.

7.3.15 AC/DC supplies for panel

Final relay settings as per customer requirements.

7.3.16 Tightness of terminal connections for HT & LT connections.

7.3.17 Opening operation of breaker, manually and electrically.

7.3.18 Working of ammeters and voltmeters for their entire range and other panel mounted instruments like recorder, indicator etc.

7.4.0 TEST FOR GENERATOR RELAY AND CONTROL PANELS :

A. For generator relay panel :

(i) Functional checks on all the relays in the panel like pickup and drop of voltage and by doing secondary injection.

(ii) Loop checking of the relays.

(iii) Checking of interlock and protection as per schemes by Primary injection.

(iv) Checking of synchronising circuits.

(v) Calibration of energy meter

B. For generator and transformer control panel :

(i) Checking of the control circuits.

(ii) Calibration of the panel meters.

(iii) Checking of the total annunciator / indication system.

(vi) Calibration of energy meters.

7.5.0 BATTERY AND BATTERY CHARGER TESTS

Battery

1. Checking for completion of civil/ventilation requirement of battery room.
2. Checking of adequacy of charger output/requirement wrt current required battery charging as per the manual.
3. Check availability of safety devices, water and first aid kit.
4. Check polarity of connections between battery and charger
5. Visual inspection test for level and leakage.
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.

Battery Charger

1. IR test
2. HV test
3. Checking voltage ratio of boost and float mode transformers
4. Checking for charging mode of batteries, 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 calibration of all indicating meters.
9. Check functional operation of charger, auto/manual change over from float to boost and boost to float etc.

10. Checking and setting of all relays
11. Check AC ripple in boost and float mode after charging.
12. Check polarity of cables connected to battery.

Apart from above following tests also to be carried out.

1. Insulation resistance and earth resistance checks.
2. Primary and secondary injection test.
3. Calibration of all instruments
4. 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.
5. Battery capacity test

7.6.0 SITE TESTS - FOR THE EQUIPMENT ERECTED BY MECHANICAL CONTRACTOR

The tests to be carried out on the equipment's 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 for 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 minimum tests shall be carried out on the generators :

1. Insulation resistance test and determination of polarization index value of:
   - **Generator**
   - **Excitor**
   - **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. Overspeed test
7. Vibration tests*
8. Calculation of efficiency
9. Phase sequence/voltage balance/current balance checks.
10. Insulation of bearing pedestal/housing
11. Determination of reactances and time constants.
12. Wave form test and harmonic analysis (Type test results are acceptable).
13. Determination of moment of inertia (Type test results are acceptable).

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.

14. Instantaneous short circuit test (Optional).
15. Noise measurement test.
16. Response of voltage and frequency with sudden shedding of 25%, 50%, 75% and 100% of rated load respectively.
17. Response of voltage and frequency with sudden application of 25%, 50%, 75% and 100% rated load respectively.
18. General dimensional alignment checks.
19. Temperature detector test
20. Measurement of DC resistance of winding
21. Pressure test on heat exchangers (cooling system)
22. Inter turn insulation test of stator winding with induced voltage 130% of rated value for 5 minutes (if applicable).

23. Measurement of shaft voltage.

24. String test as per data sheet.

b) AC MOTORS

1. IR test of stator and rotor windings.
2. Heating of both windings upto the permissible temp.
3. Ensure that checking/testing of associated switchboard, cables, relays/meter interlockings as mentioned in relevant chapters are completed.
4. Check tightness of cable connection.
5. Winding resistance measurement of stator and rotor.
6. Checking continuity of winding.
7. Check tightness of earth connections.
8. Check space heaters and carryout heating of winding (if required)
9. Check direction of rotation in decoupled condition during kick start
10. Measure 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. During load running, measurement of stator and bearing temperatures (if applicable) for every half and hour interval till saturation comes.
16. Checking tightness of foundation bolts
17. Check operation of speed switch (if there)
18. Check continuity of temp. detectors.
19. Check alignment, paralleling of shafts, level of lubricating oil etc. as per manufacturer's manual.
20. Check contact of slip ring brush and measure brush pressure (150-200 gm/sq. cm)

21. For CACW drive check cooling water and system/piping, availability of pressure, cleaning and pressure testing of pipelines etc.

22. Check for 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.

23. Dielectric test (only for HT motors).

24. Measurement of open circuit rotor winding voltage for slip ring motor.

25. For actuator drives following shall be checked/tested :

    – Visual and dimensional

    – Hydraulic pressure for valves

    – IR and operation of limit switches

    – Winding resistance

c) 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.

CONTROLS & INSTRUMENTATION PACKAGE

7.7.0 **GUIDELINES FOR INSTALLATION OF C & I EQUIPMENTS**

7.7.1 Instruments location shall be decided to the convenience of operation and maintenance. The location shall have least mechanical vibration and placed where corrosive, toxic and explosive gases and dust particles will not deposit and the place is not subject to high-temperature atmosphere or radiation. However, actual location shall be decided in consultation with customer/consultant.

7.7.2 Maintenance platforms & approach facilities shall be provided for all sensing & primary devices wherever possible.

7.7.3 Instruments shall be located in weatherproof enclosures and wherever required suitable canopy shall be provided.

7.7.4 High & Low pressure impulse lines shall not be grouped and run together. Also impulse lines for explosive & inert gases shall not run together.

7.7.5 Impulse lines of high pressure steam, harmful gases, etc. shall not be brought into the control room, as far as possible.

7.7.6 Intrinsically safe circuits shall be used for explosion hazardous areas.

7.7.7 Separate cable routing shall be followed for high and low voltage lines.

7.7.8 All electrical equipments shall meet the requirements of Indian Electricity Rules.

7.7.9 Wherever severe vibrations are expected, shock absorbers shall be provided.

7.7.10 Before and after regulating/control valves, straight pipe lengths of 10 mm dia. on either side must be ensured.

7.7.11 Installation of instruments with radioactive isotopes, mercury and other toxic substances shall be as per statutory regulations provided by authorities.

7.7.12 Compensating cables should be connected directly to instruments, i.e. no junction boxes shall be used if CJCBs are not provided..

7.7.13 Orifice plates or flow nozzles must be provided with at least 10D upstream and 5D

downstream straight length of pipe from bends tees, branch pipes & control valves.

7.7.14 Control valves shall be installed after orifice plates.

7.7.15 Pressure gauges shall be provided with snubbers, syphons (for more than 100°C), 3 way valve manifolds wherever applicable.

7.7.16 For pneumatic instruments, air shall be dry & free from oil. Air must be supplied from oil-free compressors specially erected for this purpose. After drying, air must be stored in receiver. Pressure gauges must be provided on each supply line and after the pressure reducer.

7.7.17 Correct level (height) between detecting element and tapping point and transmitter shall be maintained.

7.7.18 The equipment shall maintain its normal posture (level, perpendicular, front and back).

7.7.19 Connection between detecting element/tapping point and transmitter shall be maintained at short distances wherever practicable to avoid any time lag.

7.7.20 Orifice plates and control valves shall be mounted on process piping, only after completion of cleaning of the process piping in order that these instruments may not suffer damage from metal waste, etc.

7.7.21 For details of installing each measuring instruments, instruction manual issued by the respective manufacturer of instruments may be referred to, wherever necessary.

7.7.22 The drain pipes shall be terminated in a common closed header and finally the common header shall be connected to plant open drain.

7.7.23 Impulse pipe material shall be identified for each individual pipe prior to its use at site. For this purpose coloring is to be done immediately after receipt.

7.8.0 GUIDE LINE FOR ERECTION OF IMPULSE LINES

7.8.1 All impulse lines burrs and airlines shall be thoroughly cleaned of any foreign matter by cleaning with compressed air and the same shall be done before installation.

7.8.2 The routing of pipelines shall include sufficient flexibility near tappings to allow for

thermal expansion of the process equipment.

7.8.3 The pipes shall be cold bent using hydraulic bending machines only.

7.8.4 The horizontal impulse lines shall be laid with proper slopes towards the tapping point.

7.8.5 Supports for piping and tubing shall be adequate and in no case exceed limits shown below:

a) ¼" OD/ ⅜" OD Copper Continuous

b) ½" NB Pipe/Tube 5'

c) ¾" NB Pipe/Tube 5'

d) 1" NB Pipe/Tube 8'

7.8.6 All impulse line welding shall be done through welding generator/rectifier and only structural welding could be done through welding transformer.

7.8.7 Impulse pipe of Alloy Steel/SS/CS shall be TIG welded wherever required. Welding of impulse pipe shall be carried out in accordance with BHEL welding procedure. The welding electrodes shall be approved by BHEL welding Engineers. Impulse pipes welders shall undergo welding Test and approved by BHEL welding engineer at site.

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

7.8.9 The impulse pipe laying is recommended to be limited to a maximum of 10 metres (each limb) generally, unless otherwise specified, to have optimum response from the transmitter. However, this will depend upon plant layout.

7.8.10 Where the tapping point is subjected to mechanical shift due to heating/cooling of main equipment, care should be taken to route the impulse pipe in such a way as to absorb the shift of tapping point without straining the impulse piping. To accommodate this, sufficient loop for the impulse pipes can be provided near to the tapping point.

7.8.11 Alternatively hose assembly - S.S. flexible may be used for connection between tapping point and impulse pipe.

7.8.12 The expansion bends are to be avoided as far as possible, as these act as air/sedimentation traps hampering the system performance.

7.8.13 Impulse piping shall be arranged as short as possible with a minimum of bends.

7.8.14 Horizontal piping shall be avoided and 1/10 slope shall be maintained.

7.8.15 Pipes shall not be laid parallel to high temperature process piping.

7.8.16 Pipe joints shall be carried out using sockets and flanges. Union fittings may be used when pressure is low. In the case of D.P. instruments both piping on low side and high side shall be maintained at same length and in the same route.

7.8.17 **Impulse Piping for Air & Flue Gas System**

For furnace pressure and furnace flue gas, suitable piping for air and furnace flue gas pressure, the impulse pipe shall be arranged to rise vertically from the tapping point to a distance at least of 300 mm before a change of direction is made.

7.8.18 Arrangements should be made for air purge in the impulse piping system at the end of the instrument airline or roding facilities may also be provided with suitable tees and cross.

7.8.19 In order to take care of the boiler expansion, suitable flexible connecting pipes can be arranged either at the tapping point end or at the instrument end.

7.8.20 **Impulse Piping for Vacuum Measurement**

The measuring instruments used on vacuum measurement should always be installed above the level of the tapping point in order to minimise measuring errors as much as possible. A suitable condensing chamber can be arranged which will eliminate the condensate or any blocking in the impulse pipe.

7.8.21 **Impulse Piping for Steam and Water System**

As a rule, instrument installation position for steam and water shall be downward from root valves.

7.8.22 Impulse pipes shall have a minimum slope of 1:10 and shall be supported at every 2 metres length.

7.8.23 At the transmitter end, the connection can be either through 2 way valve manifold or nipple with coupling.

7.8.24 In case 2 way manifold used and connected with nipple and coupling, it is necessary to provide tee with plug for purging or venting. The impulse pipe connection to the transmitter from the main pipe may be either upper side or lower side of the transmitter. In any case sufficient slope shall be maintained.

7.8.25 Some supplier recommends capillary type tube for transmitter connection from the impulse pipe to instrument by using S.S. tube and compression fittings.

7.8.26 It is always preferable to mount the instrument below the tapping points because the condensate shall protect the instruments against high temperature. In any case, the temperature entering the instrument should not exceed 150 F. Incase the instrument is installed above tapping, before opening the process root valves, the impulse pipe shall be filled with water.

7.8.27 In the case of high temperature steam applications, sufficient length or siphon shall be provided to ensure certain length of condensate is formed thereby protecting breaking the measuring instruments from high temperature. Snubbers can also be provided if there is likely to be any pulsating of the medium measured.

7.8.28 **Bending**

It is recommended for cold bend for the impulse pipes with the help of a hydraulic bending machine to achieve a particular shape.

7.8.29 Use of 45° elbow and 90° bends (ready-made) is restricted to bare minimum to minimise the number of joints in a system. Hot bending is not to be used as this leads to flattening of pipes at the bends and also results in thinning of walls, apart from introducing changes in metallurgical properties of the pipe material.

7.8.30 Hot bending may be permitted for carbon steel pipe for low pressure service as instructed by supervisor only when it cannot be avoided. In the case of 90° bending radius shall be more than 3 times the outside diameter of pipe and in the case of 'u'

bending, radius of bending shall be 5 times the outside diameter of pipe. When the radius of bending becomes small, elbow fitting shall; be used.

7.8.31 Large bending shall be so made as to form smooth curve.

7.8.32 **Cutting**

- Pipe cutter or wheel grinder shall be used for pipe cutting.

- Gas cutting shall be avoided.

- Burr inside the cut end shall be removed.

- The cutting surface shall be as perpendicular to the axis as possible.

7.8.33 **Impulse Pipe Welding**

Generally, welding of impulse pipe and fitting shall be carried out by arc welding and socket welding is adopted. Welding shall be performed by a qualified welders. Only D.C. arc welding is recommended for impulse pipe. Motor generator is preferred to rectifier transformer, since it may damage the welding joints due to surge.

In order to prevent the cracking of the weld it is recommended to provide a small gap between the bottom of the socket and pipe end.

7.8.34 **Testing**

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

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

7.9.0 GUIDELINES FOR INSTALLATION OF PNEUMATIC LINE

7.9.1 Copper tubing shall be connected with Olive type of compression fittings,

7.9.2 When two or more lines run together, the joint in the adjacent alternate line shall be

a offset.

7.9.3 In case of copper tubing, the single run copper tube may be supported with an angle. However, suitable trays shall be used for more than one tubing.

7.9.4 Multi-core copper tubing shall not to be bend less than 10 deg and D is the OD if the multi-core copper.

7.9.5 All air distribution, main and branch lines shall be galvanised internally as well as externally and the galvanised pipe, never, shall be braced or welded.

7.9.6 The joints shall be screwed with Teflon tapping wherever the pipes are to be removed frequently for cleaning and other purposes and suitable union fittings shall be used.

7.9.7 Care shall be taken while taking a branch pipe to see that the line is not taken from the lower part of the main line or main header in order to avoid entry of any drain or dust into the system.

7.9.8 Instrument airline should not be routed where severe vibration, high temperature exists and adequate space should be available for maintenance.

7.9.9 Care shall be taken when removing the PVC sheeting, while connecting the copper tube. The exposed portion after jointing shall not be excessive and also while removing PVC, the tube should not get damaged. Pipe cutters should not be used for cutting the copper tube, instead the specific copper tube cutter shall be used. Similarly, for bending copper tubes, specific copper tube bender should be used and the radius of the bending shall be more than 2.5 times of the OD of the copper tube.

7.9.10 While using the pipe cutter, care shall be taken to remove burr from the cutting side.

7.9.11 In locations where the copper tube is likely to be damaged from outside, the copper tube can be routed near a different pipe. While laying copper tube either inside angle or trays, the tube shall be supported at least at every one meter distance.

7.9.12 While fixing the copper tube fittings only Teflon tapes should be used. However, no tape shall be used while tightening the ferrules.

7.9.13 **Instrument Air line Testing**

– All instrument air lines shall be isolated from the instruments and pressurised pneumatically to maximum working pressure. It shall then be isolated from the source of pressure and fall shall be less than 1 psi in 20 minutes.

– All pneumatic signal lines shall be disconnected and blown through with instrument air. The line shall be blanked off and pressurised pneumatically 20 psi, and checked with soap solution for leak.

7.10.0 GENERAL GUIDELINES ON INSTALLATION OF FLEXIBLE HOSES

Flexible hoses can be classified into two broad categories, viz., Rubber hoses and Metallic hoses. The selection of the hoses is made depending upon the service conditions (pressure, temperature and other environmental conditions).

7.10.1 Under pressure, a hose may change in length. Always provide some slack in the hose to allow for this shrinkage or expansion. (However, excessive slack in hose lines is one of the most common causes of poor appearance).

7.10.2 At bends, provide enough hose for a wide radius curve. Too tight a bend pinches the hose and restricts the flow. The line could even kink and close entirely. In many cases, use of the right fittings or adapters can eliminate bends or kinks.

7.10.3 In applications where there is considerable vibration or flexing, allow additional hose length. The metal hose fittings, of course, are not flexible and proper installation protects metal parts from undue stress, and avoids kinks in the hose.

7.10.4 Hose assemblies in service should be inspected frequently for leakage, kinking, corrosion, abrasion or any other signs of wear or damage. Hose assemblies that are worn or damaged should be removed from service and replaced immediately.

7.10.5 The service life expectation of a flexible hose mainly depend on the correct installation layout. In most cases, when flexible hoses fail prematurely, the reason of failure may be found in an incorrect layout.

7.10.6 As a rule, the hose is not to be bent over its limit of elasticity. The choice of the right hose length is of crucial importance. The hose should not be subject to torsion.

Torsion can be usually eliminated by changing the layout.

7.11.0 GENERAL NOTES ON INSTALLATION OF LOCAL INSTRUMENT RACKS AND JB FRAMES

7.11.1 In **cases** where the local instrument stands are to be installed on a concrete foundation, it shall be fixed by anchor bolts.

7.11.2 In cases where the local instrument stands are to be installed on the base plate, the stand can be placed on an angle and the same can be welded. However, in cases where there is a probability for removal of stand is likely to arise, it shall be fixed by bolts.

7.11.3 Installation of local junction boxes shall be installed in such a way that they are fixed on a column by welding or by fixing bolts.

7.11.4 Local Instrumentation rack, which shall be installed utilising the Beam and Structure, shall be fixed by welding. Care shall be taken while deciding the location in order to ensure that no hindrance is caused to the maintenance personnel in their moving space within the work area. Further, as a standard practice, it should be ensured that no instrument stands/racks/JBs shall be supported by/welded on to any of the working equipments, or even hand grilled or floor grilled, as peer safety norms.

7.11.5 Proper care should be taken to ensure that welding of the stand on any structure or Beam is fully welded.

7.12.0 GENERAL GUIDELINE ON FLOW INSTRUMENTS INSTALLATION

7.12.1 Extreme care shall be taken when welding and assembling the flow element on the pipe. Any misalignment or rough particle or edge inside the welded area may cause inaccuracy and this will increase as the flow increases.

7.12.2 Flow elements should always be located in upstream from any valve. Downstream side of valve shall no longer be a homogenous mixture and this may cause erratic behaviour of reading periodically.

7.12.3 Care shall be taken while welding the impulse pipe. Improper arrangement of piping of DP instruments can create error in the reading and even it gives an indication of negative flow of steam even though the flow is to be positive. Inadequate exchange

of steam and condensate in the piping may cause negative flow. The presence of burr or dirt in the pipe can impede the flow of condensate back to the pipe, and when this happens, the pipe becomes full of water and has the effect of creating negative head.

7.12.4 Always ¾" to 1" pipe is recommended for free flow condensate. Gate valve shall be used for the tapping and pipe should be insulated up to condensing pot.

7.12.5 The Measuring instrument shall be located close to the flow-sensing element. The speed of response is reduced if there is a long run,

7.12.6 The orifice plates shall be installed such that the extreme face is perpendicular to the axis of the pipe within the +2 deg or -2deg. and it should be ensured that when the extreme face is facing the direction of flow, invariably the sign of positive (+) is marked on the upstream.

7.12.7 Location of Flow element should have clear straight run of 10D in upstream and 5D in downstream.

7.12.8 For non-viscous liquid flow measurements, the best location for the instruments shall be below the pipeline, If the instrument is above the line, more maintenance will be involved. Suitable vapour traps shall be provided.

7.12.9 In the case of air and gas flow measurement system, as part of basic requirement, it should be transmitted to the instruments without any change in the differential head due to leakage.

7.12.10 If the flow of any dry gases are to be measured, the location of instrument can be kept above or below the tapping points.

7.12.11 For air flow measurements, it is always preferable to install the instruments above the pipeline. Incase, if the instrument must be installed below the duct/pipeline, suitable Dust Collection Chamber can be installed.

7.12.12 The condenser pot should be located nearer to the tapping point and both condenser chamber should be at the level of upper tapping,

7.12.13 The unequal level will cause significant error due to false heads. If the flow nozzle is

installed in vertical pipe, the lower tapping pipe which is bent and taken up to upper tapping in order to align with the upper condensate pot, must be insulated, otherwise, error is created when the bent pipe fills with condensate. The error may add or subtract depending upon the direction of flow.

7.12.14 For flow measurements, the instruments should always be located below the condenser pot, otherwise, the condensate will be lost from the system and the instrument will reach 'O' during the shutdown and the total system must be vented after the start up of the boiler in order to remove Air and Vapour which might have got entrapped.

7.12.15 In an installation where the instruments must be located above the tapping points and the condensing chamber should be equally located above the instruments the pipeline up to the condensing pot should be insulated.

7.12.16 In the case of viscous fluids, flow measurements which are likely to freeze or concealed in the pressure pipe or like such corrosive type fluids, suitable sealing chamber shall be used, the sealing liquid should not mix or react with the medium to be measured.

7.12.17 The commonly used sealing liquid includes water, light oil, glycerol, ethylene glycol and mixtures of the last two with water.

7.12.18 The sealing chambers, in each pressure pipe, should be installed at the same level and as close as possible to the pressure tappings.

7.12.19 The general arrangement for pressure tappings from the Sealing Chamber to the instrument is shown in the sketch.

7.12.20 The flow elements should be inspected before installation to find out the presence of any corrosion/rusting or any blockage on the pressure tapping holes or any deposits on the face of the orifice plate.

7.13.0 GENERAL GUIDELINE ON INSTALLATION OF VALVES

7.13.1 Primary isolating valves (root valves) must be located at the tapping which can be of globe valves.

7.13.2 These valves shall be installed where access is possible.

7.13.3 Secondary isolating valves shall be located at the end of inter-connecting pipe. It should be as nearer as possible to the measuring instruments and should be of needle type.

7.13.4 For pressure more than exceeding 40 kg, 2 isolating valves shall be provided.

7.13.5 In the case of heavy duty isolating valves, suitable support shall be provided to avoid any loading on the stubs.

7.13.6 In viscous fluids, suitable steam tracing shall be provided.

7.13.7 These valves are always located as nearer to the measuring device as possible.

7.13.8 Blowdown Valves or Drain Valves

a) These valves are fixed at the lowest end of impulse pipe.

b) In the case of high-pressure line always 2 valves shall be fitted in series. Normally, these valves will be of globe type.

c) For low-pressure application, single valve is used.

d) In case of air and flue gas measurements, either a plug or a suitable gate valve of gunmetal `on/off' valve shall be provided.

e) The drain valve shall be connected to the common drain header which finally is terminated at plate operation drain system.

7.14.0 GUIDELINES FOR CABLE LAYING

7.14.1 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.

7.14.2 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.

7.14.3 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.

7.14.4 GI conduits shall also be used for flameproof installations, wherever required, with sealing at both ends.

7.14.5 In corrosive atmosphere, where 1100 V grade cables are required to be taken in pipes, rigid heavy-duty PVC pipes shall be provided.

7.14.6 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.

7.14.7 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.

7.14.8 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 up to a height of 2000mm from the working floor levels and platforms, for protection against mechanical damage. All vertical risers shall be of enclosed type.

7.14.9 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.

7.14.10 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.

7.14.11 Wherever direct heat radiation exists, heat isolating barriers (subject to customers approval), for cabling system shall be adopted.

7.14.12 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.

7.14.13 If required, a few number of cables in exceptional areas may be directly buried into the earth.

7.14.14 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.

7.14.15 At certain places where hazardous fumes/gases may cause fire to the cables, cable trenches after installation of cables may be sand-filled.

7.14.16 In corrosive atmosphere, PVC conduits shall be used for cables.

7.14.17 Single core cables, when pulled individually shall be taken through PVC pipes only.

7.14.18 Laying and installation of power, control and special cables shall generally conform to IS : 1255

7.14.19 The cables shall be laid-out in proper direction from the cable drums (opposite to the normal direction of rotation for transportation).

7.14.20 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.

7.14.21 Suitable extra length of cables shall be provided for all feeders for any future contingency, in consultation with Engineer.

7.14.22 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.

7.14.23 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.

7.14.24 When a cable passes through a wall, cable number tags shall be fixed on both sides of the wall.

7.14.25 Single core cables for AC Circuits shall form a complete circuit in trefoil formation supported by means of trefoil clamps of non-magnetic material.

7.14.26 Multi-core cables above 1100 V grade shall be generally laid in ladder type trays in one layer with spacings not less than one cable diameter of bigger diameter cable.

7.14.27 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.

7.14.28 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.

7.14.29 Segregation of the cables on the basis of their types and their functions shall be as under for horizontal formation:

a) HT cables shall be laid in the top tier(s)

b) LT power cables to be laid in the tray(s) below the HT cable trays.

c) LT control cables to be laid in the Tray(s) next below to the LT power cable (trays)

d) Special control cables including screened control cables to be laid in the bottom most tray(s).

7.14.30 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.

7.14.31 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.

a) Control cables are mixed up with the special control cables with clear minimum gap of 100mm between them.

b) LT power cables are mixed up with control cable with clear minimum gap of 150mm between them.

c) LT power cables are mixed up with HT power cables with clear minimum gap of 200mm between them.

d) LT power cables are mixed up with special control cables with clear minimum gap of 200mm between them.

7.14.32 In case 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.

7.14.33 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.

7.14.34 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 6mm thickness.

7.14.35 To facilitate pulling of cables in GI conduits, powdered soft stone, plastic scoap or other dry inert lubricant may be used but grease or other material harmful to the cable sheaths shall not be used.

7.14.36 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.

7.14.37 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.

7.14.38 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.

7.14.39 Wherever specific cable routes are not shown in cable schedules cables shall be laid as directed by Engineer.

7.14.40 Support Spacings & Clampings

Support spacing and clamping suitably provided and as required

7.14.41 Laying of cables directly buried in ground

Laying and installation of directly buried cables in ground shall conform to the requirements of IS 1255.

7.15.0 DESIGN REQUIREMENT FOR EQUIPMENT AND MATERIAL - FOR SUPPLY ITEMS.

7.15.1 CABLE GLANDS

Cable glands shall be tinned or nickel plated brass, single/double compression type, weather/explosion-proof as the case may be complete with necessary armour clamp and tapered washer etc. Cable glands shall match with the sizes of different cables as indicated in the Schedule of Rates

7.15.2 STRIP CABLE CLAMPS

a) Strip Clamps shall be of aluminium alloy or cast steel or M.S. and shall be used to fasten the group of multicore cables on the tray.

b) Clamps shall be of simple construction, made of 4 mm thick, 25 mm wide strip to cover the entire width upto 300 wide tray and part of the tray for more than 300 wide trays. Strip shall have two right angle bends for fixing on the rung with two bolts.

c) Clamps shall be of different lengths for different sizes of tray width. The maximum size of clamp width shall be 300 mm and for cable trays of greater width, two clamps shall be used.

7.15.3 SELF LOCKING CLAMPS

a) Clamps shall be of nylon material/fibre glass.

b) Clamps shall have self locking feature when the cord is looped.

c) Clamps shall be provided with manual lock release.

d) Clamp cord shall not move in the backward position once it has been locked, unless the lock release is applied.

e) Type test certificates to ascertain the strength of clamps shall be submitted for purchaser's approval.

f) Nylon self locking clamps shall be of BHEL approved make only.

7.15.4 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.

7.15.5 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 60 mm x 12 mm 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 tagging.

7.15.6 PVC Tapes, Special Tapes and supporting arrangements.

7.15.7 CABLE LUGS:

Cable lugs shall be tined copper lugs suitable for termination of different sizes of HT/LT/Control cables as indicated in the Schedule of Rates. Lugs for power cables shall be compression type whereas lugs for control cables shall be insulated terminal crimping type. Lugs shall be supplied with sleeves.

7.15.8 STEEL FABRICATION:

Steel for fabrication shall be straightened and cleaned of rust and grease. All fabrication shall be free of sharp edges. The painting of the fabricated steel shall be as per the requirement of this specification.

Every effort shall be made to minimize the wastage of steel as far as practicable during fabrication. The wastage in no case shall exceed 2% of the total quantity of steel fabricated.

7.15.9 SURFACE TREATMENT

Two coats of abrasion resistant synthetic enamel of desired colour shall be applied on the pretreated surface with sufficient time interval for drying up. Surface finish after the painting shall be smooth, uniform and free from spots.

7.15.10 GALVANISED ITEMS shall be given a surface treatment only at the welded joints and at the places where the galvanisation has been damaged. Welded joints shall be applied with two coats of cold zinc paint whereas damaged galvanising shall be applied with single coat of zinc paint.

7.15.11 In addition to the above, the contractor shall ensure after completion of cable erection work that the final finish of all surfaces of trays and support materials is in good condition and wherever needed a touch up of enamel/cold zinc paint, as applicable shall be given.

7.15.12 The final finish of all erected materials shall be uniform, clean, smooth and free from spots.

7.16.0 GUIDELINES FOR ERECTION OF CABLE TRAYS, GI PIPES , SUPPORTS AND ACCESSORIES

7.16.1 Constructional details and supporting arrangement for the cable trays shall be as shown in the drawings which will be handed over to the successful bidder. All cable trays, vertical raceways and supporting steel work shall be installed along the routes as indicated in the drawings and as per the instructions of the Engineer-in-charge. The contractor has to fabricate and install complete tray supporting structures as per the drawing/site requirement.

7.16.2 Wherever specified or directed by Engineer, the contractor shall install galvanised MS sheets covers over cable trays. The width of the covers shall be same as that of cable trays. Bolting shall be done to fasten covers to the cable trays, elbows, reducers, tees, crosses etc.

7.16.3 The contractor shall install all angles, channels, beams, hangers, brackets, clamps etc. as may be necessary to suit the actual site conditions to support the cable trays.

7.16.4 Straight pieces of standard MS angles/channels shall be used for fabrication of supports/racks. All welded joints shall be smooth enough to provide a good appearance and shall not cause injury to working personnel.

7.16.5 Cable trays within cable trenches, tunnels and basements shall be of ladder type. Bottom most tray within plant buildings for overhead runs of trays shall be of perforated type. Cable trays in the areas exposed to coal dust shall be installed in vertical formation. Wherever due to layout constraints, it is not possible to install the trays in vertical formation with Engineer's prior permission installing the trays in horizontal formation may be considered.

7.16.6 Cable trays/racks shall be so arranged that they do not obstruct or impair clearances of passage way or maintenance of adjacent equipment.

7.16.7 For installation of cables in GI conduits the conduits shall be installed first without cables but having suitable pull wires laid in conduits.

7.16.8 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.

7.16.9 GI conduits shall run without moisture or water traps and shall be made drawing arrangement towards the end.

7.16.10 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.

7.16.11 Bends of GI pipes/conduits shall be made without causing damage to the pipes/conduits.

7.16.12 Occupancy of conduits shall not be greater than 40%.

7.16.13 The adopter for coupling rigid GI pipe/conduits and flexible conduit shall be of aluminium or galvanised steel.

7.16.14 Transportation and storage of cable drums

Transportation and storage of cable drums shall generally conform to the requirements of IS : 1255

7.16.15 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.

7.16.16 The cable drums shall be transported on wheels to the place of work.

7.17.0 GUIDELINES FOR CABLE TERMINATION AND JOINTING

7.17.1 Contractor shall carry out cable terminations at various electrical and electronic equipment terminals.

7.17.2 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.

7.17.3 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 by the column at no extra cost as part of the termination.

7.17.4 All cable entries in the equipment shall be sealed after glanding the cables..

7.17.5 Adequate length of cables shall be pulled inside the switch boards, control panels, terminal boxes etc. as per near termination of each core/conductor.

7.17.6 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.

7.17.7 Control cable cores entering switchboard or control panels shall be neatly bunched and strapped with PVC perforated tapes/nylon ties and suitably supported to keep them in position at the terminal block. All spare cores shall be connected to spare terminals wherever possible. If spare terminals are not available, spare cores shall be neatly dressed and suitably taped at both ends.

7.17.8 Screened control cables of 0.5 sq. mm cross-sectional area shall be terminated by means of Maxi-termi termination system (if applicable).

7.17.9 Individual cores of control cables shall have ferrules for identification. Ferrule numbers shall be provided as per the control schemes and other related documents supplied.

7.17.10 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.

7.17.11 Termination and jointing of aluminium/copper conductor power cables shall be done by means of compression method using compression type aluminium/tinned copper lugs.

7.17.12 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.

7.17.13 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.

7.17.14 Junction boxes shall be used, wherever required, for jointing of control cables.

7.17.15 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.

7.18.0 INSPECTION OF CABLES, TRAYS & TRAY SUPPORT MATERIALS

7.18.1 The following shall be the stages of inspection by BHEL/Customer **(IF SUPPLY IS COVERED IN CONTRACTOR'S SCOPE) :**

a) Inspection of all erection materials hardware items supplied by the contractor.

b) Inspection of storage and material handling.

c) Inspection of fabrication processes such as shearing, punching, bending, welding, galvanising, painting, etc.

d) Inspection at intermediate stages of erection.

e) Final inspection after erection.

7.18.2 The actual inspection shall be carried out as per the quality plan of BHEL/Customer.

7.18.3 Testing of Cables :

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.

7.18.4 Testing and electrical measurement of cable installations shall conform to IS : 1255

7.18.5 Prior to installation, cables shall be tested for :

a) Continuity of conductors

b) Insulation resistance between conductors & earth

c) Insulation resistance between conductors.

7.18.6 After installation cables shall be tested for :

a) Insulation resistance between conductors & iron

b) Insulation resistance between conductors & earth

c) Conductor resistance

d) Capacitance between conductors (for cables above 7C.1.7C.1.kV grade)

e) Capacitance between conductors & earth (for cables above 7C.1.3KV grade)

f) DC high voltage test (for HT cables/LT power cables of higher sizes interconnecting PCCs & MCC)

g) Absence of cross phasing

h) Firmness of terminations.

7.19.0 CODES AND STANDARDS

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.

Installation of cabling work shall comply with the following Indian Standards (Latest editions) :

IS 1255 Code of practice for installation and maintenance of power cables upto and including 33 KV rating.

IS 732 Electrical wiring installation (system voltage not exceeding 650 V).

IS 2274 Code of practice for electrical wiring installations (System voltages not exceeding 650 V)

IS 4029 Guide for testing of 3 phase induction motors.

IS 1293 Three pin plugs and socket outlets.

IS 2309 Code of practice for the protection of buildings and allied structures against lightning.

IS 3043 Code of practice for earthing

IS 3072 Installation and maintenance of switchgear

IS 5133 Box for enclosure of electrical equipment

IS 1653 Rigid steel conduits for electrical equipment

IS 3480 Flexible steel conduits for electrical wiring

IS 2667 Fittings for rigid steel conduits for electrical wiring

IS 3837 Accessories for rigid steel conduits for electrical wiring

IS 2062	Specification for structural steel
IS 3502	Specification for steel chequered plates
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 226	Structural steel (Standard quality)
IS 800	Code of practice for use of structural steel
IS 316	Code of practice for use of metal arc welding for general construction in mild steel.
IS 1363	Hexagonal bolts, nuts and screws
IS 1572	Electroplated coatings of cadmium on iron and steel.
IS 2629	Code of practice for hot dip galvanising for iron and steel.
IS 2633	Method of testing uniformity of coating on zinc coated articles.

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

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.

7.20.0 GUIDELINES FOR EARTHING INSTALLATION

7.20.1 All equipments shall be earthed by two separate and distinct connections. Earthing terminals will be available in all the equipment supplied by BHEL.

7.20.2 The earthing conductors shall be mild steel/G.I. strips/wires. All connections from the equipments to the main earthing conductors shall be made as illustrated in earthing drawings. A copy of earthing drawing shall be provided to the successful tenderer.

7.20.3 A continuous earthing conductor shall be installed in all cables trays and securely clamped to each tray section by suitable connectors to form a continuous earthing system. When two or more trays supporting power cables run on parallel a continuous earthing conductors shall be provided on one tray only with tap offs to the control cable trays. All valve and damper motor and rapping motors will be earthed to this conductor.

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

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

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

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

7.20.8 Conduits shall be bonded together and grounded at all switchgear and control centres.

7.20.9 M.S.Earthing conductors shall be coated with one coat of bituminous paint, wrapped with a layer of bitumen tape and finally coated with bitumen paint. For site welded GI strips/wires required coat of aluminium paint should be given.

7.20.10 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.

7.21.0 GUIDELINES FOR ERECTION OF CONTROL PANELS AND DISTRIBUTION BOARDS

7.21.1 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 channels will have to the grouted. All necessary concrete chipping and finishing works are to be completed. Suitable concrete drilling machine shall be used for making hole on the concrete floor.

7.21.2 For the panels which are to be mounted on the trenches, channel supports have to be provided across the cable trenches over which the base frames of the panels shall be mounted. Fabrication and erection of these support structures shall be carried out as per drawings.

7.21.3 All the panels/board shall be placed on its foundation or supporting structures and shall be assembled equipment as required. All equipment should be installed with parallel, horizontal and vertical alignment by skilled craftsmen.

7.21.4 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.

7.21.5 **The following points shall be checked up during erection**

7.21.6 Layout of foundation channels.

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

7.21.8 Location and serial no. panels.

7.21.9 Positioning of panels.

7.21.10 Verticality of panels and breaker truck to station earth.

7.21.11 Earthing of panels and breaker truck to station earth.

7.21.12 Lugs for termination of HT and LT cables.

7.21.13 Mounting and fixing arrangements all modules.

7.21.14 Check the operation of :

i. Remote control

ii. Various required - closing / tripping / alarm / indications / interlocks

7.21.15 Installation position of instruments and relays

Operation of relays and instruments.

7.21.16 AC / DC supplies for panel.

7.21.17 Tightness of terminal connections for HT & LT connections.

7.21.18 Working of ammeters and voltmeters for their entire range and other panel mounted instruments like recorder, indicator etc.

7.21.6 415 V switchgear tests

a) IR Test on each pole of breaker

b) IR test on control circuit

c) Measurement of contact resistance for all three phases of breaker

d) Measurement of resistance of the closing and tripping coil of breaker

e) Checking the close trip operation at 70% and 100% of the rated auxiliary D.C. Voltage.

f) Checking of interlocks provided and tripping of breaker through relays

g) Space heater operation check

h) Opening and closing time check

i) Control and metering circuit checks.

j) Primary and secondary injection tests.

k) Thermal overload relay testing and checking

l) Calibration of all instruments and meters

m) Phase rotation checks

n) High voltage test on 7C.1.3KV switchboard

7.22.0 CUTTING & WASTAGE ALLOWANCE

7.22.1 The following scrap allowances are permissible:

	non-salvageable	unaccountable
1. Length below 0.5 M steel pipes, SS/Cu tubes, Single pair cables	2%	0.5%
2. Length below 20m multi cable, multitubes	2%	0.5%

7.23.0 GUIDELINES FOR HANDLING OF SOLID STATE MODULES:

- All the solid-state modules shall be handled by qualified person.
- Electronic modules should only be touched when it is absolutely essential.
- Before touching any electronic modules, the operator should discharge the static electricity by earthing himself or better still, ensure constant discharge by wearing an earthed wrist strip.
- The operator should not wear clothing made entirely from synthetic fibres, but a mixture containing atleast 65% cotton.
- PCB should always be held by the front panel or by the module frame and the electronic components should never be touched.
- The electronic modules should never be placed close to television sets or CRT units.
- Soldering irons and any other tools used must be grounded.
- All modules using CMOs components are packed in antistatic bags, when transported loose to avoid ESD failures. The antistatic bags must always be used to transport modules at site from one place to the other.

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

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

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

7.24.3 Cases should be opened/unpacked using correct nail pullers. While opening the planks, care should be taken to see that the equipment is not damaged. Cases should not be unpacked in areas where they are exposed to rain water/liquid splashing, dust or other harmful materials like chlorine gas, Sulphur dioxide etc.

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

7.24.5 Hinged frames should not be opened when equipment is not secured to the floor as this is likely to cause it to topple over. The hinged frame can be opened only if the equipment is still fixed on to the bottom wooden pallet.

Note : The erection, testing and commissioning guide line covered in this tender for all the electrical and C&I equipments are not exhaustive and may or may not applicable for this scope of work. Any other pre-commissioning and field tests not included in tender but necessary as per relevant standards, code of practice and instructed by the manufacturer of the equipment shall also have to be carried if deemed necessary free of cost. The contractor shall take the full responsibility of testing, commissioning, trial run and successful operation of the equipment under overall guidance of BHEL engineer as detailed in the tender.

SECTION VIII
APPENDIX - I

DATA SHEET

SPECIFIC TECHNICAL REQUIREMENTS

SUPPLY ITEMS

1. Clamps

   a. Material & Type : Nylon self locking ties aluminium strips clamps as per Section VI

   b. Sizes : To meet the requirements of Section VI

2. Ferrules : As per Section VI

3. Tag

   a. Material : Aluminum/Fibre/Stainless Steel

   b. Markings : Engraving/Embossing/Printing

   c. Size : As required.

4. Cable lugs : Copper/Aluminium (crimping type)

5. Clamp Spacing:

   a. 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 150mm 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 35 mm 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

6. **Cable termination:**

Type of Lugs:

a.	Power Cables	: Copper/Aluminium/Both crimping type
b.	Control Cables	: Copper pin type, copper screw type, Direct termination
c.	Special Cables	: Pin type, maxi-termi type.

7. **Wastage Allowance:**

a.	HT cables	: 1%
b.	LT cables above 70mm	: 1%
c.	LT cables upto 70mm	: 1%
d.	Control & Special cables	: 1%
e.	Fire Survival cables	: 1%
f.	Steel materials (for cable trays/tray support installation)	: 1% by weight

SECTION VIII

APPENDIX – II

DECLARATION SHEET

I, hereby certify that, all the information and data furnished by me with regard to this Tender Specification No.BHEL:PSSR:SCT:1242 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 – III

TENDER SPECIFICATION NO BHEL:PSSR:SCT:1242

CERTIFICATE OF DECLARATION FOR CONFIRMING KNOWLEDGE ON SITE CONDITIONS

We,

hereby declare and confirm that we have visited the project site under subject, namely and acquired full knowledge and information about the site conditions. We further confirm that the above information is true and correct and we will not raise any claim of any nature due to lack of knowledge of site conditions.

TENDERER'S NAME AND ADDRESS

Place:

Date :

SIGNATURE OF AUTHORISED REPRESENTATIVE WITH NAME & ADDRESS:

OFFICE SEAL

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

SECTION VIII

APPENDIX - IV

CHECK LIST

TENDER SPECTFICATION NO, BHEL: PSSR : SCT : 1242

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

1 X 20 MW CO-GEN CYCLE POWER PLANT, CPCL –CHENNAI (STAGE – II)

BILL OF MATERIALS FOR ELECTRICAL/ C&I / ILLUMINATION PACKAGE

Bill of Materials (BOM) contains detailed specification of various instruments and items, system-wise and BHEL Unit-wise. Scope of work specific for each item is indicated in the last column of BOM. In addition to these clauses, other common clauses like painting, calibration, Civil Work etc. related to the work are also to be referred.

SL NO	DESCRIPTION	QUANTITY	REFER CLAUSE
A.1.0	***BHEL-HYDERABAD SCOPE (E&M)***		
A.1.1	GENERATOR TRANSFORMER (GT) 33.5 MVA, 11kV/7.07 kV, ONAF/ONAN Generator Transformer complete with NGR, off load tap changer, neutral side CTs, HV/LV/HVN bushings, bushing CTs, radiators, cooling fans, conservators, marshalling panels, pipings etc. Loose items like raise/lower PBs, 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. Max. dimension: 4400 x 4400 x 5400 mm <u>Approximate weights</u> Tank & fittings 13,000 kg Core & winding 27,000 kg Total wt of transformer 81,000 kg Untanking Weight 27,000 kg Shipping weight(Gas Filled) 40,000 kg Total oil (24,500 lts) 22,000 kg Dimension of NGR: 1500 x 1500 x 1000 mm; Weight: 250 kg	1 set*	6.2.1

* Lumpsum rate to be quoted per set

SL NO	DESCRIPTION	QUANTITY	REFER CLAUSE
A.1.0	***BHEL-HYDERABAD SCOPE (E&M)***		
A.1.2	SEGREGATED PHASE BUSDUCT FOR GTG 11 kV, 2000 A, segregated phase bus ducts for GTG with PTSP Cubicle, NG Cubicle, Cable Panel, Phase & neutral side CTs, Line/Neutral Side open busbars, support structures, air drying equipment with accessories etc. <u>Approximate Dimension & weights</u> Size of Main Busduct Enclosure: 1250 x 400 mm; Approx. length of main Busduct on Phase Side: 20.5 Mtrs Size of Tap-Off Busduct Enclosure: 400 x 400 mm; Length of tap-off busducts on Neutral Side: 13.7 Mtrs Length of tap-off busduct to PTSP Cubicle: 4 Mtrs Weight of Support structure - 5 T PTSP Cubicle:1950 x 1500 x 1900 mm; 1000 kg NG Cubicle: 1100 x 1500 x 1300 mm; 750 kg Cable Panel: 145 0 x 800 x 1900 mm; 500 kg	1 set*	6.2.2, 6.2.3
A.1.3.0	CONTROL PANELS		
A.1.3.1	Generator Control Panel Size: 2000 x 950 x 2286 mm Weight: 1000 kg	1 No.	6.2.4.2

* Lumpsum rate to be quoted per set

SL NO	DESCRIPTION	QUANTITY	REFER CLAUSE
A.1.0	***BHEL-HYDERABAD SCOPE (E&M)***		
A.1.3.2	Generator Relay Panel with discrepancy recorder, PC etc. Size: 1800 x 950 x 2286 mm Weight : 1000 kg	1 No.	6.2.4.2
A.1.4.0	CONTROL CABLES *1100V, FRLS/PVC, Cu/Al Armoured cables*		
A.1.4.1	10 T x 0.5 sq. mm cable	1000 Mtrs	6.5.1
A.1.4.2	2 C x 0.75 Sq mm Screened cable	150 Mtrs	6.5.1
A.1.4.3	3 x 4 Sq mm control cable	1000 Mtrs	6.5.1
A.1.4.4	3 x 6 Sq mm power cable	500 Mtrs	6.5.1
A.1.4.5	5 x 2.5 Sq mm control cable	2000 Mtrs	6.5.1
A.1.4.6	10C x 2.5 Sq mm control cable	1000 Mtrs	6.5.1
A.1.4.7	Termination of 3 C x 6 sq. mm power cable	6 Nos.	6.5.1

SL NO	DESCRIPTION	QUANTITY	REFER CLAUSE
A.2.0	***BHEL-HYDERABAD SCOPE (GT-ELECTRICAL)***		
A.2.1	GT MCC, 415 V, 3 phase Size: 7580 x 900 x 2430 mm, in suitable shipping sections Weight: 7,250 kg	1 No.	6.2.4.1
A.2.2	GT DCDB, 125 V DC Size: 3260 x 600 x 2430 mm Weight: 1700 kg	1 No.	6.2.4.1
A.2.3	BATTERY/ BATTERY CHARGER 125 V DC, G.T. DC system Main and Standby, float cum boost chargers, along with 300 AH, Ni-Cd batteries including discharge resistor, mounting racks and accessories. Size of battery charger: 1700 x 1000 x 2200 mm; 300 kg Total Size of batteries with racks: 5000 x 410 x 1400 mm; 1835 kg Approximate No. of cells : 98	1 set*	6.2.5
A.2.4.0	POWER CABLES FOR GT 1100V, FRLS, PVC, Armoured, Cu/ Al conductor cables		
A.2.4.1	3C x 2.5 sq. mm, Cu cable	8000 Mtrs	6.5.1
A.2.4.2	3C x 16 sq. mm, Al cable	1560 Mtrs	6.5.1
A.2.4.3	3 ½ C x 25 sq. mm, Al cable	2500 Mtrs	6.5.1
A.2.4.4	3 ½ C x 70 sq. mm, Al cable	1000 Mtrs	6.5.1

* Lumpsum rate to be quoted per set

SL NO	DESCRIPTION	QUANTITY	REFER CLAUSE
A.2.0	***BHEL-HYDERABAD SCOPE (GT-ELECTRICAL)***		
A.2.4.5	3 ½ C x 95 sq. mm, Al cable	650 Mtrs	6.5.1
A.2.4.6	1C x 120 sq. mm, Al cable	500 Mtrs	6.5.1
A.2.4.7	3C x 95 sq. mm, Al cable	300 Mtrs	6.5.1
A.2.5.0	TERMINATION OF POWER CABLES		
A.2.5.1	3C x 2.5 sq. mm cable	100 Nos.	6.5.1
A.2.5.2	3C x 16 sq. mm cable	12 Nos.	6.5.1
A.2.5.3	3 ½ C x 25 sq. mm cable	32 Nos.	6.5.1
A.2.5.4	3 ½ C x 70 sq. mm cable	16 Nos.	6.5.1
A.2.5.5	3 ½ C x 95 sq. mm cable	10 Nos.	6.5.1
A.2.5.6	1C x 120 sq. mm cable	6 Nos.	6.5.1
A.2.5.7	3C x 95 sq. mm cable	4 Nos.	6.5.1
A.2.6.0	CONTROL CABLES FOR GT *1100V, PVC, Armoured, Copper cables*		
A.2.6.1	19 C x 2.5 sq. mm	3000 Mtrs	6.5.1
A.2.6.2	12 C x 2.5 sq. mm	3500 Mtrs	6.5.1
A.2.6.3	7 C x 2.5 sq. mm	3000 Mtrs	6.5.1

SL NO	DESCRIPTION	QUANTITY	REFER CLAUSE
A.3.0	***BHEL-HYDERABAD SCOPE (BOP – ELECTRICAL)***		
A.3.1	SCADA Marshalling Panel Dimension: 1000 x 800 x 2200 mm Weight: 370 kg	1 No.	
A.3.2.0	LT SWITCHGEAR		
A.3.2.1	415 V BOP MCC Dimension: 12,800 x 900 x 2450 mm Weight: 10,000 kg	1 No.	6.2.4.1
A.3.2.2	110 V STN DCDB Dimension 3200 x 800 x 2450 mm Weight 6,000 kg	1 No.	6.2.4.1
A.3.2.3	110 V UPS DB Dimension 3200 x 800 x 2450 mm Weight 3,200 kg	1 No.	6.2.4.1
A.3.3.0	LOCAL CONTROL STATIONS		
A.3.3.1	Start/ Stop Push Button Stations without ammeters (Weatherproof/Explosion proof) 280 x 100 x 300 mm; 5 kg each	42 Nos.	6.5.3
A.3.3.2	Start/ Stop Push Button Stations with ammeters (Weatherproof/Explosion proof) 300 x 100 x 500 mm; 5 kg each	17 Nos.	6.5.3

SL NO	DESCRIPTION	QUANTITY	REFER CLAUSE
A.3.0	***BHEL-HYDERABAD SCOPE (BOP – ELECTRICAL)***		
A.3.3.3	Emergency Stop Push Button (Weatherproof) 300 x 100 x 500 mm; 5 kg each	5 Nos.	6.5.3
A.3.4.0	HT POWER CABLES/ TERMINATION KITS		
A.3.4.1	11 KV, Armoured, Aluminium conductor, XLPE insulated, PVC/ FRLS outer sheathed, 1 Core x 630 sq.mm cable	2400 Mtrs	6.5.1
A.3.4.2	6.6 KV, Armoured, Aluminium conductor, XLPE insulated, PVC/ FRLS outer sheathed, 3 Core x 240 sq.mm cable	300 Mtrs	6.5.1
A.3.4.3	HT Cable termination kits for 1 Core x 630 sq.mm, 11kV cable	30 Nos.	6.5.1
A.3.4.4	HT Cable termination kits for 3 Core x 240 sq.mm cable, 6.6 kV	6 Nos.	6.5.1
A.3.5.0	LT POWER CABLES (1100 V grade, PVC/FRLS Armoured Cables)		
A.3.5.1	3 ½ Core, 25 sq. mm, Al	2000 Mtrs	6.5.1
A.3.5.2	3 ½ Core, 35 sq. mm, Al	1000 Mtrs	6.5.1
A.3.5.3	3 ½ Core, 50 sq. mm, Al	2000 Mtrs	6.5.1
A.3.5.4	3 ½ Core, 95 sq. mm, Al	1250 Mtrs	6.5.1
A.3.5.5	1 Core, 150 sq. mm, Al	750 Mtrs	6.5.1
A.3.5.6	3 ½ Core, 300 sq. mm, Al	2000 Mtrs	6.5.1
A.3.5.7	4 Core, 6 sq. mm, Cu	500 Mtrs	6.5.1
A.3.5.8	3 Core, 4 sq. mm, Cu	2500 Mtrs	6.5.1

SL NO	DESCRIPTION	QUANTITY	REFER CLAUSE
A.3.0	***BHEL-HYDERABAD SCOPE (BOP – ELECTRICAL)***		
A.3.6.0	TERMINATION OF LT POWER CABLES		
A.3.6.1	3 ½ Core, 25 sq. mm, Al	25 Nos.	6.5.1
A.3.6.2	3 ½ Core, 35 sq. mm, Al	20 Nos.	6.5.1
A.3.6.3	3 ½ Core, 50 sq. mm, Al	90 Nos.	6.5.1
A.3.6.4	3 ½ Core, 95 sq. mm, Al	10 Nos.	6.5.1
A.3.6.5	1 Core, 150 sq. mm, Al	10 Nos.	6.5.1
A.3.6.6	3 ½ Core, 300 sq. mm, Al	40 Nos.	6.5.1
A.3.6.7	4 Core, 6 sq. mm, Cu	5 Nos.	6.5.1
A.3.6.8	3 Core, 4 sq. mm, Cu	30 Nos.	6.5.1
A.3.7.0	LT CONTROL CABLES (1100 V grade, Armoured, Copper, PVC insulated, FRLS outer sheathed Cables)		
A.3.7.1	3 core, 2.5 sq. mm	15000 Mtrs	6.5.1
A.3.7.2	5 core, 2.5 sq. mm	5000 Mtrs	6.5.1
A.3.7.3	7 core, 2.5 sq. mm	7500 Mtrs	6.5.1
A.3.7.4	12 core, 2.5 sq.mm	2000 Mtrs	6.5.1
A.3.7.5	16 core, 2.5 sq.mm	2000 Mtrs	6.5.1
A.3.7.6	19 core, 2.5 sq.mm	7500 Mtrs	6.5.1

SL NO	DESCRIPTION	QUANTITY	REFER CLAUSE
A.3.0	***BHEL-HYDERABAD SCOPE (BOP – ELECTRICAL)***		
A.3.8.0	CABLE TRAYS		
A.3.8.1	600 mm wide Ladder type GI Cable tray	2500 Mtrs	6.5.2
A.3.8.2	300 mm wide Ladder type GI Cable tray	750 Mtrs	6.5.2
A.3.8.3	300 mm wide Perforated type GI Cable tray	2250 Mtrs	6.5.2
A.3.8.4	50 mm wide Perforated type GI Cable tray	1250 Mtrs	6.5.2
A.3.9.0	ABOVE GROUND EARTHING MATERIALS		
A.3.9.1	GI Strip 75 x 10 mm	1000 Mtrs	6.5.5
A.3.9.2	GI Strip 50 x 6 mm	1500 Mtrs	6.5.5
A.3.9.3	GI Strip 35 x 6 mm	1000 Mtrs	6.5.5
A.3.9.4	8 SWG GI wire	2000 Mtrs	6.5.5
A.3.10.0	STRUCTURAL STEEL		
A.3.10.1	Structural steel for fabrication of cable tray supports, frames for pushbutton station and junction boxes, panel supports (ISMC100, ISA50 etc)	15 M Tons	6.5.4

SL NO	DESCRIPTION	QUANTITY	REFER CLAUSE
A.3.0	***BHEL-HYDERABAD SCOPE (BOP – ELECTRICAL)***		
A.3.11.0	GI CONDUITS		
A.3.11.1	200 mm dia.GI conduits	100 Mtrs	6.5.2
A.3.11.2	100 mm dia. GI conduits	100 Mtrs	6.5.2
A.3.12.0	SUPPLY OF THE FOLLOWING ITEMS		
A.3.12.1	11 kV/ 6.6 kV/ 415 V Danger boards and hand gloves Each set comprising of 2 Nos. 11 kV boards, 3 Nos. 6.6 kV boards, 3 Nos. 415 V boards and 2 Nos. First Aid Boxes. Danger Boards shall be as per IS2713:1980.	1 set*	6.17.0
A.3.12.2	Rubber mats for LT Switchgear Room, 1 m x 2 m x 12 mm thick, as per IS5424	15 Nos.	6.17.0
A.3.12.3	Die-cast Aluminum Trefoil Clamps for 1 core, 630 sq. mm XLPE insulated PVC/FRLS sheathed cable. The sketch given is only indicative. The dimensions of the clamps shall suit the cable supplied. Erection will be part of cable laying work.	150 Nos.	6.17.0

* Lumpsum rate to be quoted per set

SL NO	DESCRIPTION	QUANTITY	REFER CLAUSE
A.4.0	***BHEL- HYDERABAD SCOPE (BOP -ILLUMINATION)***		
A.4.1.0	**LIGHTING PANELS**		
A.4.1.1	For HRSG Area 415 V, 9 kA/ sec, 3ph, 4 wire, lighting panel with 1 No. 63 A TPN Switch with 32 A fuse as incomer & 12 Nos. 10 A SP MCB as outgoing feeders Approximate Size: 1000 x 800 x 200 mm; 30 kg	1 No.	6.4.1
A.4.1.2	For HRSG Area Emergency Lighting 415 V, 9 kA/ sec, 3ph, 4 wire, lighting panel with 1 No. 63 A TPN Switch with 32 A fuse as incomer & 6 Nos. 10 A SP MCB as outgoing feeders Approximate Size: 875x800x200 mm; 30 kg	1 No.	6.4.1
A.4.1.3	DC Lighting Panel For HRSG Area Critical Lighting 110 V DC, 2 wire Emergency Lighting Panel with 1 No. 32 A DP Switch with 16 A fuse as incomer & 6 Nos. 10 A DP MCB outgoing feeders Approximate Size: 875x800x200 mm; 30 kg	1 No.	6.4.1
A.4.2.0	**LIGHTING FIXTURES**		
A.4.2.1	HRSG Area Fixtures Well glass fixture with heat-resistant glass cover and wire guard and having IP55 degree of protection with 1 x 125 W HPMV lamp & Control gear box	45 Nos.	6.4.1
A.4.2.2	HRSG Area DC Lighting Fixtures Bulkhead type fixture with frosted thermal shockproof glass cover and galvanized wire guard with 1 x 100 W GLS lamp	15 Nos.	6.4.1
A.4.2.3	24V AC, 1Ph, Explosion proof Plug & Socket for Hand Lamps	2 Nos.	6.4.1

SL NO	DESCRIPTION	QUANTITY	REFER CLAUSE
A.4.0	***BHEL- HYDERABAD SCOPE (BOP -ILLUMINATION)***		
A.4.3.0	**LIGHTING POLES**		
A.4.3.1	3 Mtr lighting pole GI pipe, 65 mm dia, with reducer, swan neck made of 40 mm dia GI pipe along with Control Gear box and other accessories.	30 Nos.	6.4.1
A.4.4.0	**ACCESSORIES**		
A.4.4.1	FLP Receptacle, 63 A, Ex. proof	7 Nos.	6.4.1
A.4.4.2	FLP Receptacle, 20 A, Ex. proof	8 Nos.	6.4.1
A.4.4.3	Lighting JB, Round 88 mm dia, 3 way	15 Nos.	6.4.1
A.4.4.4	20 mm dia. GI conduit	75 Mtrs	6.4.1
A.4.4.5	50 mm dia. GI conduit	125 Mtrs	6.4.1

SL NO	DESCRIPTION	QUANTITY	REFER CLAUSE
A.4.0	***BHEL- HYDERABAD SCOPE (BOP -ILLUMINATION)***		
A.4.5	**HRSG STACK LIGHTING** AVIATION LAMPS & LIGHTNING ARRESTOR PACKAGE consisting of the following : Aviation lamp Assembly : 04 Nos. 50 mm dia GI pipe for aviation lamps & lightning arrestors: 15 Mtrs. 34.2 x 3.25 dia GI conduit with accessories : 100 Mtrs. Switch fuse unit 32 A(Industrial type) : 01 No. 2 Core, 2.5 Sq. mm copper Unarmoured PVC cable: 175 Mtrs. Junction Box (VAR – A) : 02 Nos. GI Flat 50 x 6 mm : 175 Mtrs.	1 set*	6.4.1
A.4.6	**GT STACK LIGHTING** AVIATION LAMPS & LIGHTNING ARRESTOR PACKAGE consisting of the following : Aviation lamp Assembly : 04 Nos. 50 mm dia GI pipe for aviation lamps & lightning arrestors: 15 Mtrs. Switch fuse unit 32 A(Industrial type) : 01 No. 2 Core, 2.5 Sq.mm copper Unarmoured PVC cable: 175 Mtrs. Junction Box (VAR – A) : 02 Nos. GI Flat 50 x 6 mm : 175 Mtrs.	1 set*	6.4.1

* Lumpsum rate to be quoted per set

SL NO	DESCRIPTION	QUANTITY	REFER CLAUSE
A.4.0	***BHEL- HYDERABAD SCOPE (BOP -ILLUMINATION)***		
A.4.7	**GT ENCLOSURE LIGHTING** Fixing of around 10 Nos. explosion proof light fittings, 2 Nos. of Junction Boxes, ¾"/1" conduits of approximate length 40 Mtrs for light fixtures, and wiring from junction boxes to fittings & earth for illumination of Accessory Module, GT Compartment, Generator Compartment and Off base Compartment	1 set*	6.4.1

* Lumpsum rate to be quoted per set

SL NO	DESCRIPTION	QUANTITY	REFER CLAUSE
A.5.0	***BHEL-HYDERABAD SCOPE (BOP- C&I PACKAGE)***		
A.5.1.0	**LOCAL/FIELD INSTRUMENTS & PANELS:**		
A.5.1.1	Mass Flow Meter	4 Nos.	6.3.3
A.5.1.2	Differential Pressure Transmitters	30 Nos.	6.3.3
A.5.1.3	Level Switches	6 Nos.	6.3.3
A.5.1.4	Pressure Gauges	150 Nos.	6.3.3
A.5.1.5	Pressure Switches	12 Nos.	6.3.3
A.5.1.6	Pressure Transmitters	150 Nos.	6.3.3
A.5.1.7	Themocouples with thermowell	30 Nos.	6.3.3
A.5.1.8	RTDs along with thermowell	50 Nos.	6.3.3
A.5.1.9	Temperature Gauges with thermowell	35 Nos.	6.3.3
A.5.1.10	Air Filter Regulators	60 Nos.	6.3.3
A.5.1.11	Radar Level Instrument (wt: 30 kg)	2 Nos.	6.3.3
A.5.2	40 KVA, 110 V UPS unit comprising of inverter, chargers, servo stabiliser, etc. Approximate Size: 5000 x 800 x 2000 mm; 3000 kg	1 set*	
A.5.3	UPS battery 150 AH, Ni Cd Battery made up of around 300 Nos. cells, along with rack etc. Approximate Size: 6000 x 3000 x 3000 mm; 5000 kg	1 set*	6.2.4.1

* Lumpsum rate to be quoted per set

SL NO	DESCRIPTION	QUANTITY	REFER CLAUSE
A.5.0	***BHEL-HYDERABAD SCOPE (BOP- C&I PACKAGE)***		
A.5.4	GT Stack Analyzer Package comprising of the following: • Panel Rack of size 800 x 800 x 2200; 200 kg : 2 Nos. • SOX Analyser : 1 No. • NOX Analyser: 1 No. • SPM Analyser: 1 No. • CO Analyser: 1 No. • HC Analyser: 1 No. local control unit/sampling unit, sample tubing upto Control Panel in SWAS Control Room and fittings etc.	1 set*	6.3.3
A.5.5	SWAS Analyser comprising of the following: • Wet Panel Rack of size 800 x 800 x 2200; 200 kg • Dry Panel Rack of size 800 x 800 x 2200; 200 kg • PH Analyser with sensor, Display Unit, cables etc. : 2 Nos. • Conductivity Analyser with sensor, Display Unit, cables etc. : 2 Nos. • Dissolved Oxygen Analyser : 01 No. • Silica Analyser with sensor, Display Unit, cables etc: 2 Nos. • Conductivity Cells: 2 Nos. tubings and fittings for the above analysers etc.	1 set*	6.3.3
A.5.6	VFD Panel for Hitec Additive Dosing Size: 800 x 800 x 2200 mm; 1500 kg	1 No.	6.2.4.2

* Lumpsum rate to be quoted per set

SL NO	DESCRIPTION	QUANTITY	REFER CLAUSE
A.5.0	***BHEL-HYDERABAD SCOPE (BOP- C&I PACKAGE)***		
A.5.7.0	DCS + PLC PACKAGE		
A.5.7.1	DCS Package Panels Approx. Weight: 500 kg each	10 Nos.	6.3.2
A.5.7.2	Interlock PLC (BOP) Panels Approx. Weight: 500 kg each	6 Nos.	6.3.2
A.5.7.3	Control Desk Approx. Weight: 270 kg each	6 Nos.	6.3.2
A.5.8.0	IMPULSE PIPES		
A.5.8.1	SS tube 12.7 x 2.1 mm	850 Mtrs	6.3.4
A.5.8.2	SS Pipe 21.3 x 3.7	700 Mtrs	6.3.4
A.5.8.3	SS Pipe 33.4 x 3.4	100 Mtrs	6.3.4
A.5.8.4	SS Tube 6 x 1 mm	1000 Mtrs	6.3.4
A.5.8.5	SS Pipe 21.3 x 4.74	2000 Mtrs	6.3.4
A.5.8.6	AS Pipe 21.3 x 4.74	300 Mtrs	6.3.4
A.5.9.0	**CONTROL/INSTRUMENTATION CABLES**		
A.5.9.1	1 P x 1.5 sq. mm, Individual and Overall Shielded	22,000 Mtrs	6.5.1
A.5.9.2	6 P x 1.5 sq. mm, Individual and Overall Shielded	30,000 Mtrs	6.5.1

SL NO	DESCRIPTION	QUANTITY	REFER CLAUSE
A.5.0	***BHEL-HYDERABAD SCOPE (BOP- C&I PACKAGE)***		
A.5.9.3	12 P x 1.5 sq. mm, Individual and Overall Shielded	28,000 Mtrs	6.5.1
A.5.9.4	2 P x 1.5 sq. mm, Individual and Overall Shielded	4000 Mtrs	6.5.1
A.5.9.5	1 P x 1.5 sq. mm, Cr-Al Extension cable	20,000 Mtrs	6.5.1
A.5.9.6	12 P x 16 AWG Cr-Al Extension	20,000 Mtrs	6.5.1
A.5.9.7	6 P x 16 AWG Cr-Al Extension	9000 Mtrs	6.5.1
A.5.9.8	1 P x 16 AWG Cr-Al Extension	6000 Mtrs	6.5.1
A.5.9.9	2 T x 1.5 sq. mm, Individual and Overall Shielded	9000 Mtrs	6.5.1
A.5.9.10	8 T x 1.5 sq. mm cable	15,000 Mtrs	6.5.1
A.5.9.11	3 C x 2.5 sq.mm, PVC/ FRLS, Cu conductor armoured cable, 1.1 kV	16,000 Mtrs	6.5.1
A.5.10.0	**ERECTION HARDWARE**		
A.5.10.1	Structural Steel for fabrication of supports, panel base frame, mounting JBs etc. (Angles & Channels, 6mm thick plate etc.)	15 MT	6.5.4
A.5.10.2	Explosion proof Junction Boxes, 60 way	150 Nos.	6.5.3
A.5.10.3	GI pipe, 2”	500 Mtrs	6.3.6
A.5.10.4	MS Flat, 50 x 6 mm	300 Mtrs	6.5.5
A.5.10.5	Perforated Cable Trays, 50 mm wide	100 Mtrs	6.5.2
A.5.10.6	Perforated Cable Trays, 100 mm wide	100 Mtrs	6.5.2

SL NO	DESCRIPTION	QUANTITY	REFER CLAUSE
A.5.0	***BHEL-HYDERABAD SCOPE (BOP- C&I PACKAGE)***		
A.5.11.0	**SKID MOUNTED INSTRUMENTS** Rate to be quoted for removal, calibration and re-fixing		
A.5.11.1	Pressure Gauges	43 Nos.	6.3.3
A.5.11.2	Level Transmitters	5 Nos.	6.3.3
A.5.11.3	Level Switches	2 Nos.	6.3.3
A.5.11.4	DP Gauges	13 Nos.	6.3.3
A.5.11.5	DP Transmitters	13 Nos.	6.3.3
A.5.11.6	Temperature Gauges	12 Nos.	6.3.3
A.5.11.7	Pressure Transmitters	15 Nos.	6.3.3
A.5.11.8	DP Switch	1 No.	6.3.3

SL NO	DESCRIPTION	QUANTITY	REFER CLAUSE
A.6.0	***BHEL-HYDERABAD SCOPE (GT – C&I PACKAGE)***		
A.6.1.0	*CONTROL PANELS/ SPECIAL INSTRUMENTS*		
A.6.1.1	GT Auxiliary Panel along with loose supplied items like 3 Nos. Haz. Gas Monitors etc. Dimension of Aux. Panel: 1000 x 900 x 2400 mm; 200 kg	1 set*	6.3.1
A.6.1.2	Inlet Air Filter Panel Dimension: 660 x 255 x 1015 mm; 50 kg	1 No.	6.3.1
A.6.1.3	CO_2 Fire Fighting Panel along with loose supplied items like 6 Nos. Manual Call Points, 4 Nos. Hooters, 6 Nos. Pressure Switches, 6 Nos. solenoid valves, Fire Alarm Bell etc. Size of panel: 600 x 500 x 1800 mm; 200 kg	1 set*	6.3.1
A.6.1.4	Vibration monitoring System for GTG consisting of the following 1 set BNC 3500 System Work Station & Vibration Monitor along with 8 Nos. Shaft Vibration probes (Bently make), proximitors, interconnecting cables etc. The Vibration Monitor is to be mounted in GT Auxiliary Panel Wt of BNC System: 40 kg	1 set*	6.3.3
A.6.2.0	LOCAL/ FIELD INSTRUMENTS		
A.6.2.1	Pressure Switches	8 Nos.	6.3.3
A.6.2.2	Hazardous Gas Detectors (Naptha)	9 Nos.	6.3.3
A.6.2.3	Pressure Transmitter	1 No.	6.3.3

* Lumpsum rate to be quoted per set

SL NO	DESCRIPTION	QUANTITY	REFER CLAUSE
A.6.0	***BHEL-HYDERABAD SCOPE (GT – C&I PACKAGE)***		
A.6.2.4	DP Transmitter	3 Nos.	6.3.3
A.6.2.5	Thermocouples with thermowell	3 Nos.	6.3.3
A.6.2.6	Vibration Sensors (Seismic type)	7 Nos.	6.3.3
A.6.2.7	Solenoids for inlet air system	45 Nos.	6.3.3
A.6.2.8	Pressure/DP Switches for DD & GD	4 Nos.	6.3.3
A.6.3.0	*CABLES*		
	SIGNAL CABLES FOR GT (Armoured type)		
A.6.3.1	18 P x 1.5 sq. mm	750 Mtrs	6.5.1
A.6.3.2	6 P x 1.5 sq. mm	600 Mtrs	6.5.1
A.6.3.3	19 C x 0.5 sq. mm	750 Mtrs	6.5.1
A.6.3.4	18 P x 0.5 sq. mm	600 Mtrs	6.5.1
A.6.3.5	4 P x 0.5 sq. mm	650 Mtrs	6.5.1
A.6.3.6	2 T x 0.5 sq. mm, shielded Cable	800 Mtrs	6.5.1
A.6.3.7	6 T x 0.5 sq. mm, shielded Cable	800 Mtrs	6.5.1
A.6.3.8	2 P x 1.5 sq. mm	1500 Mtrs	6.5.1
A.6.3.9	2 P x 0.5 sq. mm	3300 Mtrs	6.5.1

SL NO	DESCRIPTION	QUANTITY	REFER CLAUSE
A.6.0	***BHEL-HYDERABAD SCOPE (GT – C&I PACKAGE)***		
A.6.4.0	ERECTION HARDWARE		
A.6.4.1	Local Push Buttons	15 Nos.	6.5.3
A.6.4.2	Explosion proof Power/Control Junction Boxes (for DD & GD) (weight : 50 kg each)	4 Nos.	6.5.3
A.6.4.3	Explosion Proof PB Junction Box (for DD & GD)	2 Nos.	6.5.3
A.6.4.4	Local Control Panel for DD	1 No.	
A.6.4.5	Junction Boxes (ex-proof) for inlet air system	6 Nos.	6.5.3
A.6.4.6	1” / ½” conduits for wiring solenoids	50 Mtrs	6.5.2
A.6.4.7	Wiring in rigid GI conduit for solenoid valves to Junction Box and local panel with 1 C x 2.5 sq. mm wire	1000 Mtrs	
A.6.4.8	6 mm SS Tube (including CO2 dampers)	250 Mtrs	6.3.5
A.6.4.9	12 mm OD SS tubes	50 Mtrs	6.3.5
A.6.4.10	Enlarging of flame-proof motor terminal box gland holes, rethreading to suit cable gland/cable	15 Nos.	
A.6.4.11	Fixing of 12 Nos. fire detectors (RTDs) in GT enclosure, running of 20 Mtrs 1” GI pipe with supports, wiring with PTFE for fire detectors	1 set*	
A.6.4.12	Exhaust Area devices installation: Mounting/relocation of Exhaust JBs Replacing the terminals of exhaust thermocouple JBs on GT Skid with ceramic terminals, installing 2 Nos. additional JBs outside GT Enclosure, conduiting / wiring from on base exhaust JBs to these JBs using PTFE cables	1 set*	
A.6.4.13	Mounting of JBs for Fire Detectors in Off Base Enclosure	1 set*	

* Lumpsum rate to be quoted per set

SL NO	DESCRIPTION	QUANTITY	REFER CLAUSE
A.6.0	***BHEL-HYDERABAD SCOPE (GT – C&I PACKAGE)***		
A.6.5.0	REMOVAL, CALIBRATION & REFIXING OF THE FOLLOWING GT INSTRUMENTS		
A.6.5.1	Solenoid Valves (checking only)	30 Nos.	6.3.3
A.6.5.2	Temperature Switches	12 Nos.	6.3.3
A.6.5.3	Vibration/ Axial Shift Probes	10 Nos.	6.3.3
A.6.5.4	Temperature-rise type fire detectors	9 Nos.	6.3.3
A.6.5.5	Pressure Switches	28 Nos.	6.3.3
A.6.5.6	Limit Switches	12 Nos.	6.3.3
A.6.5.7	Magnetic Pickups	12 Nos.	6.3.3
A.6.5.8	Pressure Transmitters	11 Nos.	6.3.3
A.6.5.9	LVDTs	2 Nos.	6.3.3
A.6.5.10	Thermometers	5 Nos.	6.3.3
A.6.5.11	Pressure Gauges	25 Nos.	6.3.3
A.6.5.12	DP Gauges	15 Nos.	6.3.3
A.6.5.13	Thermocouples (including exhaust thermocouples)	45 Nos.	6.3.3
A.6.5.14	Fire Scanner	2 Nos.	6.3.3
A.6.5.15	Ignitor with Excitor Probes	2 Nos.	6.3.3

SL NO	DESCRIPTION	QUANTITY	REFER CLAUSE
B.	***BHEL-EDN SCOPE***		
B.1	AVR Regulation Cubicle Size: 1150 x 1150 x 2295 mm Weight: 1200 kg	1 set *	6.2.4.2
	GT CONTROLS		
B.2	Mark VI GT Control Panel along with 2 sets of <HMI> Stations, and around 300 Mtrs of Ethernet Cable interconnecting <HMI> Station to DCS Size of Panel: 2260 x 910 x 2400 mm; 1100 Kg Each <HMI> consists of 1 no. Operator Station (PC) along with flat screen monitor, & other accessories like mouse, keyboard, printer, line drivers, interconnecting cables, furniture etc. The scope of work includes integration of the system and commissioning.	1 set*	6.3.2

* Lumpsum rate to be quoted per set

SL NO	DESCRIPTION	QUANTITY	REFER CLAUSE
C.	***BHEL - TRICHY SCOPE (HRSG - C&I PACKAGE)***		
C.1.0	**FIELD INSTRUMENTS**		
C.1.1	Pressure Gauges	14 Nos.	6.3.3
C.1.2	Temperature Gauges (With flanged Thermowells)	10 Nos.	6.3.3
C.1.3	Pressure & DP Transmitters	31 Nos.	6.3.3
C.1.4	Temperature Transmitters	7 Nos.	6.3.3
C.1.5	Thermocouples (Gas Path, W/O Well)	12 Nos.	6.3.3
C.1.6	Thermocouple (Gas Path, With Well)	4 Nos.	6.3.3
C.1.7	Thermocouple With Flanged Well	11 Nos.	6.3.3
C.1.8	RTD With Flanged Well	4 Nos.	6.3.3
C.1.9	MTM Thermocouples	10 Nos.	6.3.3

SL NO	DESCRIPTION	QUANTITY	REFER CLAUSE
C.	***BHEL - TRICHY SCOPE (HRSG - C&I PACKAGE)***		
C.2.0	**PANELS/ SPECIAL INSTRUMENTS**		
C.2.1	Smoke Density Analyser Opacity monitor with auto-calibration facility comprising of • 1 Set of transmitter receiver probes (to be mounted at a height of 30 Mtrs on stack) • Local Control Cabinet with display (to be mounted in platform near 30 Mtrs level of stack) • Purge Air Blower Assembly ((to be erected near 30 Mtrs level of stack) • Air tubing for purging • Power and Control Cables between panel, local panel, compressor etc. Approx. Total Weight: 100 Kg The scope of work includes erection, integration of the system and commissioning.	1 set*	6.3.3

* Lumpsum rate to be quoted per set

SL NO	DESCRIPTION	QUANTITY	REFER CLAUSE
C.	***BHEL - TRICHY SCOPE (HRSG - C&I PACKAGE)***		
C.2.2	CO + SO2 + NOX + HC ANALYSER Comprising of • 1 No. local analyser and display panel of size 800 x 800 x 2200 mm, with sample handling system • Ring header with electrical heating, heater to be mounted at site, header to be mounted at 30 Mtrs level of HRSG stack, Control Panel to be mounted at suitable location on platform or floor • Approximately 50 Mtrs long impulse pipe with electrical tracing consisting of 50 Mtrs heat tracing tapes, aluminium foil covering, ceramic wool insulation, aluminium cladding • Purge Instrument Air Line of approx. length 20 Mtrs • Sampling cylinders, and 20 Mtrs long sampling lines • Electrical & power cabling between these equipments, earthing of panels and water resistant painting for impulse pipes & header Approx. Total Weight: 500 Kg The scope of work includes erection, integration of the system and commissioning.	1 set*	6.3.3

* Lumpsum rate to be quoted per set

SL NO	DESCRIPTION	QUANTITY	REFER CLAUSE
C.	***BHEL - TRICHY SCOPE (HRSG - C&I PACKAGE)***		
C.2.3	SWAS ANALYSER comprising of the following: • Wet Panel Rack of size 2700 x 600 x 2200 mm • Dry Panel Rack of size 600 x 500 x 2200 mm • PH Analyser with sensor, Display Unit, cables etc. : 3 Nos. • Conductivity Analyser with sensor, Display Unit, cables etc. : 3 Nos. • Silica Analyser Sensor : 01 No. tubings and fittings for the above analysers etc. Approx. Total Weight: 4000 Kg	1 set*	6.3.3
C.2.4	Electronic Water Level Indicator EWLI comprising of the following: – 1 No. 10 Port pressure vessel with loose supplied electrodes – 1 No. of Local Display Unit, of size 400 (W) x 425 (H) mm – 1 No. of Remote Display Unit of approx. size 100 x 90 x 230 mm – interconnecting cables between local panel and electrodes, etc.	2 sets*	6.3.3
C.2.5	HRSG MCC Approximate size: 4960 x 876 x 2430 mm Weight: 6400 kg	1 No.	6.2.4.1

* Lumpsum rate to be quoted per set

SL NO	DESCRIPTION	QUANTITY	REFER CLAUSE
C.	***BHEL - TRICHY SCOPE (HRSG - C&I PACKAGE)***		
C.3.0	**ERECTION HARDWARE**		
C.3.1	Push Button Boxes Weight: 10 kg each	4 Nos.	6.5.3
C.3.2	Junction Boxes Weight: 10 kg each	16 Nos.	6.5.3
C.3.3	¼" OD Copper Tube	200 Mtrs	6.3.5
C.3.4	Structural Steel (Angles, Channels)	2 Tonnes	6.5.4
	Earthing Materials		
C.3.5	40 x 6 mm GI Flat	850 Mtrs	6.5.5
C.3.6	GI wires- 18 SWG	300 Mtrs	6.5.5
C.4.0	**CABLES**		
C.4.1	Power Cable 3 C x 2.5 Copper	10500 Mtrs	6.5.1
C.4.2	Control Cable 5 C x 1.5 Sq mm	250 Mtrs	6.5.1
C.4.3	Control Cable 10 C x 2.5 Sq mm	1500 Mtrs	6.5.1
C.4.4	2 Pair, 1.5 sq. mm Screened Inst Cable	300 Mtrs	6.5.1
C.4.5	2 Pair, 20 AWG KX Screened Compensating Cable	1500 Mtrs	6.5.1

SL NO	DESCRIPTION	QUANTITY	REFER CLAUSE
C.	***BHEL - TRICHY SCOPE (HRSG - C&I PACKAGE)***		
C.5.0	**CABLE TRAYS**		
C.5.1	Ladder type tray, 100 mm wide	140 Mtrs	6.5.2
C.5.2	Ladder type tray, 450 mm wide	17.5 Mtrs	6.5.2
C.5.3	Ladder type tray, 600 mm wide	50 Mtrs	6.5.2
C.5.4	Perforated type tray, 100 mm wide	25 Mtrs	6.5.2
C.5.5	Perforated type tray, 450 mm wide	50 Mtrs	6.5.2

SL NO	DESCRIPTION	QUANTITY	REFER CLAUSE
D.	***GENERAL***		
D.1.0	*Commissioning of the following equipment erected by others.*		
D.1.1	Meggering and HV test of Generator Bushings of GTG, including commissioning of Generator	1 set*	6.3.9
D.1.2	Meggering and dry out of Electric Actuators	80 Nos	6.3.9
D.1.3	Meggering and dry out of LT Drives	50 Nos	6.3.9
D.1.4	Control Valves	30 Nos.	6.3.9
D.1.5	Hoists	2 Nos.	6.3.9
D.2	Excavation & back filling of trenches for cables and earth strips in all types of soil except in hard rock for a maximum of 1.2 m depth, 0.6 m wide, shoring, shuttering, and dewatering of surface/ sub soil water if required, disposal of surplus earth etc.	30 cu.m	
D.3	Spreading of approved fine river sand in cable trenches on cubic metre basis including supply of river sand.	5 cu.m	
D.4	Laying of approved class bricks of thickness 3” in cable trenches for cable protection etc. including supply of bricks	5 cu. m	

TENDER SPECIFICATION

BHEL:PSSR:SCT: 1242

FOR

Handling at Site Stores / Storage yard, Transportation to site of work, Erection, Testing and Commissioning of Electrical and Control & Instrumentation System for 1 x 20 MW Co-Generation Plant (Stage II)

At

Chennai Petroleum Corporation Limited

(CPCL) ,
Manali, Chennai ,Tamilnadu .

PART – II PRICE BID

BOOK NO :

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

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:1242

NAME OF WORK

Handling at Site Stores / Storage yard, Transportation to site of work, Erection, Testing and Commissioning of Electrical and Control & Instrumentation System for 1 x 20 MW Co-Generation Plant (Stage II) at Chennai Petroleum Corporation Limited (CPCL) , Manali, Chennai ,Tamilnadu .

(PRICE BID)

PART II

Issued to
M/s.

For and on behalf of
BHARAT HEAVY ELECTRICALS LIMITED

Addl. General Manager/Contracts

(This tender document is not transferable)

Place: Chennai-600 035.
Date:

1 X 20 MW CO-GEN CYCLE POWER PLANT, CPCL –CHENNAI (STAGE – II)

RATE SCHEDULE FOR ERECTION, TESTING AND COMMISSIONING OF

ELECTRICAL/ C&I / ILLUMINATION PACKAGE SECTION – VIII APPENDIX – V

Before filling the Rates, the bidder shall go through the detailed specification of all the items given in the Bill of Materials(BOM) as well as Scope of Work specified in Section VI

SL. NO.	BOM REF.	DESCRIPTION	QUANTITY	UNIT RATE	TOTAL RATE
	ERECTION/ COMMISSIONING OF GENERATOR TRANSFORMER/ BUSDUCT				
1.	A.1.1	33.5 MVA, 11kV/7.07 kV, Generator Transformer along with NGR and other accessories	1 set*		
2.	A.1.2	11 kV, 2000 A, Segregated Phase Busduct for GTG along with associated equipment	1 set*		
	ERECTION/ COMMISSIONING OF LT SWITCHGEAR/ ELECTRICAL PANELS				
3.	A.2.1	415 V GT MCC	1 No.		
4.	C.2.5	HRSG MCC	1 No.		
5.	A.3.2.1	415 V BOP MCC	1 No.		
6.	B.1	AVR Panel	1 set *		
7.	A.1.3.1	Generator Control Panel	1 No.		
8.	A.1.3.2	Generator Relay Panel	1 No.		

* Lumpsum rate to be quoted per set

Signature of the Tenderer

SL. NO.	BOM REF.	DESCRIPTION	QUANTITY	UNIT RATE	TOTAL RATE
9.	A.2.2	GT DCDB, 125 V DC	1 No.		
10.	A.2.3	125 V DC Battery/ Battery Charger	1 set*		
11.	A.3.2.2	110 V STN DCDB	1 No.		
12.	A.5.2	40 KVA, 110 V UPS	1 set*		
13.	A.5.3	UPS battery, 150 AH, Ni Cd	1 set*		
14.	A.3.2.3	110 V UPS DB	1 No.		
15.	A.5.6	VFD Panel for Hitec Additive Dosing	1 No.		
	ERECTION/ COMMISSIONING OF C&I CONTROL PANELS				
16.	B.2	Mark VI GT Control Panel along with accessories	1 set*		
17.	A.3.1	SCADA Marshalling Panel	1 No.		
18.	A.6.1.1	GT Auxiliary Panel along with accessories	1 set*		
19.	A.6.1.2	Inlet Air Filter Panel	1 No.		
20.	A.6.1.3	CO_2 Fire Fighting Panel along with accessories	1 set*		
	ERECTION/ COMMISSIONING OF DCS PACKAGE				
21.	A.5.7.1	DCS Package Panels	10 Nos.		
22.	A.5.7.2	Interlock PLC (BOP) Panels	6 Nos.		
23.	A.5.7.3	Control Desks	6 Nos.		

* Lumpsum rate to be quoted per set

Signature of the Tenderer

SL. NO.	BOM REF.	DESCRIPTION	QUANTITY	UNIT RATE	TOTAL RATE
	ERECTION/ COMMISSIONING OF LOCAL/FIELD INSTRUMENTS				
24.	A.5.1.1	Mass Flow Meter	4 Nos.		
25.	A.5.1.2, A.5.1.6, A.6.2.3, A.6.2.4, C.1.3	Pressure/ DP Transmitters	215 Nos.		
26.	C.1.4	Temperature Transmitters	7 Nos.		
27.	A.5.1.11	Radar Level Instrument	2 Nos.		
28.	A.5.1.5, A.6.2.1, A.6.2.8	Pressure/DP Switches	24 Nos.		
29.	A.5.1.3	Level Switches	6 Nos.		
30.	A.5.1.4, C.1.1	Pressure Gauges	164 Nos.		
31.	A.5.1.9	Temperature Gauges with thermowell	35 Nos.		
32.	C.1.2	Temperature Gauges with flanged thermowell	10 Nos.		
33.	A.6.2.6	Vibration Sensors (Seismic type)	7 Nos.		
34.	A.5.1.10	Air Filter Regulators	60 Nos.		
35.	A.6.2.2	Hazardous Gas Detectors (Naptha)	9 Nos.		
36.	A.5.1.8	RTDs along with thermowell	50 Nos.		

Signature of the Tenderer

SL. NO.	BOM REF.	DESCRIPTION	QUANTITY	UNIT RATE	TOTAL RATE
37.	C.1.8	RTD With Flanged Well	4 Nos.		
38.	A.5.1.7, A.6.2.5	Themocouples with thermowell	33 Nos.		
39.	C.1.7	Thermocouple With Flanged Well	11 Nos.		
40.	C.1.5	Thermocouples (Gas Path, W/O Well)	12 Nos.		
41.	C.1.6	Thermocouple (Gas Path, With Well)	4 Nos.		
42.	C.1.9	MTM Thermocouples	10 Nos.		
43.	A.6.2.7	Solenoids for inlet air system	45 Nos.		
44.	A.5.4	GT Stack Analyzer Package, along with accessories	1 set*		
45.	A.5.5	SWAS Analyser package, along with accessories	1 set*		
46.	C.2.1	Smoke Density Analyser, along with accessories	1 set*		
47.	C.2.2	CO + SO2 + NOX + HC Analyser, along with accessories	1 set*		
48.	C.2.3	SWAS Analyser, along with accessories	1 set*		
49.	C.2.4	Electronic Water Level Indicator, along with accessories	2 sets*		
50.	A.6.1.4	Vibration monitoring System for GTG	1 set*		

* Lumpsum rate to be quoted per set

Signature of the Tenderer

SL. NO.	BOM REF.	DESCRIPTION	QUANTITY	UNIT RATE	TOTAL RATE
	ERECTION/ TESTING OF IMPULSE PIPES				
51.	A.5.8.4, A.6.4.8	SS Tube 6 mm	1250 Mtrs		
52.	A.6.4.9	12 mm OD SS tubes	50 Mtrs		
53.	A.5.8.1	SS tube 12.7 x 2.1 mm	850 Mtrs		
54.	A.5.8.2	SS Pipe 21.3 x 3.7	700 Mtrs		
55.	A.5.8.5	SS Pipe 21.3 x 4.74	2000 Mtrs		
56.	A.5.8.3	SS Pipe 33.4 x 3.4	100 Mtrs		
57.	A.5.8.6	AS Pipe 21.3 x 4.74	300 Mtrs		
	LIGHTING				
58.	A.4.1.1, A.4.1.2, A.4.1.3	Lighting Panels for HRSG Area/ HRSG Area Emergency Lighting/ HRSG Area Critical Lighting	3 Nos.		
59.	A.4.5	HRSG Stack Lighting	1 set*		
60.	A.4.6	GT Stack Lighting	1 set*		
61.	A.4.7	GT Enclosure Lighting	1 set*		

* Lumpsum rate to be quoted per set

Signature of the Tenderer

SL. NO.	BOM REF.	DESCRIPTION	QUANTITY	UNIT RATE	TOTAL RATE
	LIGHTING FIXTURES				
62.	A.4.2.1	HRSG Area Fixtures (Well glass fixture)	45 Nos.		
63.	A.4.2.2	HRSG Area DC Lighting Fixtures (Bulkhead type fixture)	15 Nos.		
64.	A.4.2.3	24V AC, 1Ph, Explosion proof Plug & Socket	2 Nos.		
	LIGHTING POLES				
65.	A.4.3.1	3 Mtr lighting pole, along with accessories	30 Nos.		
	LIGHTING ACCESSORIES				
66.	A.4.4.1	FLP Receptacle, 63 A, Ex. proof	7 Nos.		
67.	A.4.4.2	FLP Receptacle, 20 A, Ex. proof	8 Nos.		
68.	A.4.4.3	Lighting JB, Round 88 mm dia, 3 way	15 Nos.		
69.	A.4.4.4	20 mm dia. GI conduit	75 Mtrs		
70.	A.4.4.5	50 mm dia. GI conduit	125 Mtrs		
	LAYING, TERMINATION & TESTING OF CABLES				
	HT Power Cables/ Termination Kits				
71.	A.3.4.1	11 KV, Armoured, Aluminium conductor, XLPE insulated, PVC/ FRLS outer sheathed, 1 Core x 630 sq. mm cable	2400 Mtrs		

Signature of the Tenderer

SL. NO.	BOM REF.	DESCRIPTION	QUANTITY	UNIT RATE	TOTAL RATE
72.	A.3.4.2	6.6 KV, Armoured, Aluminium conductor, XLPE insulated, PVC/ FRLS outer sheathed, 3 Core x 240 sq. mm cable	300 Mtrs		
73.	A.3.4.3	HT Cable termination kits for 1 Core x 630 sq. mm, 11kV cable	30 Nos.		
74.	A.3.4.4	HT Cable termination kits for 3 Core x 240 sq. mm cable, 6.6 kV	6 Nos.		
	LT Power Cables *1100 V grade, PVC/FRLS Armoured Cables*				
75.	A.3.5.7	4 Core, 6 sq. mm, Cu cable	500 Mtrs		
76.	A.2.4.3, A.3.5.1	3 ½ C, 25 sq. mm, Al cable	4500 Mtrs		
77.	A.3.5.2	3 ½ C, 35 sq. mm, Al cable	1000 Mtrs		
78.	A.3.5.3	3 ½ C, 50 sq. mm, Al cable	2000 Mtrs		
79.	A.2.4.4	3 ½ C, 70 sq. mm, Al cable	1000 Mtrs		
80.	A.2.4.5, A.3.5.4	3 ½ C, 95 sq. mm, Al cable	1900 Mtrs		
81.	A.3.5.6	3 ½ C, 300 sq. mm, Al cable	2000 Mtrs		
82.	A.2.4.6	1C, 120 sq. mm, Al cable	500 Mtrs		
83.	A.3.5.5	1 C, 150 sq. mm, Al cable	750 Mtrs		

Signature of the Tenderer

SL. NO.	BOM REF.	DESCRIPTION	QUANTITY	UNIT RATE	TOTAL RATE
84.	A.2.4.1, C.4.1	3C, 2.5 sq. mm, Cu cable	18500 Mtrs		
85.	A.3.5.8	3 C, 4 sq. mm, Cu cable	2500 Mtrs		
86.	A.1.4.4	3C, 6 Sq mm cable	500 Mtrs		
87.	A.2.4.2	3C, 16 sq. mm, Al cable	1560 Mtrs		
88.	A.2.4.7	3C, 95 sq. mm, Al cable	300 Mtrs		
	Termination of following LT Power Cables				
89.	A.3.6.7	4 C, 6 sq. mm, Cu	5 Nos.		
90.	A.2.5.3, A.3.6.1	3 ½ C, 25 sq. mm	57 Nos.		
91.	A.3.6.2	3 ½ C, 35 sq. mm, Al	20 Nos.		
92.	A.3.6.3	3 ½ C, 50 sq. mm, Al	90 Nos.		
93.	A.2.5.4	3 ½ C, 70 sq. mm	16 Nos.		
94.	A.2.5.5, A.3.6.4	3 ½ C, 95 sq. mm	20 Nos.		
95.	A.3.6.6	3 ½ Core, 300 sq. mm, Al	40 Nos.		
96.	A.2.5.6	1C, 120 sq. mm	6 Nos.		
97.	A.3.6.5	1 C, 150 sq. mm, Al	10 Nos.		
98.	A.2.5.1	3C, 2.5 sq. mm	100 Nos.		
99.	A.3.6.8	3 C, 4 sq. mm, Cu	30 Nos.		

Signature of the Tenderer

SL. NO.	BOM REF.	DESCRIPTION	QUANTITY	UNIT RATE	TOTAL RATE
100.	A.1.4.7	3 C x 6 sq. mm	6 Nos.		
101.	A.2.5.2	3C, 16 sq. mm	12 Nos.		
102.	A.2.5.7	3C, 95 sq. mm	4 Nos.		
	LT Control Cables				
103.	A.1.4.3	3 C x 4 Sq mm cable	1000 Mtrs		
104.	A.3.7.1, A.5.9.11	3 C x 2.5 sq. mm cable	31,000 Mtrs		
105.	A.1.4.5, A.3.7.2	5 C x 2.5 Sq mm cable	7,000 Mtrs		
106.	A.2.6.3, A.3.7.3	7 C x 2.5 sq. mm cable	10,500 Mtrs		
107.	A.1.4.6, C.4.3	10C x 2.5 Sq mm cable	2,500 Mtrs		
108.	A.2.6.2, A.3.7.4	12 C x 2.5 sq. mm cable	5,500 Mtrs		
109.	A.3.7.5	16 C x 2.5 sq. mm cable	2,000 Mtrs		
110.	A.2.6.1, A.3.7.6	19 C x 2.5 sq. mm cable	10,500 Mtrs		
111.	C.4.2	5 C x 1.5 Sq mm cable	250 Mtrs		

Signature of the Tenderer

SL. NO.	BOM REF.	DESCRIPTION	QUANTITY	UNIT RATE	TOTAL RATE
	Control/Instrumentation Cables				
112.	A.6.3.9	2 P x 0.5 sq. mm	3300 Mtrs		
113.	A.6.3.5	4 P x 0.5 sq. mm	650 Mtrs		
114.	A.6.3.4	18 P x 0.5 sq. mm	600 Mtrs		
115.	A.6.3.6	2 T x 0.5 sq. mm, Cable	800 Mtrs		
116.	A.6.3.7	6 T x 0.5 sq. mm, Cable	800 Mtrs		
117.	A.1.4.1	10 T x 0.5 sq. mm cable	1000 Mtrs		
118.	A.6.3.3	19 C x 0.5 sq. mm	750 Mtrs		
119.	A.1.4.2	2 C x 0.75 Sq mm Screened cable	150 Mtrs		
120.	A.5.9.1	1 P x 1.5 sq. mm cable	22,000 Mtrs		
121.	A.5.9.4, A.6.3.8, C.4.4	2 P x 1.5 sq. mm cable	5800 Mtrs		
122.	A.5.9.2, A.6.3.2	6 P x 1.5 sq. mm cable	30,600 Mtrs		
123.	A.5.9.3	12 P x 1.5 sq. mm cable	28,000 Mtrs		
124.	A.6.3.1	18 P x 1.5 sq. mm cable	750 Mtrs		
125.	A.5.9.9	2 T x 1.5 sq. mm cable	9000 Mtrs		
126.	A.5.9.10	8 T x 1.5 sq. mm cable	15,000 Mtrs		
127.	A.5.9.6	12 P x 16 AWG Cr-Al Extension	20,000 Mtrs		

Signature of the Tenderer

SL. NO.	BOM REF.	DESCRIPTION	QUANTITY	UNIT RATE	TOTAL RATE
128.	A.5.9.7	6 P x 16 AWG Cr-Al Extension	9000 Mtrs		
129.	C.4.5	2 Pair, 20 AWG KX Screened Compensating Cable	1500 Mtrs		
130.	A.5.9.8	1 P x 16 AWG Cr-Al Extension	6000 Mtrs		
131.	A.5.9.5	1 P x 1.5 sq. mm, Cr-Al Extension cable	20,000 Mtrs		
	ERECTION OF CABLE TRAYS				
132.	A.3.8.1, C.5.3	Ladder type trays, 600 mm wide	2550 Mtrs		
133.	C.5.2	Ladder type trays, 450 mm wide	17.5 Mtrs		
134.	A.3.8.2	Ladder type trays, 300 mm wide	750 Mtrs		
135.	C.5.1	Ladder type trays, 100 mm wide	140 Mtrs		
136.	C.5.5	Perforated Trays, 450 mm wide	50 Mtrs		
137.	A.3.8.3	Perforated Trays, 300 mm wide	2250 Mtrs		
138.	A.5.10.6, C.5.4	Perforated Trays, 100 mm wide	125 Mtrs		
139.	A.3.8.4, A.5.10.5	Perforated Trays, 50 mm wide	1350 Mtrs		
	FABRICATION/ ERECTION OF STRUCTURAL STEEL				
140.	A.3.10.1, A.5.10.1, C.3.4	Structural steel for fabrication	32 MT		

Signature of the Tenderer

SL. NO.	BOM REF.	DESCRIPTION	QUANTITY	UNIT RATE	TOTAL RATE
	ERECTION OF ABOVE GROUND EARTHING MATERIALS				
141.	A.3.9.1	GI Strip 75 x 10 mm	1000 Mtrs		
142.	A.3.9.2	GI Strip 50 x 6 mm	1500 Mtrs		
143.	A.3.9.3	GI Strip 35 x 6 mm	1000 Mtrs		
144.	C.3.5	GI Flat, 40 x 6 mm	850 Mtrs		
145.	A.3.9.4, C.3.6	GI wire 8 SWG/ 18 SWG	2300 Mtrs		
146.	A.5.10.4	MS Flat, 50 x 6 mm	300 Mtrs		
	ERECTION HARDWARE				
147.	A.3.11.1	200 mm dia.GI conduits	100 Mtrs		
148.	A.3.11.2	100 mm dia. GI conduits	100 Mtrs		
149.	A.5.10.3	GI pipe, 2”	500 Mtrs		
150.	C.3.3	¼” OD Copper Tube	200 Mtrs		
151.	A.3.3.1, A.3.3.2, A.3.3.3, A.6.4.1, C.3.1	Push Button Boxes	83 Nos.		
152.	A.6.4.2	Explosion proof Power/Control Junction Boxes (for DD & GD) (weight : 50 kg each)	4 Nos.		
153.	A.6.4.3	Explosion Proof Junction Box (for DD & GD)	2 Nos.		

Signature of the Tenderer

SL. NO.	BOM REF.	DESCRIPTION	QUANTITY	UNIT RATE	TOTAL RATE
154.	A.6.4.5	Junction Boxes (ex-proof) for inlet air system	6 Nos.		
155.	A.5.10.2	Explosion proof Junction Boxes, 60 way	150 Nos.		
156.	C.3.2	Junction Boxes, Wt: 10 kg each	16 Nos.		
157.	A.6.4.4	Local Control Panel for DD	1 No.		
158.	A.6.4.6	1" / ½" conduits for wiring solenoids	50 Mtrs		
159.	A.6.4.7	Wiring in rigid GI conduit for solenoid valves to Junction Box and local panel with 1 C x 2.5 sq. mm wire	1000 Mtrs		
160.	A.6.4.10	Enlarging of flame-proof motor terminal box gland holes, rethreading to suit cable gland/cable	15 Nos.		
161.	A.6.4.11	Fixing of 12 Nos. fire detectors (RTDs) in GT enclosure, running of 20 Mtrs 1" GI pipe with supports, wiring with PTFE for fire detectors	1 set*		
162.	A.6.4.13	Mounting of JBs for Fire Detectors in Off Base Enclosure	1 set*		
163.	A.6.4.12	Mounting/relocation of Exhaust JBs including conduiting / wiring from on base exhaust JBs	1 set*		

* Lumpsum rate to be quoted per set

Signature of the Tenderer

SL. NO.	BOM REF.	DESCRIPTION	QUANTITY	UNIT RATE	TOTAL RATE
	REMOVAL, CALIBRATION & REFIXING OF INSTRUMENTS MOUNTED ON EQUIPMENT				
164.	A.6.5.1	Solenoid Valves (checking only)	30 Nos.		
165.	A.6.5.2	Temperature Switches	12 Nos.		
166.	A.6.5.3	Vibration/ Axial Shift Probes	10 Nos.		
167.	A.6.5.4	Temperature-rise type fire detectors	9 Nos.		
168.	A.6.5.5	Pressure Switches	28 Nos.		
169.	A.5.11.3	Level Switches	2 Nos.		
170.	A.5.11.8	DP Switch	1 No.		
171.	A.6.5.6	Limit Switches	12 Nos.		
172.	A.6.5.7	Magnetic Pickups	12 Nos.		
173.	A.5.11.7, A.6.5.8	Pressure Transmitters	26 Nos.		
174.	A.5.11.5	DP Transmitters	13 Nos.		
175.	A.5.11.2	Level Transmitters	5 Nos.		
176.	A.6.5.9	LVDTs	2 Nos.		
177.	A.6.5.10	Thermometers	5 Nos.		
178.	A.5.11.1, A.6.5.11	Pressure Gauges	68 Nos.		
179.	A.5.11.4, A.6.5.12	DP Gauges	28 Nos.		

Signature of the Tenderer

SL. NO.	BOM REF.	DESCRIPTION	QUANTITY	UNIT RATE	TOTAL RATE
180.	A.5.11.6	Temperature Gauges	12 Nos.		
181.	A.6.5.13	Thermocouples (including exhaust thermocouples)	45 Nos.		
182.	A.6.5.14	Fire Scanner	02 Nos.		
183.	A.6.5.15	Ignitor with Excitor Probes	02 Nos.		
	SUPPLY OF THE FOLLOWING ITEMS				
184.	A.3.12.1	11 kV/ 6.6 kV/ 415 V Danger boards and hand gloves	1 set*		
185.	A.3.12.2	Rubber mats for LT Switchgear Room, 1 m x 2 m x 12 mm	15 Nos.		
186.	A.3.12.3	Die-cast Aluminum Trefoil Clamps for 1 core, 630 sq. mm XLPE insulated PVC/FRLS sheathed cable.	150 Nos.		
	COMMISSIONING OF THE FOLLOWING ERECTED BY MECHANICAL CONTRACTOR				
187.	D.1.1	Meggering and HV test of Generator Bushings of GTG, including commissioning of Generator	1 set*[$]		
188.	D.1.2	Meggering and dry out of Electric Actuators	80 Nos[$]		
189.	D.1.3	Meggering and dry out of LT Drives	50 Nos[$]		
190.	D.1.4	Control Valves	30 Nos. [$]		
191.	D.1.5	Hoists	2 Nos. [$]		

* Lumpsum rate to be quoted per set

[$] Rate to be quoted for commissioning only

Signature of the Tenderer

SL. NO.	BOM REF.	DESCRIPTION	QUANTITY	UNIT RATE	TOTAL RATE
	GENERAL				
192.	D.2	Excavation & back filling of trenches for cables and earth strips in all types of soil except in hard rock for a maximum of 1.2 m depth, 0.6 m wide, shoring, shuttering, and dewatering of surface/ sub soil water if required, disposal of surplus earth etc.	30 cu.m		
193.	D.3	Spreading of approved fine river sand in cable trenches on cubic metre basis including supply of river sand.	5 cu.m		
194.	D.4	Laying of approved class bricks of thickness 3” in cable trenches for cable protection etc. including supply of bricks	5 cu. m		

TOTAL CONTRACT VALUE Rs……..

(Rupees……only)

Signature of the Tenderer

NOTE TO RATE SCHEDULE :

1. The quantities indicated are approximate and are liable for variation and alteration at the discretion of BHEL. The quoted unit rate shall be applicable for any additional items, if included at a later date. The work executed shall be measured and payable at unit rate quoted by the contractor and accepted by BHEL.

2. The description of work indicated in the Rate Schedule shall include all types of handling and transportation of materials from storage yard / pre-assembly yard to the place of erection, preservation of components at the erection site with contractor's own handling equipments and any extra work with modification / rectification that may arise during erection testing and commissioning works which are incidental to normal erection works.

3. The tenderer is expected to fill up the rate column after satisfying all terms and conditions of Tender Specification.

4. 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.

SIGNATURE OF THE TENDERER

Signature of the Tenderer