TENDER SPECIFICATION

BHEL:PSSR:SCT: 1179

FOR

Handling at Site Stores / Storage yard, Transportation to Site of Work, Erection, Testing and Commissioning of Control & Instrumentation package of Unit 3 & 4 of 2 X 210 MW set, Stage -II

at

RAYALASEEMA THERMAL POWER PROJECT

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

PART – I TECHNICAL BID

BOOK NO :

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

INDEX SCT : 1179

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: 1179

Messrs Date:

Dear Sir,

SUB: Handling at Site Stores / Storage yard, Transportation to site of work, Erection, Testing and Commissioning of Control & Instrumentation System for 2 x 210 MW at Rayalaseema Thermal Power Project, Muddanur, Cuddapah District, and Andhra Pradesh.

Please find enclosed one set of non-transferable tender Specification documents containing - **209** - pages along with General Conditions of Contract Booklet , separate book of Rate schedule for the above work.

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

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

The completed quotations shall reach the office of the under signed on or before **05.04.2006** at **15.00** Hrs. The Technical bids will be opened on the same day at **15.30** hrs. We shall separately intimate the date for opening the price bids only to those parties who are technically qualified. You are requested to depute your authorized representative at the time of opening.

ANY REVISION OF RATES / PRICES 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

SENIOR DEPUTY GENERAL MANAGER / CONTRACTS

This Tender document is not transferable.

Place : Chennai -35

Encl: One set of Tender documents along with GCC Booklet

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

SPECIAL INSTRUCTIONS TO BIDDERS

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

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

01. Details of previous experience during the last five years indicating contract value, duration, completion period and present engagement as per G.C.C.
02. 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 posses the experience of having completed successfully DCS based Boiler & TG control and station C & I system and other related works like field instruments, Electric & Pneumatic Actuators, Impulse piping, Instrument Air Piping, trays, tray supports, cabling, earthing etc., for Thermal power Project of minimum 110 MW rating or above in the last seven years.

b) The bidders should have a minimum average financial turn over of Rs.**60** Lakhs per year in the preceding three years ending on 31.03.2005.

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

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

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

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

15. A DECLARATION SHEET INDICATING THAT THERE IS NO DEVIATION FROM 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 Senior Deputy General Manager/Contracts at the above mentioned address before the due date as indicated. The Tenderers will be intimated separately in case any clarifications are required.

NOTE:
Tenderers are issued with 2 Nos. of Technical Bids, 2 Nos. of Price Bids and 2 Nos. of GCC booklets. Out of which one set of each document shall be retained by them for their reference. Balance one set shall be submitted along with their offer as per procedure indicated above.
EMD amount for this Tender is Rs.2, 00,000/- (Rupees Two Lakhs only). This EMD amount shall be submitted in the form demand draft only drawn in favour of M/s. Bharat Heavy Electricals Limited, Chennai – 35.
EMD amount in the form of Bank Guarantee / fixed deposit receipt or in any other form will not be Accepted.

ANY REVISION OF RATES / PRICES 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.

Sr. Deputy General Manager/Contracts.

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

TENDER NOTICE

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

Tender Specification No. BHEL:PSSR:SCT: 1179

Description	EMD
Handling at Site Stores / Storage yard, Transportation to site of work, Erection, Testing and Commissioning of Electrical and Control & Instrumentation System for 2 x 210 MW at Rayalaseema Thermal Power Project Muddanur, Cuddapah District, Andhra Pradesh	Rs 2,00,000/= (Rupees Two Lakhs only)

Cost of Tender Documents (Including all Taxes)	: Rs.1105/-	
Sale Starts on	: 23.03.2006	
Sale closes on	: 04.04.2006	
Due date and Time for Submission	: 05.04.2006	15.00 Hrs.
Date and time for opening Of Technical Bids	: 05.04.2006	15.30 Hrs.

QUALIFICATION REQUIREMENT

a) **The bidders** should posses the experience of having completed successfully DCS based Boiler & TG control and station C & I system and other related works like field instruments, Electric & Pneumatic Actuators, Impulse piping, Instrument Air Piping, trays, tray supports, cabling, earthing etc., for Thermal power Project of minimum 110 MW rating or above in the last seven years.

b) The bidders should have a minimum average financial turn over of Rs.**60** Lakhs per year in the preceding three years ending on 31.03.2005.

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

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

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

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

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

SENIOR DEPUTY GENERAL MANAGER/CONTRACTS

TENDER SPECIFICATION : BHEL:PSSR:SCT:1179

CERTIFICATE FOR NO DEVIATION

I,_____of

M/s_____

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

SIGNATURE OF THE TENDERER

OFFER OF CONTRACTOR

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

Sir,

I/We hereby offer to carry out the work detailed in Tender Specification No.BHEL:PSSR:SCT:1179 issued by Bharat Heavy Electricals Limited, Power Sector : Southern Region, in accordance with the terms and conditions thereof.

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

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

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

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

DATE: CONTRACTOR:

PLACE: ADDRESS:

Witness with their address

Signature Name Address

PROJECT INFORMATION

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

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

.

SECTION III

COMMON CONDITIONS OF CONTRACT

3.1 SCOPE OF CONTRACT

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

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

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

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

3.1.5 Completion of work in time.

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

3.1.7 Preservation of all components at all stages of pre-assembly/erection/testing and commissioning till unit is handed over.

3.2 FACILITIES TO BE PROVIDED BY BHEL:

3.2.1 OPEN SPACE :

Open space for building of temporary office shed and contractor's stores shed(s) 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 contractors office and stores shed electricity will be provided at one single point free of charges. Further distribution shall be arranged by the contractor at his cost including supply of energy meter with calibration certificate.

3.2.3 WATER:

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

3.2.4 TOOLS & TACKLES:

BHEL will provide EOT crane at Power House Hall on sharing basis. Required crane operators, fuel and lubricants are to be arranged by the contractor at his cost.

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

3.2.5 CONSUMABLES:

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

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

3.3.1 CIVIL CONSTRUCTION:

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

3.3.2 WATER DISTRIBUTION:

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

3.3.3 ELECTRICITY DISTRIBUTION:

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

3.3.4 POSSESSION OF GENERATORS :

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

3.3.5 LIGHTING FACILITY :

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

3.3.6 POWER DISTRIBUTION :

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

3.3.7 CONTRACTOR'S OBLIGATION ON COMPLETION :

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

3.4 GASES :

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

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

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

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

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

3.5 ELECTRODES & FILLER WIRES :

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

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

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

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

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

3.6 TOOLS & TACKLES

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

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

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

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

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

3.7 SUPERVISORY STAFF AND WORKMEN

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

3.9.0 PRESERVATION OF COMPONENTS

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

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

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

3.9.4 Due to atmospheric conditions erected materials are likely to get rusted more frequently. It is the responsibility of the contractor to preserve the erection materials drawn from stores for erection till these are commissioned and handed over to customer. The required paint (Red oxide) and thinner shall be supplied by BHEL free of cost. All other consumables like painting brush, emery paper, cotton waste, cloth etc. have to be procured 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.

3.10.0 DRAWINGS AND DOCUMENTS

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

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

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

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

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

3.11.0 SITE CLEANLINES AND SAFETY REQUIREMENTS

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

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

SlNo	Safety	Fine (Rs)
01	Not wearing safety helmet	50/-
02	Not wearing safety belt	100/-
03	Grinding without goggles	50/-
04	Not using 24V supply for internal work	500/-
05	Electrical plugs not used for hand machines	100/-
06	Not slinging properly	200/-
07	Using damaged sling	200/-
08	Lifting cylinders without cage	500/-
09	Not using proper welding cable with lot of joints, and not insulated properly	200/-
10	Not removing small scrap from platforms	200/-
11	Gas cutting without taking proper precaution , or not using sheet below gas cutting	200/-
12	Not maintaining elec. Winches which are being operated dangerously	500/-
13	Improper earthing of electrical T & Ps	500/-

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

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

3.12.0 PROGRESS OF WORK

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

all charges incurred on this account including all expenses together with BHEL overheads from contractor's bill.

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

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

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

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

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

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

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

3.13.0 SPECIFIC REQUIREMENTS FOR ISO 9001 - 2000

IMPORTANT NOTE

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

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

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

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

3.14.0 INSPECTION / QUALITY ASSURANCE / QUALITY CONTROL STATUTORY INSPECTION

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

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

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

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

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

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

3.15.0 STAGE INSPECTION BY FES / QA ENGINEERS:

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

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

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

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

3.16 STATUTORY INSPECTION

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

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

HSE SPECIFIC REQUIREMENT

OCCUPATIONAL HEALTH & SAFETY MANAGEMENT SYSTEM

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

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

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

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

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

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

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

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

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

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

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

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

05. All power tapping points / switch boards /power & control cabling should fulfil 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 in charge, supervisors, and key workers to be submitted before commencement of work..

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

OTHER HSE REQUIREMENTS TO BE COMPLIED BY SUB CONTRACTOR

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

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

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

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

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

RAYALASEEMA TPS UNITS 3&4 (2 X210 MW)

SECTION VI

CONTROLS & INSTRUMENTATION PACKAGE

SCOPE OF WORK AND SPECIAL CONDITIONS

6.1.0 GENERAL

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

Identification of equipments at storage yard, technical assistance for checking and making the shortage/damage reports, taking delivery at storage yard/ stores and calibration, erection, aligning, fastening, supporting, cleaning, checking, testing, commissioning, troubleshooting and carrying out statutory tests as required, trial operation, up to the time of completion of commissioning activities and commercial operation of the unit and handing over to customer or till completion of contract period whichever is earlier, along with the supply of all consumables, tools and tackles and testing instruments.

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

6.1.2 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.

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

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

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

6.1.6 Contractor shall erect all items/materials etc. as per sequence prescribed by BHEL at site. BHEL engineer depending upon the availability of materials/work fronts etc 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.

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

6.1.8 During the course of erection, testing and commissioning C&I work certain rework/modification / rectification / repairs / fabrication etc. may be necessary on account of feedback from other power stations or units already commissioned and / or units under erection and commissioning and also on account of design changes and manufacturing incompatibilities and site operation / maintenance requirements. Contractor shall carryout such rework / modification / rectification / fabrication / repairs etc, promptly and expeditiously and the same shall be deemed to be part of the scope of work.

6.1.9 The contractor shall take delivery of item, materials, from the storage yard/ stores/sheds of BHEL / customer which is within a radius of 5 kms. He shall also make arrangements for, safe custody, watch and ward of equipment after it has been handed over to him till they are fully erected, tested and commissioned till the contract period. The contractor shall note that items/materials shall be transported to erection site / assembly yard etc. by the prescribed route without disturbing and causing damage to other works in the most professional manner. All items, Hardware, etc. shall be stored in appropriate manner as per BHEL's instructions.

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

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

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

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

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

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

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

6.1.17 The Contractor may have to execute work in such a place and condition where other agencies also will be under such circumstances.

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

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

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

6.1.21 The scope of specification covers the installation, testing and commissioning of the instrument, hardware along with accessories as detailed in Bill of Materials.

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

Note:

1. ***Bill of Materials (BOM) contains detailed specification of various instruments and items, system-wise and BHEL Unit- wise along with relevant clause for scope of works.***
2. ***The Rate Schedule contains the consolidated list of BOM with brief description of items.***
3. ***Rates are to be filled only in the Rate Schedule.***
4. ***Before filling the Rates in the rate schedule, the bidder shall go through the detailed specification of all items of BOM as well as Scope of Work as specified in relevant Clause of this document.***
5. ***Section VII contains general guidelines for Erection and Commissioning of C&I systems***

6.2.0 SCOPE OF WORK

6.2.0 The C&I works shall be covered for the total power plant, which consists of Boiler, Steam turbine, Generator, ESP and other auxiliaries.

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

I Erection and commissioning of All Types of Field Instruments like Temperature, Pressure and Flow instruments (local & remote) and special instruments like EWLI, Sonic Tube Leak Detection systems, Vibration Monitoring System, SWAS, Gas analyser, Coal Flow Monitor, Master clock system, Furnace CCTV System etc.

II Erection and commissioning of all types of Control room mounted instruments like Recorders, Indicators, Microprocessor based panels, DCS system and its accessories like system panels, PC, LVS, printers, furniture etc.

III Erection and commissioning of all Types of Pneumatic Power Cylinders, Controllers etc.

IV Commissioning of all Types of Pneumatic operated Valves / Actuators / Power Cylinders / Controllers and Relief Valves.

V Erection of all types of Hardware like impulse pipes, trays & tray supports, instrument air line, etc.

VI Erection & Testing of all types of power/control/instrumentation cables etc.

VII Erection and commissioning of UPS, Battery, Battery Charger and ACDB

VIII Erection and commissioning of control panels etc.

6.3.0 DETAILED SCOPE OF WORK FOR C&I:

The scope of work for C&I items like Instruments, Panels, Hardware etc. covers identification of items at stores / yards, checking, reporting the damages if any, loading, transportation, unloading at Contractor's stores / working yard, keeping in safe custody in contractor's stores, pre-assembly, calibration, checking, erection, testing, loop checking & commissioning, supply of consumables like electrodes, gas, cable dressing materials, tag plates, ferrules, lugs (specific sizes), specific types of fasteners, paints and consumables. Deployment of skilled / unskilled manpower, engineers / supervisors, T & P, Material handling equipments, Testing instruments (excepting proprietary type instruments), returning of un-used materials / items to stores are also covered in the scope of work.

6.3.1 SCOPE OF WORK FOR C&I PANELS/ CONTROL DESK:

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

6.3.1.2 The unit rate quoted for Installation of control panels, shall include fabrication of base frame wherever required, fixing of anti-vibration pads, levelling 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. Minor concrete chipping and grouting works are deemed to be included in the scope of works. For fabrication and erection of frame, unit rate shall be paid on tonnage basis.

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 and JBs shall be Electrically earthed to the nearest earth grid by means of GI flat /wire as per the instructions of BHEL engineer as indicated in the BOQ.

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 free of 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.

6.3.1.14 UPS, AC & DC DB AND OTHER ELECTRICAL CONTROL PANELS

Unit Control Panel and Unit Electrical control board are of mosaic tiles type. Fixing of console type instruments, if supplied loose, shall be part of panel erection work. The erection & commissioning scope of above panels will be in line with clause 6.3.1.

6.3.2 SCOPE OF WORK FOR INSTRUMENTS:

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

i) All types of transmitters like temperature, pressure, flow, level and position feed back 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 valves etc.

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

v) I / P converters and local controllers.

vi) Pneumatic operated control valves, trip valves, solenoid valves, power cylinders, etc. and electrically operated valves.

vii) Special instruments like vibration sensors, proximity sensors, hydra step water level indicator, SWAS, Gas analyser, PC based instruments, and special type of instruments like , Furnace CCTV System etc.

6.3.2.2 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.

6.3.2.3 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 or trial operation whichever is earlier. 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 at free of cost. 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

6.3.2.4 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

6.3.2.5 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 at 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.

6.3.2.6 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.

6.3.2.7 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.

6.3.2.8 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.

6.3.2.9 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. Welding of MTM pads shall be carried out by mechanical contractor. Necessary tray supports for routing of MTM thermocouples shall be arranged by contractor separately as part of tray erection covered in the tender.

6.3.2.10 Unit rate quoted for erection and cheeking of thermocouple, RTD etc. shall include cleaning of thermo well stubs threads using tap sets, fixing of thermo wells, seal welding of thermo well, wherever required as per BHEL specification and directive of site engineers.

6.3.2.11 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.

6.3.2.12 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.

6.3.2.13 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.

6.3.2.14 Unit rate quoted on lump sum basis for erection/commissioning of special instruments like, Flame scanner, H.E.A Igniters systems, Vibration monitoring System, Electronic water level indicator, Sonic Tube Leak Detection system, SWAS, Gas analyser, PC based instruments, 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.

6.3.2.15 Unit rate quoted for installation and commissioning of vibration monitoring systems shall covers installation of sensors along with mounting pads and if any surface finishing or tapping is required on the equipment to fix the sensors, the same shall be carried out as part of vibration monitoring systems erection at no extra cost**.**

6.3.2.16 **For Special Instruments like SWAS, Gas Analysers, Vibration Monitoring System, Master Clock system, Battery and UPS, vendor support shall be provided by BHEL for commissioning. The contractor shall provide necessary assistance for commissioning activities.**

6.3.2.17 **Some of the Gas Analysers are to be installed at Chimney 88 ML as indicated in BOQ. For the erection of associated hardware for these analysers, like cables, trays, GI pipe etc. that are to be routed from the analyser panels at 88 ML of Chimney to zero meter level, payment for the erection of above hardware shall be considered twice the unit rate quoted against each item.**

6.3.2.18 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.

6.3.2.19 Canopy shall be provided for field-mounted instruments as per site requirements. Necessary materials like MS Plate shall be provided by BHEL. Rate for fabrication and installation of canopy shall be on square meter basis.

6.3.2.20 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.

6.3.2.21 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.

6.3.3 SCOPE OF WORK FOR IMPULSE PIPES:

6.3.3.1 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.

6.3.3.2 Unit rate quoted for impulse piping shall include site routing, cold bending, TIG / Arc c 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 and painting as per BHEL 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.

6.3.3.3 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.

6.3.3.4 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 free of cost.

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

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

6.3.3.7 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.

6.3.3.8 Hydraulic test shall be conducted for all impulse pipes after completion of erection as per site engineer's directive, as part of the work.

6.3.4 SCOPE OF WORK FOR COPPER/SS TUBES:

6.3.4.1 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.

6.3.4.2 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.

6.3.4.3 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.

6.3.4.4 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. For SADC system copper tube Tag plate shall be provided near instruments, TEES and Power cylinders. Leak test shall be carried out after completion of tubing works as per guidelines.

6.3.5 SCOPE OF WORK FOR INSTRUMENT AIR LINES (GI PIPES):

6.3.5.1 Different type of GI pipes of different thickness class shall be supplied along with GI fitting accessories like union, coupling, tee, reducers, elbow, valves, etc

6.3.5.2 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.

6.3.5.3 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.

6.3.5.4 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 free of cost.

6.3.6 SCOPE OF WORK FOR JUNCTION BOXES/CJCBs /PUSH BUTTON BOXES:

6.3.6.1 Different Junction Boxes/push Button boxes shall be supplied with gland plates.

6.3.6.2 The unit rate quoted for erection of junction boxes/push button boxes shall cover providing necessary supports, drilling of bottom gland plates for cable glands as required, painting the tag nos of JB or fixing a separate tag plate 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.

6.3.6.3 For fabrication of supports the rate shall be paid on tonnage basis.

6.3.6.4 All the un-used holes on the gland plates shall be closed by **grommet** at free of cost.

6.3.7 SCOPE OF WORK OF 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 fabrication and installation of base frame, 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 Commissioning of bi-directional electrical actuators will be done by the Electrical Contractor. It shall be the responsibility of the C&I Contractor to do the loop checking of command and feedback signals from DCS to the bi-directional Electric actuators /MCC.

6.3.7.6 During commissioning of the bi-directional Electrical Actuators by Electrical Contractor, the C&I Contractor shall co-ordinate with the Electrical Contractor to ensure that all feedback and command signals and settings are made available. The list of such actuators is indicated separately in the BOM under commissioning scope.

6.3.7.7 The Unit Rate quoted for loop checking shall cover all the activities mentioned above. The work for loop checking of bi-directional actuators shall be deemed to be completed only after satisfactory operation of actuator from DCS.

6.3.7.8 In case the power cylinder 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 pneumatic power cylinder of similar type.

6.3.7.9 In case the power cylinder 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 power cylinder of similar type.

6.3.8 SCOPE OF WORK OF MMIPIS(DCS) PACKAGE WITH RELATED INSTRUMENTATION :

6.3.8.1 BHEL will supply sophisticated MAX-DNA DCS system. The scope of DCS system includes erection of sophisticated microprocessor based systems MAX control panels, I/O panels, Ethernet switching panels, Network Enclosure cabinets, CPU, Engineers workstations, operator workstations, CRTs, LVS, server, printers, portable UPS power supply, furniture and interconnecting cables like Ethernet/Fibre-optic etc.

6.3.8.2 Unit rate quoted for MMIPIS (DCS) equipments shall cover installation & integration of all the above said equipment and providing necessary commissioning assistance. No separate unit rate applicable for installation of all loose items/ modules/ components or accessories etc, which is not explicitly mentioned in the BOQ, but comes as part of the system.

6.3.8.3 The DCS System shall be hooked up with off-site plants like CW Pump House through fibre-optic cables. Laying and termination of Ethernet, i.e. Data Highway between CPUs and DCS i.e. panels, workstation etc. shall be on per metre basis. All the Ethernet/Fibre-optic cables shall be isolated from other cables and routed in a separate cable tray. (Ref. clause-6.3.10).

6.3.8.4 Necessary care shall be taken by the contractor while removing the modules, and other components, etc.

6.3.8.5 The complete details of MMIPIS (DCS) System shall be furnished in the BOM so as to enable the contractor to carry out erection as per scope.

6.3.9 SCOPE OF COMMISSIONING OF EQUIPMENT ERECTED BY THE MECHANICAL CONTRACTOR.

6.3.9.1 <u>PNEUMATIC (ALL TYPES OF VALVES AND POWER CYLINDERS)</u>

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.

6.3.9.2 FLOW METERS/ SWITCHES

a) Checking the calibration and servicing if required.

b) Setting the alarm value

c) Replacement of defective components if any

6.3.9.3 LIMIT SWITCHES & LEVEL SWITCHES

a) Checking the operation

b) Replacing defective components if required

6.3.9.4 SOLENOID VALVES

a) Checking the healthiness of coil

b) Checking the operation

c) Replacement of defective components if required.

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

a) Checking the healthiness

b) Replacement of defective element (only for bearing)

6.3.9.6 DIRECT WATER LEVEL GAUGES (REMOTE & LOCAL)

a) Checking the calibration

b) Fixing of bulbs and extending Power supply

c) Replacing defective components

6.3.9.7 INSTRUMENTS MOUNTED ON THE EQUIPMENTS/ SKIDS/ PANELS,

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

NOTE:

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

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

6.3.10 SCOPE OF WORK FOR CABLES:

6.3.10.1 Cable supplied shall be of LT, 1.1 KV, armoured/ unarmoured, Copper PVC FRLS insulation, screened Control and Instrumentation cables of different sizes. The special cables supplied shall be of Compensating cable, Ethernet cables and Fibre-optic cable of different sizes and type.

6.3.10.2 Unit rate quoted for cable shall covers laying, termination, drilling of holes on the gland plates of the panels/JB or Enlargement of cable entry holes by tapping or any modification required fixing of cable glands, fixing of glands, ferrules and tag plates and dressing.

6.3.10.3 Unit rates quoted for cabling shall also includes supply of clamping/ dressing materials such as Aluminium/GI strips or PVC ties, ferrules, tag plates, lugs upto 1.5 sq. mm. apart from the work mentioned above. Supply of above material shall conform to the specification detailed in Section VII.

6.3.10.4 Uniform unit rate shall be quoted for the cables whether laid on cable trays or routed through duct bank, conduits, cable shafts etc.

6.3.10.5 Ethernet cables and Fibre optic cables shall be isolated from other cables and laid in a separate cable tray as directed by site Engineer. Wherever required I/O Box shall be installed for Ethernet cable termination and PUNCH DOWN crimping tools shall be used for Ethernet cable termination.

6.3.10.6 The scope of work for Fibre Optic cable shall be laying only. Termination of Fibre optic cables is not in contractor's scope. This shall be carried out by the vendor and the contractor shall provide necessary assistance to the vendor during cable termination. Wherever required, the Fibre optic cable shall be laid through HDPE Conduit.

6.3.10.7 Unit rate quoted for laying of Fibre Optic cable shall include laying of HDPE conduit wherever required. No separate rate shall be applicable for laying of HDPE conduit.

6.3.10.8 The contractor shall provide Tools/ equipment required for the connections and termination of cable wherever necessary. No separate rate shall be paid for cable terminations. For cable joining, if any, separate rate shall be considered on extra works basis.

6.3.10.9 If the cables are to be laid on the angles or routed in conduit pipe as per site condition, the unit rate for erection of angles and conduit pipes shall be as per the unit quoted elsewhere in the tender.

6.3.10.10 Any fabrication required at site for cable support shall be carried out at the rate quoted for fabrication.

6.3.10.11 The contractor shall carry out cable dressing and clamping for all the cables laid by the contractor. However, if any other agency laid cables of lesser quantity for which no separate trays have been allotted, the contractor shall do clamping along with the cables.

6.3.10.12 Wherever cable entry holes have not been provided for equipment installed by another agency, the contractor shall co-operate to get the same done.

6.3.10.13 During testing and commissioning, if the equipment on which the cables are terminated not functioning, it is the responsibility of the contractor to check and establish in coordination with the commissioning agencies that there is no defect in the cabling, The contractor shall promptly depute his supervisor or technicians to assist the commissioning agencies to check the interconnecting cables.

6.3.10.14 Contractor shall carefully plan the cutting schedule for each cable drum in consultation with Engineer such that wastage is minimized and any resultant short lengths can be used where appropriate route lengths are available.

6.3.10.15 Cable installation shall be properly coordinated at site with other services and wherever necessary suitable adjustment shall be made in the cable routings with a view to avoid interference with any part of the building, structures, equipment, utilities and services any such adjustment shall be done with the approval of Engineer.

6.3.10.16 The approximate number of termination for the purpose of estimation to be assumed as follows: The average RUN length shall be considered as 150 Mtrs. However, for 10% of the 2 pair and below, the average length shall be considered as 30 Mtrs.

6.3.10.17 The cables covered in the BOQ may be appearing either in C&I cable schedule or in Electrical cable schedule. The contractor shall lay and terminate all the cables covered in the BOQ, as per directive of BHEL Engineers.

6.3.10.18 Printed ferrules only are to be used and necessary ferrules printer to be arranged at site.

6.3.11 SCOPE OF WORK FOR HEAT TRACING SYSTEM:

6.3.11.1 Heat tracing systems shall have heat tracing control panels and electrical heat tracer tape. Heat Tracer Tape will be supplied with all the accessories like power connector, tee connector, splice connector, end connector, adhesive tapes, pipe straps, thermostats etc

6.3.11.2 Separate heat tracing panels shall be supplied with transformer and other protection.

6.3.11.3 Unit rate quoted for Heat Tracer Tape shall cover laying and termination of tape and installation of all the above said accessories. No separate unit rate shall be applicable foe installation of accessories. All other terms and condition shall be in line with scope cable laying.

6.3.11.4 Unit rate quoted for Erection and commissioning Heat tracer panels shall be in line with LT electrical /control panels.

6.3.12 SCOPE OF WORK FOR CABLE TRAYS/ CONDUITS/ FLEXIBLE CONDUITS/ HOSE:

CABLE TRAYS / CONDUITS/ FLEXIBLE CONDUITS

Scope of cable tray works covers erection various sizes of perforated trays with accessories mostly for branch trays in Power House building. All type of cable trays including, standard tray accessories shall be supplied by BHEL.

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

A-CABLE TRAYS

1. The unit rate for erection of trays shall be on meter basis. The unit rate quoted for erection of tray shall also include erection of all tray accessories such as elbow, cross, TEEs, bends such as vertical and

Horizontal, reducers, coupler plates/fixing plates, anchor bolts, fasteners etc.

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

3. If standard tray accessories like TEES, Reducers, Bends , cross etc requires any modification to suit the tray routing, the same shall be carried out at no extra cost.

4. The unit rate quoted for trays shall also cover making of offsets by means of cutting standard tray sections and inserting suitable trays to match with the existing arrangement,

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

6. The contractor shall quote a uniform rate on meter basis for erection of trays and Trays accessories like TEES, Reducers, Bends, cross etc.

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

8. Welded Joints of trays shall be painted with red lead and aluminium paint in turn with bitumen as per IS 3043. The unit rate shall also include supply of paints, thinner, other consumables and brush etc.

B- RIGID & FLEXIBLE CONDUITS

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

2. Unit quoted on meter basis 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. No separate payment will be made for fixing of end connectors.

3. Unit quoted on meter basis for GI rigid conduit includes supply of suitable clamps,/supports fasteners etc.

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6.3.13 SCOPE OF WORK FOR FABRICATION MATERIALS & STRUCTURAL STEEL:

6.3.13.1 The scope of fabrication generally includes supports for cable tray, instruments, impulse pipes, GI pipes, support angles for copper tubing, mounting frames for JB, Control Box/Panel, canopy for local instruments and local instrument rack etc. wherever required.

6.3.13.2 The fabrication steel materials such as angles, channels, plates, flats shall be supplied by BHEL, free of cost.

6.3.13.3 Unit rate quoted for steel fabrication on tonnage basis shall cover fabrication as per site requirement, installation, minor chipping and grouting, painting and supply of paints and consumables, etc. Fabrication shall be carried out as per schemes in consultation with site engineers.

6.3.13.4 If nuts, bolts, anchor fasteners required for fixing the racks or frames the same shall be arranged by the contractor at free of cost.

6.3.13.5 All the fabricated steel materials shall be painted as per the details given in the scope of painting and no separate rate shall be paid for painting.

6.3.13.6 Supply of all cement, sand etc. required for grouting of supports shall be included in the unit rate quoted.

6.3.14 SCOPE OF WORK FOR PRE-FABRICATED/ SEMI-FABRICATED LIR/ LIE/ GAUGE BOARDS

6.3.14.1 If the frame or rack is supplied as a pre-fabricated item like LIR, same shall be erected, grouted and painted as per site requirement

6.3.14.2 If any frame or support or rack supplied as semi fabricated item, same shall be assembled at site either by welding or bolting and be erected, grouted and painted as per site requirement

6.3.14.3 Unit rate quoted for such pre-fabricated /semi fabricated items like LIE/LIR and enclosure shall cover installation, grouting, painting and supply of nuts, bolts, anchor fasteners, grouting materials such as cement, sand etc as required. Unit rate is applicable on Number basis. Unit rate shall also include full painting of impulse line fitted and supplied along with LIR/LIE.

6.3.15 SCOPE OF PAINTING:

6.3.15.1 The scope of painting generally includes for all the steel fabrication works such as supports, racks, frames, canopy, LIE/LIR, impulse pipes etc. Carried out by the contractor.

6.3.15.2 The scope also includes supply of synthetic enamel paints, primers, consumables like brushes, emery papers, thinner etc.

6.3.15.3 The painting shall include two coats of Red oxide primer and two coats of final painting of synthetic enamel paint of colour approved by BHEL.

6.3.15.4 Paints shall be arranged from standard reputed suppliers in consultation with BHEL.

6.3.15.5 Only touch up painting shall be generally required for trays, control panels, junction boxes and full painting shall be required only for specific equipments as per the scope of erection.

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

6.3.15.7 For any bare copper tube require painting same shall be carried out by the contractor at free of cost.

6.3.16 SCOPE OF CALIBRATION:

6.3.16.1 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

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

6.3.16.3 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.

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

6.3.16.5 BHEL shall provide vendors supports for calibration and commissioning of 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 as per the list of min T & P / instruments enclosed for calibration and testing of above proprietary type instruments

6.3.16.6 If BHEL is unable provide or arrange vendor support for above mentioned proprietary instruments, contractor shall carry out the calibration through authorized agency, at extra cost. The actual cost of such calibration carried out by out side agency shall be absorbed by BHEL. All other supports like manpower , standards, T & P , Instruments shall be provided as mentioned in clause 6.3.16.5. However if above such calibrator is available with BHEL at site the calibration shall be carried out by the contractor at free of cost.

6.3.17 SCOPE OF WORK FOR UPS, 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 rectifiers/inverters are fully thyristorised and shall comprise of Silicon Controlled Rectifier with transformer, switchgear and automatic regulation. Tentative details are given in the BOM. Lump sum shall be quoted for Erection and commissioning of UPS and Battery. No additional payment shall be made for any variation in the number of cells. The unit rate quoted for erection of UPS and battery will include the following works.

SCOPE OF WORK FOR UPS, BATTERY AND CHARGER

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

2. Filling of alkali to the individual cells after shipping the cells ..

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

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

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

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

6.3.18 SCOPE OF CIVIL WORKS

Minor civil works like drilling, chipping and punching holes on slabs and brick-walls and grouting related to installation of LIR/LIE/Gauge Board, control panels, Junction boxes etc., shall be included in the erection cost of such items. no separate payment is applicable. The scope also includes supply of grouting material. More details regarding scope of civil are given in the respective equipment erection.

6.3.19 SCOPE OF EARTHING

6.3.19.1 The scope of earthing covered in this contract is above ground earthing i.e equipments earthing. Scope of earthing covers earthing of field Instruments, JBs, Branch trays, LIR/LIE/ , JB, push Button boxes etc. shall be electrically earthed. All DCS and its accessories PLC/Instrumentation panels/systems etc, shall be earthed to a separate Electronic earth grid.

6.3.19.2 Different type of earthing materials shall be supplied and same shall be erected as per site requirement.

6.3.19.3 The unit rate shall be quoted for earthing on meter basis. The rate shall cover supply of fasteners, lugs, minor civil works etc.

6.3.19.4 All connections from the equipment 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.

6.3.19.5 Entire system shall be earthed in accordance with the provisions of the relevant IEC recommendations/IS code of practice IS 3043-1947 and Indian Electricity Rules, so that the values of the step and contact potentials in case of faults are kept within safe permissible limits .All electrical Panel/equipment shall have two separate and distinct earth connections each to confirm to the stipulation of the Indian Electricity Rules and equipments rated 240 V and below may have single earth connections.

6.3.20 **SCOPE OF PRE-COMMISSIONING/ COMMISSIONING AND POST COMMISSIONING WORKS:**

6.3.20.1 The scope of commissioning works covers 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. The

contractor shall be responsible for overall commissioning of all the instruments and systems covered in the BOQ.

6.3.20.2 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:

i) Trial run of various equipment.

ii) Light up of boiler.

iii) Boiler acid cleaning.

iv) Boiler alkali boil out.

v) Turbine barring gear.

vi) Steam blowing of piping.

vii) Turbine rolling.

viii) Safety valve floating.

ix) First synchronization of unit.

x) Heavy oil firing and synchronization.

xi) Coal firing of boiler.

xii) Full load operation of unit.

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

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

6.3.20.3 The pre commissioning activities of the main power plant will start with run of various equipments prior to light up of boiler and commissioning operations shall continue till the unit is handed over to customer. The contractor shall simultaneously start commissioning activities for the equipment erected to match with the various milestone activities of commissioning programme of the project.

6.3.20.4 Contractor shall arrange specialized 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

6.3.20.5 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.

6.3.20.6 If at any time the requisite manpower, consumables, T & P are not arranged by the contractor to meet the schedule, BHEL shall make alternate arrangements and recover the cost with overhead from the running bills of the contractor.

6.3.20.7 After erection of various equipment prior to commissioning and after commissioning, protocols have to be made with BHEL's customer. The formats will be given by BHEL and have to be printed by the contractor in adequate numbers.

6.3.20.8 For electrical works, 415 volts and above, the contractor has to bring qualified electricians and the total work has to be certified by electrical license holder.

6.3.20.9 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.

6.3.20.10 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.

6.3.20.11 Minimum requirement of Man Power for commissioning works per unit shall be as follows:

	Boiler	TG	Station C&I	TOTAL
Engineer (C&I)	1 No.	1 No.	2 Nos	**4 Nos.**
Supervisor (C&I)	3 Nos.	3 Nos.	4 Nos	**10 Nos.**
Technician (C&I/ Elec)	6 Nos.	6 Nos.	10 Nos.	**22 Nos.**

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.

6.3.20.12 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.)

6.3.20.13 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 the BHEL engineers and reports signed shortly. Contractor shall follow checklist of BHEL and testing & commissioning activities shall be carried out in accordance with the checklist.

6.3.20.14 **The scope of commissioning shall also cover the commissioning of the equipment/drives erected by the mechanical contractors. (as detailed in the BOQ)**

6.3.21 EXCLUSIONS

The following are specific exclusions from this work

a. Erection of dampers, valves, electrical actuators, HT/LT drives

b. Attachment welding of thermocouple pads, flow nozzle, orifice plates and control valves

c. Root valves on the instruments tapping points

NOTE:

The above exclusions should not be concluded as final. They are meant for general guidelines. BHEL reserves the right to include or exclude any item which is required for completing the job as per rates indicated in rate schedule. Contractor should carry out all such jobs as per the instructions of BHEL, Engineer.

6.4.0 TIME SCHEDULE

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

1)	Boiler Light up	2months from start of work.
2)	Steam Blowing Completion	5 months from start of work
3)	Barring Gear	6 months from start of work.
4)	Synchronization	7 months from start of work.
5)	Full Load/ Trial operation	10 months from start of work
6)	Handing over	15 months from start of work

6.4.2 Commissioning program for Unit-4 shall be in a phase shift of 3 months. However depending up on the availability of work front unit-4 works can be taken up.

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

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

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

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

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

6.4.8 CONTRACT PERIOD

The total contract period for completion entire work shall be **18 months** from the start of erection activity. 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.

6.4.9 GRACE PERIOD

Grace period of THREE months beyond the contract period of 18 months is provided for this contract.

6.5.0 OVER RUN CHARGES

6.5.1 Please refer clause 16.6.0

6.6.0 MEASUREMENTS & WASTAGE & CUTTING ALLOWANCES:

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

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

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

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

6.6.5 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.

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

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

6.6.8 The wastage allowances as permissible for various items are indicated in Section VII. Cutting and wastage allowance shall be computed on the lengths and weight of materials actually used, measured and accepted.

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

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

6.6.10 If however, the bidder quotes for more wastage than specified above, the excess portion will be considered for adjustment during the tender evaluation at the quoted supply rate of material.

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

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

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 one time or other.

6.7.0 **STORAGE**

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

6.7.2 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 fort lift truck.

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

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

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

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

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

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

6.7.9 Sub-Assemblies

a) All sub-assemblies should be kept in a separate place where it is easily accessible.

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

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

6.7.10 Loose items (wherever applicable)

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

6.8.0 TOOLS AND PLANT TO BE ARRANGED BY THE CONTRACTOR

6.8.1 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.

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

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

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

6.8.5 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.

6.9.0 TERMS OF PAYMENT

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

6.9.2 FOR ALL TYPE OF INSTRUMENTS INCLUDING POWER CYLINDER/ ACTUATOR.

a.	Receipt, transport to erection site, assembly, checking, calibration, fixing and clamping Adjustment, Alignment, on pro rata basis and protocol signed	75%
b.	Pre-commissioning tests, checks, and making ready for energisation pro rata basis and protocol signed	15%
c.	Completion of pending points & submission of final bill	5%
d.	After guarantee period	5%

6.9.3 FOR AC& DCDB /UPSDCS/MMI/PLC system and all types of control panels including MMIPIS(DCS) Related instrumentation:

a.	Receipt, transport to erection site Placement, assembly fixing and clamping Adjustment, Alignment, grouting and electrical interconnections on pro rata basis and protocol signed	70%
b.	Pre-commissioning tests, checks, and making ready for energisation on pro rata basis and protocol signed	20%
c.	Completion of pending points/as built drawing & submission of final bill	5%
d.	After guarantee period	5%

6.9.4 For UPS/ Battery/ Battery Charger

a.	Receipt, transport to erection site, checking, Placement, assembly, grouting Mounting and wiring of loose components Adjustment, alignment, inter connections and pouring of Alkali	70%
b.	Pre commissioning test checks, and making ready for Energisation	20%
c.	Completion of pending points &submission of final bill	5%
d.	After guarantee period	5%

6.9.5 For Cable Laying & Cable Termination including Heat tracing cables.

a.	Laying /tagging /termination on pro rata basis and protocol signed	75%
b.	Checking/dressing on pro rata basis and protocol signed	15%
c.	On submission of as built drawing and final bill	5%
d.	After guarantee period	5 %

6.9.6 For fabrication and installation of steel materials including LIR/LIE

a	After fabrication &installation and applying of primer on pro rata basis	85%
b.	On completion of painting and protocol signed	5%
c.	On submission of final bill	5%
d.	After guarantee period	5 %

6.9.7 For Cable Trays, Tray Supports, Rigid & Flexible Conduits & Copper tubes, Earthing

a.	On satisfactory completion of work on pro rata basis	75%
b.	On completion of drawing or area wise on pro rata basis	15%
c.	On submission of final bill	5 %
d.	After guarantee period	5 %

6.9.8 For Impulse Pipes.

a.	On Laying and welding on pro rata basis and protocol signed	70%
b.	On Clamping and painting on pro rata basis and protocol signed	25%
c.	After guarantee period	5 %

6.9.9 For commissioning of equipment erected by other agency

a.	On completion of commissioning of individual racks/ skid/ actuators / loop checking/ instruments etc. on pro rata basis	80%
b.	On completion of commissioning of main equipment/ system on pro rata basis	15%
c.	After guarantee period	5 %

6.9.10 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 pro rata basis on satisfactory completion of work.

b. 20% of the accepted rate on completion of the commissioning of the respective Items/Equipments etc on pro rata basis.

c. 5% shall be paid on submission and passing of final bill.

d. 5% after Guarantee period.

6.10.0 GUARANTEE

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

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

a. Welding electrodes and gas

b. Provision for Temporary Scaffoldings.

c. "U" Clamps with nuts and washers for impulse pipes and GI pipe clamping.

d. Tags- Plates.

e. Insulation tape.

f. Teflon tape for GI pipe coupling.

g. Paints required for primer coating and final coating of synthetic enamel paint of approved colour

h. Solder wire (Lead) -(60/40)

i. Protocol/Calibration report sheets as per BHEL Format.

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

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

l. Ferrules, sleeves for cables

m. Lugs upto 1.5 sqmm

n. Fastener for mounting JB and local PB Boxes ,LIE,LIR.

6.12.0 PRICE ESCALATION:

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

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

6.13.0 ELECTRICAL INSPECTORATE'S APPROVAL:

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

- Completion certificate for all the equipment covered in the contract
- Copy of Test results conducted at site for all the equipment including Electrical Equipment erected by Mechanical Contractor.
- All other documents as required by statutory authority.
- Contractor shall carry out the modifications/rectifications if any as suggested by the authority at his cost. However, it is not applicable for equipment erected by Mechanical contractor.
- Contractor shall also have valid electrical installation license on his company as well as for individuals acceptable to respective state electrical inspectorate requirement.

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

6.14.0 PROGRESS AND MONITORING OF WORK

6.14.1 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.

6.14.2 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.

6.14.3 Contractor shall monitor the progress of works on day to day basis as per the format furnished by BHEL .

6.15.0 EXTRA CHARGES FOR MODIFICATION AND RECTIFICATION WORK

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

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

6.15.3 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.

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

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

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

6.15.7 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.

6.15.8 **Extra work does not include :**

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

6.15.10 **Extra works are broadly defined as below**:

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

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

6.16.0 Over run charges

6.16.1 Incase due to reasons not attributable to the contractor, the work gets delayed and completion time gets extended beyond **Eighteen (18) months** from the date of commencement of the work, the contractor shall not be entitled for any over run compensation (ORC) for a period of first **Three (3) months** after the expiry of **Eighteen (18) months**. Incase ORC arises the same will apply at **Rs.30,000/- (Rupees Thirty Thousand only)** per month for extension of the completion period beyond **21 (18+3) months** as stated above duly taking into account the balance work at the end of that period.

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

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

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

6.17.0 TAXES

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

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

6.17.3 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.

6.18.0 IMPORTANT CONDITIONS FOR PAYMENT

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

i. PF Regn. No.
ii. Labour Licence No.
iii. Workmen Insurance Policy No.
iv. Un Qualified Acceptance for Detailed L.O.I.
v. Initial 50% Security Deposit.
vi. Rs. 100/- Stamp Paper for Preparation of contract agreement

6.19.0 PROVIDENT FUND & MINIMUM WAGES

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

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

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

6.20.0 OTHER STATUTORY REQUIREMENTS

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

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

3) The Contractor should ensure compliance of Sec 21 of Contract Labour (R&A) Act 1970 regarding responsibility for payment of Wages. Incase of "Non-compliance of Sec 21 or non-payment of wages" to the workmen before the expiry of wage period by the contactor, BHEL will reserve its right to pay the workmen under the orders of Appropriate authority at the risk and cost of the Contractor.

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

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

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

6.21.0 SERVICE TAX

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

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

6.21.1 TAXES, DUTIES, LEVIES

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

New Levies / Taxes

Incase the government imposes 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 reimbursement on account of increase in the rate of existing levies shall be made.

6.22.0 REPORTING DAMAGES AND CARRYING OUT REPAIRS.

6.22.1 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.

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

6.22.3 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 Performa prescribed by BHEL site management. Any consequential loss arising out of non-compliance of this stipulation will be borne by contractor.

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

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

6.22.6 All Rectifications, repairs, Rework and fabrication of components lost, which are minor and incidental to erection work and also any of the repairs/rectification/rework of damages and fabrication of components lost which cannot be claimed/admitted under/by insurance shall be deemed to be included in normal erection and no additional charges shall be paid for doing these works. Decision of BHEL Engineer in this regard will be final and binding on the contractor.

6.22.7 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 man hours. 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.

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

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

6.23.0 SPLITTING OF THE WORK

6.23.1 BHEL also reserves the right to split up work of this tender specification and award the same to more than one contractor on each unit basis or in any other fashion and deemed fit.

6.23.2 The terminal points, decided by BHEL is final and binding on the contractor for effecting payment for the work done or distributing and work in case of splitting the work among more than one contract.

6.24.0 MANPOWER REQUIREMENT

Manpower requirement for Erection and Commissioning shall as follows:

There shall be 3 separate area In-charges, each for Boiler, TG and Station C&I. under a residence manager. They shall work independently with required manpower, T&P etc., Each area In-charge shall have minimum 2 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. For all practical purposes, each of the above In-charges shall be provided with a PC and good communication facilities.

6.25.0 DETAILS TO BE FURNISHED BY THE TENDERERS

6.25.1 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

6.25.2 The following information shall be furnished within two weeks of award of contract for approval:

a. Final field quality plan

b. Detailed organization chart

c. Erection Schedule.

d. Experience details of site staff

e. Details of calibration instruments

6.26.0 DOCUMENTATION

6.26.1 The following information shall be furnished after commencement of works.

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

6.26.2 As built drawings :

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

6.27.0 TECHNICAL REQUIREMENTS FOR SUPPLY ITEMS

1 CABLE LUGS:

a)	Type:	Solder less crimping type
b)	Material	Copper
c)	Whether tinning required (For copper cable lugs)	Yes.
d)	Thickness of tinning:	10 microns
e)	Applicable Standard for LT Cables	IS:8309

2 FERRULES:

a) Colour of ferrules: Yellow/White

b) Colour of engraving Black

3. TAGS:

a) Material : Aluminium/ Stainless Steel

b) Markings: Engraving/Embossing/Printing

LIST OF MINIMUM TOOLS AND TACKLES / INSTRUMENTS TO BE ARRANGED BY CONTRACTOR

SL 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	01 No.
	0 to 5/6 Kg/Sq.cm	01 No.
	0 to 10 Kg/Sq.cm	01 No.
	0 to 16 Kg/Sq.cm	01 No.
	0 to 25 Kg/Sq.cm	01 No.
	0 to 60 Kg/Sq.cm	01 No.
	0 to 100 Kg/Sq.cm	01 No.
	0 to 250 Kg/Sq.cm	01 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	02 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	03 Nos.

LIST OF MINIMUM TOOLS AND TACKLES / INSTRUMENTS TO BE ARRANGED BY CONTRACTOR

SL NO	DESCRIPTION	QUANTITY
09	Portable air compressor with drier and regulator rated for 10 Kg/Sq.cm	01 No.
10	Vacuum pump with standard vacuum gauge	01 No.
11	Standard Milliamps Source (Digital)	03 Nos.
12	Standard Millivolts Source (Digital)	03 Nos.
13	Mercury Manometer different range	04 Nos.
14	DC Power Supply , 24 V ; 5A	03 Nos.
15	Single Phase Variac 250V; 10A	01 Nos.
16	Glass Thermometers of ranges in Deg C as below : 0-120 ; 0-200; 0-600	02 Nos. (Each)
17	Tong tester AC 5/10/25 ; KEW Snap Make	01 No. (Each)
18	Function Generator	01 No.
19	Hand Operated Megger 500V ; 2.5 KV / 100 M Ohms	Each type As required
20	Torque wrench	As required
21	AC Voltmeter 0-125 ; 250 ; 625V	01 No. (Each)
22	AC Ammeter 0-2A ; 10A	1 No. (Each)
23	Analog Multimeter Motwane Make	03 Nos.
24	Digital Multimeter 3 1/2 Digit	08 Nos.
25	Digital Multimeter 4 1/2 Digit	03 Nos.
26	Wire wrapping tool	As required
27	Oscilloscope	01 Nos.
28	Soldering irons, soldering pump, Vacuum cleaner, Air blower etc.	As required

HANDLING INSTRUMENT AND MAJOR TOOLS & PLANTS

S.NO	DESCRIPTION	QUANTITY
01	Steel wire ropes	As required
02	Chain pulley block/turfer	As required
03	2 " size pipe bending machine	As required
04	Grinding machine	As required
05	Drilling machines : 1/4" , ½" , 3/4" , 1 "	As required
06	Copper tube bender and cutter sizes 6 mm ;8 mm ;1/2",1/4"	As required
07	Dye sets for threading upto 2 " pipe	As required
08	Set of spanners	As required
09	Allenkey sets	As required
10	Bench vice	1 No.
11.	Spirit level	As required
12	Tap sets for both BSP & NPT threads upto 1 "	1 Set each
13	Measuring instruments like micrometers, calipers etc.	1 each
14	Welding generator	1 No.
15	Welding transformer	As required
16	TIG Welding set	1 No.
17	Mechanical tool kit for fitters	As required
18	Electrician tool kit	As required
19	Crimping tool	As required
20	Flood light fittings	As required
21	Fire extinguishers	As required
22	Distribution boards with power cable complete as required	As required
23	Hydraulic test pump rating 750 Kg/SQ.cm	As required
24	Painting brush	As required
25	Fire proof tarpaulin	As required
26	Safety belts & safety helmets	As required
27	Telephone sets	As required

ACCURACY 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% + 3 digits
		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%
			Dial size
03	MV/mV Source	0 to 200 mA/200mV	0.2%
		0 to 700	± 1% Lc – 10 kg/cm^2 10”
		0 to 700	± 1% Lc – 5 kg/cm^2 10”
		0 to 100	± 1% Lc – 0.2 kg/cm^2 10”
		0 to 70 kg	± 1% Lc – 1 kg/cm^2 10”
		0 to 60 kg	± 1% Lc – 11 kg/cm^2 10”
		0 to 60 kg	± 1% Lc – 0.5 kg/cm^2 10”
		0 to 10.5 kg/cm^2	± 1% Lc – 0.25 kg/cm^2 10”
		0 to 420	± 1% Lc – 2.5 kg/cm^2 10”
		0 to 280	± 1% Lc – 2.5 kg/cm^2 10”

Sl. No	INSTRUMENT / TOOL	RANGE	ACCURACY
		0 to 40	$\pm$ 1% Lc – 1 kg/cm^2 10”
		0 to 106	$\pm$ 1% Lc – 2.5 kg/cm^2 10”
		0 to 28	$\pm$ 1% Lc – 0.5 kg/cm^2 10”
		0 to 25 kg/cm^2	$\pm$ 1% Lc – 0.5 kg/cm^2 10”
		0 to 250 kg/cm^2	$\pm$ 1% Lc – 0.25 kg/cm^2 10”
		0 to 16 kg/cm^2	$\pm$ 1% Lc – 0.25 kg/cm^2 10”
04	Hand operated Megger 500V/1000V	Upto 200 m Ohms	$\pm$ 5% at Centre scale
05	Standard Pressure Gauges	0 to 1 kg/Cm^2	$\pm$0.25% Lc–0.02 kg/cm^2 10”
		0 to 10 kg/Cm^2	$\pm$0.25% Lc–0.02 kg/cm^2 10”
		0 to 25 kg/Cm^2	$\pm$0.25% Lc–0.25 kg/cm^2 10”
		0 to 60 kg/Cm^2	$\pm$0.25% Lc–0.1 kg/cm^2 10”
		0 to 250 kg/Cm^2	$\pm$0.25% Lc–2.5 kg/cm^2 10”
		0 to 400 kg/Cm^2	$\pm$0.25% Lc–2.5 kg/cm^2 10”
		0 to 600 kg/Cm^2	$\pm$0.25% Lc–2.5 kg/cm^2 10”
		0 to 6 kg/Cm^2	$\pm$0.25% Lc–0.1 kg/cm^2 10”
		0 to 1000 kg/Cm^2	$\pm$0.25% Lc–1.0 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^{0}C	Lc - 1^{0}C
		0 to 110^{0}C	Lc - 1^{0}C
		0 to 250^{0}C	Lc - 1^{0}C
		0 to 150^{0}C	Lc - 1^{0}C
		0 to 360^{0}C	Lc - 1^{0}C
		0 to 420^{0}C	Lc - 1^{0}C
08	Single Phase Variac	15A Capacity	N/A

Sl. No	INSTRUMENT / TOOL	RANGE	ACCURACY
09	Power Pack	0 to 50V DC, 3A	± 2%
10	Vibration Measuring Equipments	Velocity upto 50 mm/sec.	± 0.5% mm/sec
		Displacement upto 300 microns	± 2 microns
11	a) Tongue tester	0/300/600A AC	± 5%
	b) Tongue tester	0 to 300A DC	± 5%
12	Tacho Meter (Hand held	0 to 4000 rpm	± 5%
13	Phase Sequence Meter		N/A
14	Earth Megger (Tester)	0 to 1, 10, 100 Ohms	± 5% at Centre Scale range
15	DC Ammeter	0 to 300 A	± 10%
16	DC Voltmeter	0 to 500 V	± 10%

Note for Contractors' Instruments

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

b. The contractor at his cost shall arrange all cranes and truck/tractor, trailers required for 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 CONTRACTOR

S.NO	CATEGORY	MONTHS 1 2 3 4 5 6 7 8 AND SO ON .....
01	Resident Manager	
02	Engineers for Boiler/TG Engineers for Planning/ Safety .	
03	Supervisors	
	a. Impulse line	
	b. cabling/tray	
	c. panels	
	d.calibration/installation	
04	Riggers	
05	Fitters	
06	HP Welders	
07	Structure Welders	
08	TIG welders	
09	Electricians	
10	Store Keeper	
11	Semi skilled and unskilled workers	
12	Watchman/Security	

N O T E

01. Minimum Number of persons to be indicated month wise.

02. Above deployment plan will be discussed with BHEL Site Engineer in details after award necessary changes shall 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.

07. Planning/safety Engineers should have experience in construction field especially in power plant

APPENDIX - VI B

DEPLOYMENT PLAN FOR MAJOR TOOLS AND PLANTS / INSTRUMENTS

(MONTH WISE QUANTITY TO BE INDICATED CATEGORY-WISE BY THE CONTRACTOR)

S.NO	CATEGORY	MONTHS 1 2 3 4 5 6 & SO ON	PRESENT LOCATION
01.	Welding Generators		
02.	Welding Transformer		
03.	TIG Welding sets (air cooled)		
04.	Insulation Tester Hand operated Megger 500 & 1000 V Grade		
05.	Torque wrench		
06.	Volt Meter/Ammeter/ Avometer/other instrument		
07.	Multimeter/Test lamps/ Field telephone sets/ different gauges		
08.	Single phase		
09.	5 Amps DC Power Supply unit		
10.	Crimping Tools with various sizes of dyes.		
11.	Instrument Air compressor		
12.	Deadweight Tester		
13.	mAmp source		
14	Temperature calibration insts		

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.

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

RAYALASEEMA TPS UNITS 3&4 (2 X210 MW)

SECTION VII

CONTROLS & INSTRUMENTATION PACKAGE

GENERAL TECHNICAL REQUIREMENTS AND GUIDELINES FOR INSTALLATION, TESTING & COMMISSIONING

7.1. GUIDELINES FOR INSTALLATION OF C & I EQUIPMENTS

7.1.1 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.

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

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

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

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

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

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

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

7.1.9 Wherever severe vibrations are expected, shock absorbers shall be provided

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

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

7.1.13 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.

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

7.1.16 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.

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

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

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

7.1.20 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.

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

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

7.1.23 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.

7.2.0 GUIDE LINE FOR ERECTION OF IMPULSE LINES

7.2.1 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.

7.2.2 The routing of pipelines shall include sufficient flexibility near tappings to allow for thermal expansion of the process equipment.

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

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

7.2.5 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'

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

7.2.7 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.

7.2.8 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.

7.2.9 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.

7.2.10 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.

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

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

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

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

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

7.2.16 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.

7.2.17 **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.

7.2.18 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.

7.2.19 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.

7.2.20 **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.

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

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

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

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

7.2.24 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.

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

7.2.26 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.

7.2.27 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.

7.2.28 **Bending**

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

7.2.29 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.

7.2.30 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.

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

7.2.32 **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.

7.2.33 **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.

7.2.34 **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.

7.3.0 GUIDELINES FOR INSTALLATION OF PNEUMATIC LINE

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

7.3.2 When two or more lines run together, the joint in the adjacent alternate line shall be a offset.

7.3.3 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.

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

7.3.5 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.

7.3.6 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.

7.3.7 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.

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

7.3.9 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.

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

7.3.11 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.

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

7.3.13 **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.

7.4.0 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).

7.4.1 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).

7.4.2 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.

7.4.3 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.

7.4.4 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.

7.4.5 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.

7.4.6 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.

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

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

7.5.2 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.

7.5.3 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.

7.5.4 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.

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

7.6.0 GENERAL GUIDELINE ON FLOW INSTRUMENTS INSTALLATION

7.6.1 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.

7.6.2 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.

7.6.3 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.

7.6.4 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.

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

7.6.6 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.

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

7.6.8 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.

7.6.9 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.

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

7.6.11 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.

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

7.6.13 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.

7.6.14 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.

7.6.15 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.

7.6.16 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.

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

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

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

7.6.20 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.

7.7.0 GENERAL GUIDELINE ON INSTALLATION OF VALVES

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

7.7.2 These valves shall be installed where access is possible.

7.7.3 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.

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

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

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

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

7.7.8 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.

7.8.0 PAINTING

All the supporting steelworks impulse pipe shall have protective painting. The surface shall be free from rust, foreign adhering matters, grease etc. Two coats of rust preventing red-oxide primer and final painting of two coats as per the colour DECIDED by the site engineer. (More details please refer Section VI scope of works). After cleaning the surface is painted with one coat of Red oxide zinc chromate primer confirming to IS 2074 and allowed to dry completely. The primer-coated surface is painted with two coats of final painting of desired colour which shall be selected from IS-5.

7.9.0 GUIDELINES FOR CABLE LAYING

7.9.1 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.

7.9.2 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.

7.9.3 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.

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

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

7.9.6 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.

7.9.7 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.

7.9.8 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.

7.9.9 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.

7.9.10 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.

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

7.9.12 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.

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

7.9.14 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.

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

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

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

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

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

7.9.20 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.

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

7.9.22 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.

7.9.23 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.

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

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

7.9.26 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.

7.9.27 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.

7.9.28 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.

7.9.29 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).

7.9.30 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.

7.9.31 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.

In hierarchical order:

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.

7.9.32 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.

7.9.33 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.

7.9.34 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.

7.9.35 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.

7.9.36 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.

7.9.37 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.

7.9.38 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.

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

7.9.40 Support Spacings & Clampings

Support spacing and clamping suitably provided and as required

7.9.41 Laying of cables directly buried in ground

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

7.10.0 CODES AND STANDARDS

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 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.

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

7.11.1 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.

7.11.2 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.

7.11.3 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.

7.11.4 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.

7.11.5 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.

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

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

7.11.8 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.

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

7.11.10 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.

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

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

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

7.11.14 Transportation and storage of cable drums

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

7.11.15 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.

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

7.12.0 GUIDELINES FOR CABLE TERMINATION AND JOINTING

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

7.12.2 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 driling holes. cutting shall not be allowed.

7.12.3 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.

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

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

7.12.6 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.

7.12.7 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.

7.12.8 Screened control cables of 0.5 sq. mm cross-sectional area shall be terminated by means of wire rapping system.

7.12.9 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.

7.12.10 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.

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

7.12.12 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.

7.12.13 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.

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

7.12.15 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.

7.14.0 DESIGN REQUIREMENTS OF ITEMS SUPPLIED FOR CABLING INSTALLATION WORK (if supply is covered in contractor scope).

7.14.1 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 up to 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.

7.14.2 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.

7.14.3 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.

7.14.4 Tags

a) Cables shall be provided with cable number tags for identification.

b) Cable tags shall be of durable fibre, aluminium, stainless steel sheets or lead. of suitable thickness

c) Cable number shall be engraved type in case of aluminium or stainless steel tags, and printed type in case of fibre sheet.

d) Tags shall be durable quality of size 60mm x 12mm with holes at both ends.

e) Samples of tags shall be approved by BHEL Engineer before delivery.

f) Tags shall be provided with non-corrosive wire of sufficient strength for taggings.

7.15.0 GUIDELINES FOR EARTHING INSTALLATION

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

7.15.2 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.

7.15.3 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.

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

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

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

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

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

7.15.9 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.

7.15.10 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.

.7.16.0 GUIDELINES FOR ERECTION OF CONTROL PANELS AND DISTRIBUTION BOARDS

7.16.1 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. Suitable concrete drilling machine shall be used for making hole on the concrete floor.

7.16.2 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.

7.16.3 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.

7.16.4 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.

7.16.5 The following points shall be checked up during erection

. a) Layout of foundation channels.

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

c) Location and serial no. panels.

d) Positioning of panels.

e) Verticality of panels and breaker truck to station earth.

f) Earthing of panels and breaker truck to station earth.

g) Lugs for termination of HT and LT cables.

h) Mounting and fixing arrangements all modules.

i) Check the operation of:

i. Remote control

ii. Various required - closing / tripping / alarm / indications / interlocks Installation position of instruments and relays Operation of relays and instruments.

j) AC / DC supplies for panel.

k) Tightness of terminal connections for HT & LT connections.

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

7.16.6 415 V switchgear and Electrical panels tests(as applicable)

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

7.17.0 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

7.18.0 CUTTING & WASTAGE ALLOWANCE

7.18.1 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, multitudes	2%	0.5%

7.19.0 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.

7.20.0 GUIDELINES FOR HANDLING AND STORAGE OF ELECTRONIC CUBICLES/SUB-ASSEMBLISES/LOOSE ITEMS.

7.20.1 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.

7.20.2 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.

7.20.3 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.

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

7.20.5 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.

DATA SHEET

SPECIFIC TECHNICAL REQUIREMENTS

FOR SUPPLY ITEMS IF MENTIONED IN THE BOQ

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	: Aluminium/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 – I

DECLARATION SHEET

I, hereby certify that, all the information and data furnished by me with regard to this Tender Specification No.BHEL:PSSR:SCT:1179 are true and complete to the best of my knowledge. I have gone through the specifications, conditions, stipulations in detail and agree to comply which the requirements and intent specifications.

I further certify that I am duly authorized representative of the under mentioned tenderer and a valid power of Attorney to this effect is also enclosed.

TENDERER'S NAME & ADDRESS

AUTHORISED REPRESENTATIVE'S
SIGNATURE WITH NAME & ADDRESS

SECTION VIII

APPENDIX – II

TENDER SPECIFICATION NO BHEL:PSSR:SCT:1179

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 - III

CHECK LIST

TENDER SPECTFICATION NO, BHEL: PSSR : SCT : 1179

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

SECTION-VIII - APPENDIX- IV-A

BILL OF MATERIALS FOR C&I 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. (under 6.3.0) related to the work are also to be referred.

SL.	DESCRIPTION	QTY	QTY	QTY	REFER
A.	BHEL-TRICHY SCOPE	Unit 3	Unit 4	Total	Clause No.
A.1.0	FUEL OIL SYSTEM				
A.1.1	PD Type Flow meter (including erection of 1 No. Pulse Amplifier, 15 Mtrs of shielded signal cable, condensing pots etc.)	1 set*	1 set*	2 sets*	6.3.2
A.1.2	Pressure Gauges	35 Nos.	35 Nos.	70 Nos.	6.3.2
A.1.3	DP Gauges	2 Nos.	2 Nos.	4 Nos.	6.3.2
A.1.4	Temperature Gauges	6 Nos.	6 Nos.	12 Nos.	6.3.2
A.1.5	DP Switches	2 Nos.	2 Nos.	4 Nos.	6.3.2
A.1.6	Pressure Switches	20 Nos.	20 Nos.	40 Nos.	6.3.2
A.1.7	Temperature Switches	5 Nos.	5 Nos.	10 Nos.	6.3.2
A.1.8	Flame Scanner Head Assembly with fibre optic cable of length 110", Lens Barrel Assembly, Miniature 6 way Junction Box etc.	20 sets*	20 sets*	40 sets*	6.3.2
A.1.9	FSSS Local Oil Gun Maintenance Switch Box	12 Nos.	12 Nos.	24 Nos.	6.3.6

SL.	DESCRIPTION	QTY	QTY	QTY	REFER
A.	BHEL-TRICHY SCOPE	Unit 3	Unit 4	Total	Clause No.
A.1.10	Microprocessor based flame scanner amplifier 5 Nos. of 19" Racks of size 482 x 263 x 134 (W x D x H) to be mounted in Flame Scanner Panel supplied by EDN.	1 set*	1 set*	2 sets*	6.3.2
A.1.11	H.E.A. Excitor box along with advance/retractor assembly, flexible spark rod, spark tip, flexible cable assembly, S.S. Hose (1 Mtr long, 6.35 mm ID), Air Filter Regulator etc.	12 sets*	12 sets*	24 sets*	6.3.2
A.1.12	Solenoid Valves, 3 way	47 Nos.	47 Nos.	94 Nos.	6.3.2
A.1.13	Speed Regulator/ Air Lock Valves	12 sets*	12 sets*	24 sets*	6.3.2
A.1.14	OD 8 mm Copper Tube	25 Mtrs	25 Mtrs	50 Mtrs	6.3.4
A.1.15	Air Filter Regulator	17 Nos.	17 Nos.	34 Nos.	6.3.2
A.1.16.0	*COMMISSIONING OF THE FOLLOWING*				
A.1.16.1	**Limit Switches (checking only).**	32 Nos. $	32 Nos. $	64 Nos. $	6.3.9.3
A.1.16.2	**Pneumatic Valves: On/Off Type**	50 Nos. $	50 Nos. $	100 Nos. $	6.3.9.1
A.1.16.3	**Pneumatic Valves: Regulating Type**	25 Nos. $	25 Nos. $	50 Nos. $	6.3.9.1
A.2.0	**AIR & FLUE GAS SYSTEM**				
A.2.1	Pressure Gauges	7 Nos.	7 Nos.	14 Nos.	6.3.2
A.2.2	Pressure Switches	8 Nos.	8 Nos.	16 Nos.	6.3.2

SL.	DESCRIPTION	QTY	QTY	QTY	REFER
A.	BHEL-TRICHY SCOPE	Unit 3	Unit 4	Total	Clause No.
A.2.3	DP Switches	4 Nos.	4 Nos.	8 Nos.	6.3.2
A.2.4	Air Filter Regulators- SADC	8 Nos.	8 Nos.	16 Nos.	6.3.2
A.2.5	¼" OD PVC Sheathed Copper Tube	2,150 Mtrs	2,150 Mtrs	4,300 Mtrs	6.3.4
A.2.6	¼" size Teflon Hose of 2M length	56 Nos.	56 Nos.	112 Nos.	6.3.12
A.2.7	1" size Teflon Hose of 3M length	4 Nos.	4 Nos.	8 Nos.	6.3.12
A.2.8	Burner Tilt Shear Pin Failure Indication Box (Dimension: 340 x 200 x 300 mm; weight 15 kg each)	4 Nos.	4 Nos.	8 Nos.	6.3.6
A.2.9	Heavy Duty Limit Switch (for Burner Tilt Shear Pin Failure Indication Purpose)	12 Nos.	12 Nos.	24 Nos.	6.3.2
A.2.10	Vibration Monitoring System (VMS) for Fans & Mills, consisting of a) Horizontal/ vertical velocity type pick-up with 10 Mtr long pigtail noise proof cable and conduit upto local JB: 64 sets b) Local junction boxes: 12 Nos. c) VMS Remote Cabinets: 2 Nos. d) Mounting accessories etc. Size of each Remote Cabinet: 1000 x 800 x 2400 mm; 500 kg (approx.) The panel will be located in ESP Room. The scope covers installation of equipment, integration of system, commissioning etc. including drilling and tapping.	1 set*	1 set*	2 sets*	6.3.2

SL.	DESCRIPTION	QTY	QTY	QTY	REFER
A.	BHEL-TRICHY SCOPE	Unit 3	Unit 4	Total	Clause No.
A.2.11.0	***PNEUMATIC POWER CYLINDERS (REGULATING TYPE)***				
A.2.11.1	FD Fan Blade Pitch Control Power Cylinder Weight 30 kg each	2 Nos.	2 Nos.	4 Nos.	6.3.7
A.2.11.2	Power Cylinders for SADC / Over Fire Air Damper Approx. weight 30 kg each	56 Nos.	56 Nos.	112 Nos.	6.3.7
A.2.11.3	Burner Tilt Power Cylinders Approx. Weight 200 kg each	4 Nos.	4 Nos.	8 Nos.	6.3.7
A.2.11.4	ID Fan Inlet Damper Weight: 350 kg each	2 Nos.	2 Nos.	4 Nos.	6.3.7
A.2.11.5	PA Fan Blade Pitch Control Damper Weight 60 kg each	2 Nos.	2 Nos.	4 Nos.	6.3.7
A.2.11.6	Hot Primary Air Regulating Damper Weight 90 kg each	6 Nos.	6 Nos.	12 Nos.	6.3.7
A.2.11.7	Cold Primary Air Regulating Damper Weight 70 kg each	6 Nos.	6 Nos.	12 Nos.	6.3.7
A.2.11.8	Dynavane Filter Bleed Air Damper Approx. weight : 70 kg	1 No.	1 No.	2 Nos.	6.3.7

SL.	DESCRIPTION	QTY	QTY	QTY	REFER
A.	BHEL-TRICHY SCOPE	Unit 3	Unit 4	Total	Clause No.
A.2.12.0	***PNEUMATIC POWER CYLINDERS (ON/OFF TYPE)***				
A.2.12.1	Scanner Air Emergency Damper (Weight 30 kg)	1 No.	1 No.	2 Nos.	6.3.7
A.2.12.2	Seal Air to Pulveriser Damper (Approx. weight 20 kg each)	6 Nos.	6 Nos.	12 Nos.	6.3.7
A.2.13.0	***COMMISSIONING OF THE FOLLOWING***				
	Pneumatic Actuators (On/Off Type)				
A.2.13.1	Hot Air Shutoff Gate	6 Nos. $	6 Nos. $	12 Nos. $	6.3.9.1
A.2.13.2	Cold Air Gate	6 Nos. $	6 Nos. $	12 Nos. $	6.3.9.1
A.2.13.3	Feeder Outlet Gate	6 Nos. $	6 Nos. $	12 Nos. $	6.3.9.1
A.2.13.4	**Electrical Actuators/ Soot Blower System (Loop Checking Only)**	138 Nos. $	138 Nos. $	276 Nos. $	6.3.7
A.3.0	PULVERISER SYSTEM				
A.3.1	Pressure Gauges	1 No.	1 No.	2 Nos.	6.3.2
A.3.2	DP Switches	19 Nos.	19 Nos.	38 Nos.	6.3.2

SL.	DESCRIPTION	QTY	QTY	QTY	REFER
A.	BHEL-TRICHY SCOPE	Unit 3	Unit 4	Total	Clause No.
A.3.3	Pressure Switches	4 Nos.	4 Nos.	8 Nos.	6.3.2
A.3.4	**Pneumatic Pressure Controller including 1 No. Pneumatic Transmitter, 2 Nos. Air Filter Regulators etc.**	1 set*	1 set*	2 sets*	6.3.2
A.3.5	Air Filter Regulators (for Mill System)	6 Nos.	6 Nos.	12 Nos.	6.3.2
A.3.6	Purge Meters cum DP Regulators	12 Nos.	12 Nos.	24 Nos.	6.3.2
A.3.7	GRAVIMETRIC FEEDER PANEL Microprocessor based Gravimetric Feeder Remote Power Cabinet (including keyboard and display) Size: 1100 x 540 x 2365 mm; weight: 400 kg each	6 Nos.	6 Nos.	12 Nos.	6.3.1
A.3.8.0	COMMISSIONING OF THE FOLLOWING				
A.3.8.1	Feeder Mounted C&I Equipment like Speed Sensing Optical Encoder, micro switches, etc. along with Feeder Integral Cabinet	6 sets*$	6 sets*$	12 sets*$	6.3.9.7
A.3.8.2	Bunker Gate Limit Switches (Only checking)	12 Nos.$	12 Nos.$	24 Nos.$	6.3.9.3
A.4.0	**STEAM & WATER SYSTEM**				
A.4.1	Pressure Gauges	15 Nos.	15 Nos.	30 Nos.	6.3.2
A.4.2	Pressure Switch	1 No.	1 No.	2 Nos.	6.3.2

SL.	DESCRIPTION	QTY	QTY	QTY	REFER
A.	BHEL-TRICHY SCOPE	Unit 3	Unit 4	Total	Clause No.
A.4.3.0	**Chromel-Alumel Thermocouples**				
A.4.3.1	MTM T/Cs of route length 10 to 12 Mtrs (6 mm OD), K Type	32 Nos.	32 Nos.	64 Nos.	6.3.2
A.4.3.2	MTM T/Cs of route length 14 to 16 Mtrs (6 mm OD), K Type	70 Nos.	70 Nos.	140 Nos.	6.3.2
A.4.3.3	MTM T/Cs of route length 18 Mtrs (6 mm OD), K Type	12 Nos.	12 Nos.	24 Nos.	6.3.2
A.4.4	MTM Junction Boxes Weight: 10 kg each	26 Nos.	26 Nos.	52 Nos.	6.3.6
A.4.5	ERV Controller with Pressure Switch Size: 350 x 290 x 180 mm; weight 10 kg	1 set*	1 set*	2 sets*	6.3.2
A.4.6	Electronic Water Level Indicator EWLI comprising of the following: – 12 Port pressure vessel with loose supplied electrodes : 2 Nos. – 4 Nos. of Remote Display Units (to be mounted in UCB and FAP) – 2 Nos. of Ascertor Cabinet of size 600 x 600 x 350 mm; 40 kg each – 1 No. Local Indication Box for Local Display – interconnecting cables between local panel and electrodes	1 set*	1 set*	2 sets*	6.3.2

SL.	DESCRIPTION	QTY	QTY	QTY	REFER
A.	BHEL-TRICHY SCOPE	Unit 3	Unit 4	Total	Clause No.
A.4.7	Steam leak detection system (BHEL- STLD), comprising the following - Sensor Assembly along with head amplifier: 12 sets - Junction Box (36 way): 6 Nos. - BHELSONIC Panel: 1 No. Size of the panel: 800 x 800 x 2355 mm; 300 kg	1 set*	1 set*	2 sets*	6.3.2
A.4.8	Furnace CCTV System consisting of the following – 14" CRT Monitor : 1 No. – Local control Unit : 1No. – Remote Retract Control Unit (to be mounted in UCB): 1 No. – Pneumatic automatic advance retract mechanism along with air system components for lens tube cooling and camera housing cooling, instrument air connection, temperature sensor etc. – Loose supplied video cables between camera and monitor (approx. 250 Mtrs) etc.	1 set*	1 set*	2 sets*	6.3.2
A.4.9.0	*COMMISSIONING OF THE FOLLOWING*				
A.4.9.1	Flow Switch (only checking)	1 No. $	1 No. $	2 Nos. $	6.3.9.2
A.4.9.2	Direct Water Level Gauges (Fixing of bulbs, holders, wiring and commissioning)	2 Nos. $	2 Nos. $	4 Nos. $	6.3.9.6

SL.	DESCRIPTION	QTY	QTY	QTY	REFER
A.	BHEL-TRICHY SCOPE	Unit 3	Unit 4	Total	Clause No.
A.5.0	HARDWARE LIST				
A.5.1.0	***CABLES*** *PVC, FRLS, Armoured cables for Scanner, Mill feeder, AC Control, and Instruments*				
A.5.1.1	Flame Scanner Cable	3,000 Mtrs	3,000 Mtrs	6,000 Mtrs	6.3.10
A.5.1.2	2P X 0.5 sq.mm, Overall Shielded cable	**8,400 Mtrs**	**8,400 Mtrs**	**16,800**	6.3.10
A.5.1.3	4P X 0.5 sq.mm, Overall Shielded cable	21,100 Mtrs	21,100 Mtrs	42,200 Mtrs	6.3.10
A.5.1.4	8P X 0.5 sq. mm, Overall Shielded cable	14,700 Mtrs	14,700 Mtrs	29,400	6.3.10
A.5.1.5	16P X 0.5 sq. mm, Shielded cable	500 Mtrs	500 Mtrs	1000 Mtrs	6.3.10
A.5.1.6	10P x 0.6 sq. mm PTFE Probe Cable (for EWLI)	60 Mtrs	60 Mtrs	120 Mtrs	6.3.10
A.5.1.7	Compensating cable, K Type, 2P x 1.31 sq. mm	500 Mtrs	500 Mtrs	1000 Mtrs	6.3.10
	CONTROL CABLES (Armoured, Cu)				
A.5.1.8	2 C X 1.5 sq. mm cable	600 Mtrs	600 Mtrs	1200 Mtrs	6.3.10
A.5.1.9	4C X 1.5 sq. mm cable	8,500 Mtrs	8,500 Mtrs	17,000 Mtrs	6.3.10

SL.	DESCRIPTION	QTY	QTY	QTY	REFER
A.	BHEL-TRICHY SCOPE	Unit 3	Unit 4	Total	Clause No.
A.5.1.10	5 C X 1.5 sq. mm cable	2200 Mtrs	2200 Mtrs	4,400 Mtrs	6.3.10
A.5.1.11	7 C X 1.5 sq. mm cable	3700 Mtrs	3700 Mtrs	7,400 Mtrs	6.3.10
A.5.1.12	10C X 1.5 sq. mm cable	14800 Mtrs	14800 Mtrs	29,600 Mtrs	6.3.10
A.5.1.13	12 C X 1.5 sq. mm cable	250 Mtrs	250 Mtrs	500 Mtrs	6.3.10
A.5.1.14	19 C X 1.5 sq. mm cable	2000 Mtrs	2000 Mtrs	4,000 Mtrs	6.3.10
A.5.2.0	***CABLE TRAYS***				
A.5.2.1	Perforated Cable Tray, 50 mm wide	50 Mtrs	50 Mtrs	100 Mtrs	6.3.12
A.5.2.2	Perforated Cable Tray, 100 mm wide	1660 Mtrs	1660 Mtrs	3320 MTrs	6.3.12
A.5.2.3	Perforated Cable Tray, 150 mm wide	1020 Mtrs	1020 Mtrs	2040 Mtrs	6.3.12
A.5.2.4	Perforated Cable Tray, 300 mm wide	70 Mtrs	70 Mtrs	140 Mtrs	6.3.12
A.5.3.0	***JUNCTION BOXES***				
A.5.3.1	Junction Box (12 way)	30 Nos.	30 Nos.	60 Nos.	6.3.6
A.5.3.2	Junction Box (24 way)	82 Nos.	82 Nos.	164 Nos.	6.3.6
A.5.3.3	Junction Box (48 way)	7 Nos.	7 Nos.	14 Nos.	6.3.6
A.5.3.4	2 PB/ 3PB Push Button Boxes	3 Nos.	3 Nos.	6 Nos.	6.3.6

SL.	DESCRIPTION	QTY	QTY	QTY	REFER
A.	BHEL-TRICHY SCOPE	Unit 3	Unit 4	Total	Clause No.
A.5.4.0	***IMPULSE PIPES***				
A.5.4.1	FCS Pipe, ½" SCH80	800 Mtrs	800 Mtrs	1600 Mtrs	6.3.3
A.5.4.2	CS Pipe, 1" SCH80	400 Mtrs	400 Mtrs	800 Mtrs	6.3.3
A.5.5.0	*ERECTION HARDWARE*				
A.5.5.1	Structural Steel for fabrication of supports consisting of angles, channels (ISA 50x50x6, ISMC 100x50x6, ISA 35x35x3, ISA 40x40x5, ISMC 100x50)	15 Tonnes	15 Tonnes	30 Tonnes	6.3.13
A.5.5.2	GI Flat 50 x 6 mm	400 Mtrs	400 Mtrs	800 Mtrs	6.3.13, 6.3.19
A.5.5.3	Soft Galvanised Wire-IS 280 comml	1000 Mtrs	1000 Mtrs	2000 Mtrs	6.3.13, 6.3.19
A.5.5.4	GI Strips, 300mm x 25mm x 2mm	550 Nos.	550 Nos.	1100 Nos.	6.3.13, 6.3.19

SL.	DESCRIPTION	QTY	QTY	QTY	REFER
B.	BHEL-RANIPET SCOPE	Unit 3	Unit 4	Total	Clause No.
B.1.0	**AIR PRE-HEATERS**				
B.1.1	Pressure Gauges	10 Nos.	10 Nos.	20 Nos.	6.3.2
B.1.2	Temperature Indicators	2 Nos.	2 Nos.	4 Nos.	6.3.2
B.1.3	Temperature Elements (Pt 100 RTD)	4 Nos.	4 Nos.	8 Nos.	6.3.2
B.1.4	Temperature Switches	4 Nos.	4 Nos.	8 Nos.	6.3.2
B.1.5	Pressure Switches	4 Nos.	4 Nos.	8 Nos.	6.3.2
B.1.6	Thermocouple Assembly consisting of 6 nos. Cr-Al thermocouples	4 sets*	4 sets*	8 sets*	6.3.2
B.1.7	Rotor Stoppage Alarm Box- including sensors, interconnecting cables etc. Approx. Size: 340 x 170 x 300 mm; 12 kg each	2 sets*	2 sets*	4 sets*	6.3.2
B.1.8	ON/OFF Switch including light assembly and interconnecting cable	2 sets*$	2 sets*$	4 sets*$	6.3.2
B.1.9.0	***COMMISSIONING OF THE FOLLOWING***				
B.1.9.1	Solenoid Valves	2 Nos.$	2 Nos.$	4 Nos.$	6.3.9.4

SL.	DESCRIPTION	QTY	QTY	QTY	REFER
B.	BHEL-RANIPET SCOPE	Unit 3	Unit 4	Total	Clause No.
B.1.9.2	Air Preheater Skids The scope of work includes removal of instruments, calibration, refixing, checking cable connection from JB to instruments, motor connection, meggering and improving IR value of motor etc. The approximate quantity of instruments for each skid is given below: LT Motors - 2 Nos. Pressure Gauges – 2 Nos. Temperature Gauges –2 Nos. Flow Switch - 1 No.	4 sets*$	4 sets*$	8 sets*$	6.3.9.7, 6.3.2
B.2.0	**FANS**				
B.2.1	**Fan Bearing RTDs**	16 Nos.	16 Nos.	32 Nos.	6.3.2
B.2.2	Fan Bearing Temperature Indicators	16 Nos.	16 Nos.	32 Nos.	6.3.2
B.2.3	Fan Motor Bearing Temperature Indicators. (Removal, calibration and refixing only)	12 Nos.	12 Nos.	24 Nos.	6.3.9.7, 6.3.2
B.2.4	Fan Motor Bearing/ Winding RTDs (checking of healthiness only)	84 Nos. $	84 Nos. $	168 Nos. $	6.3.9.5

SL.	DESCRIPTION	QTY	QTY	QTY	REFER
B.	BHEL-RANIPET SCOPE	Unit 3	Unit 4	Total	Clause No.
B.2.5.0	***COMMISSIONING OF THE FOLLOWING***				
B.2.5.1	Lub Oil Skids For FD/ID/PA Fans The scope of work includes removal of instruments, calibration, refixing, checking cable connection from JB to instruments, motor connection, meggering and improving IR value of motor etc. The approximate total quantity of instruments for all the 6 Nos. skids together is given below: LT Motors - 12 Nos. DP Gauges - 4 Nos. Pressure Gauges – 14 Nos. Temperature Gauges –20 Nos. DP Switches – 6 Nos. Pressure Switches - 26 Nos. Level Switches - 4 Nos.	6 sets*$	6 sets*$	12 sets*$	6.3.9.7, 6.3.2

SL.	DESCRIPTION	QTY	QTY	QTY	REFER
C.	BHEL- PIPING CENTRE SCOPE	Unit 3	Unit 4	Total	Clause No.
	S. G. PACKAGE				
C.1.0	*LOCAL/FIELD INSTRUMENTS*				
C.1.1	Pressure Gauges	14 Nos.	14 Nos.	28 Nos.	6.3.2
C.1.2	Temperature Gauges	74 Nos.	74 Nos.	148 Nos.	6.3.2
C.1.3	Level Switches (float type)	2 Nos.	2 Nos.	4 Nos.	6.3.2
C.2.0	**HEAT TRACING SYSTEM**				
C.2.1	Electrical Heat Tracer Panel Size: 3300 x 800 x 2365 mm	2 Nos.	1 No.	3 Nos.	6.3.11
C.2.2	**Electrical Heat Tracer Tape along with accessories like power connector, tee connector, splice connector, end connector, adhesive tapes, pipestraps, thermostats etc.**	2400 Mtrs	1000 Mtrs	3400 Mtrs	6.3.11
C.3.0	CABLES/JUNCTION BOXES				
C.3.1	4 P x 0.5 sq .mm PVC shielded Cable	50 Mtrs	50 Mtrs	100 Mtrs	6.3.10
C.3.2	Junction Box, 18 way	1 No.	1 No.	2 Nos.	6.3.6

SL.	DESCRIPTION	QTY	QTY	QTY	REFER
C.	BHEL- PIPING CENTRE SCOPE	Unit 3	Unit 4	Total	Clause No.
C.4.0	**GI PIPES (HEAVY DUTY)**				
C.4.1	GI Pipes NB 15 x 3.25	2750 Mtrs	2750 Mtrs	5500 Mtrs	6.3.5
C.4.2	GI Pipes NB 25 x 4.05	850 Mtrs	850 Mtrs	1700 Mtrs	6.3.5
C.4.3	GI Pipes NB 40 x 4.5	200 Mtrs	200 Mtrs	400 Mtrs	6.3.5
C.4.4	GI Pipes NB 50 x 4.5	150 Mtrs	150 Mtrs	300 Mtrs	6.3.5
C.4.5	GI Pipes NB 65 x 4.5	200 Mtrs	200 Mtrs	400 Mtrs	6.3.5
C.4.6	GI Pipes NB 80 x 4.85	350 Mtrs	350 Mtrs	700 Mtrs	6.3.5
C.5.0	**IMPULSE PIPES**				
C.5.1.	½" CS Sch 80 pipe	**100 Mtrs**	**100 Mtrs**	**200 Mtrs**	6.3.3
C.6.0	**COMMISSIONING OF THE FOLLOWING:**				
C.6.1	Flow Indicators	40 Nos. $	40 Nos. $	80 Nos. $	6.3.9.2
C.6.2	**Control Valves**	1 No. $	1 No. $	2 Nos. $	6.3.9.1

SL.	DESCRIPTION	QTY	QTY	QTY	REFER
D.	BHEL-EDN SCOPE	Unit 3	Unit 4	Total	Clause No.
D.1.0	**S. G. PACKAGE**				
D.1.1.0	***PANELS***				
D.1.1.1	Single Cubicle (CJF07, CJF34) Of size 750 x 750 x 2415 mm; Approximate weight- 400 kg	2 Nos.	2 Nos.	4 Nos.	6.3.1, 6.3.8
D.1.1.2	Twin Cubicles (CAF 17&20, CJF21&34) of size 1500 x 750 x 2415 mm; Approximate weight- 800 kg	2 Nos.	2 Nos.	4 Nos.	6.3.1, 6.3.8
D.1.1.3	Suite of Three Cubicles (CJF23, CJF24 &CAF20, CJF25, CJF26 & CAF21, CJF27, CJF28 & CAF31) of size 2250 x 750 x 2415 mm; Approximate weight- 1200 kg	3 Nos.	3 Nos.	6 Nos.	6.3.1, 6.3.8
D.1.1.4	Suite of Four Cubicles (CJF 51,52,66&67) of size 3000 x 750 x 2415 mm; Approximate weight- 1600 kg	1 No.	1 No.	2 Nos.	6.3.1, 6.3.8
D.1.2.0	***INSTRUMENTS***				
D.1.2.1	Pressure Switch	14 Nos.	14 Nos.	28 Nos.	6.3.2
D.1.2.2	DP Switch	1 No.	1 No.	2 Nos.	6.3.2
D.1.2.3	I/P Converter	14 Nos.	14 Nos.	28 Nos.	6.3.2

SL.	DESCRIPTION	QTY	QTY	QTY	REFER
D.	BHEL-EDN SCOPE	Unit 3	Unit 4	Total	Clause No.
D.1.2.4	Air Filter Regulator	14 Nos.	14 Nos.	28 Nos.	6.3.2
D.2.0	**STG C&I PACKAGE**				
D.2.1.0	***PANELS / INSTRUMENTS***				
D.2.1.1	Single Cubicle of size 750 x 750 x 2415 mm; Approximate weight- 400 kg (Panel No. CJJ01, CJJ02, CJJ03, CJJ08, CCA07)	5 Nos.	5 Nos.	10 Nos.	6.3.1, 6.3.8
D.2.1.2	Twin Cubicles of size 1500 x 750 x 2415 mm; Approximate weight- 800 kg (CJJ11 & 12, CCA01 & 02, CCA03 & 04, CCA05 & 06, CCA09 &10, CJJ41 &42)	6 Nos.	6 Nos.	12 Nos.	6.3.1, 6.3.8
D.2.1.3	Suit of Three Cubicles of size 2250 x 750 x 2415 mm; Approximate weight- 1200 kg (Panel No. CJJ05, 06 & 07)	1 No.	1 No.	2 Nos.	6.3.1, 6.3.8
D.2.1.4	Fire Protection Switch with Junction Box	2 Nos.	2 Nos.	4 Nos.	6.3.2, 6.3.6
D.2.2.0	***CABLES***				
D.2.2.1	2 pair x 0.5 sq. mm PTFE cable	4000 Mtrs	4000 Mtrs	8000 Mtrs	6.3.10
D.2.2.2	4 pair x 0.5 sq. mm PTFE cable	1000 Mtrs	1000 Mtrs	2000 Mtrs	6.3.10
D.2.2.3	5 Core x 1.5 sq. mm PTFE cable	500 Mtrs	500 Mtrs	1000 Mtrs	6.3.10

SL.	DESCRIPTION	QTY	QTY	QTY	REFER
D.	BHEL-EDN SCOPE	Unit 3	Unit 4	Total	Clause No.
D.2.2.4	2 Pair x 0.5 sq. mm NiCr-Ni or NiAl compensating cables	2000 Mtrs	2000 Mtrs	4000 Mtrs	6.3.10
D.2.2.5	2 Pair x 0.5 sq. mm CuCu-Ni compensating cables	400 Mtrs	400 Mtrs	800 Mtrs	6.3.10
D.2.3.0	***JUNCTION BOXES***				
D.2.3.1	64 way Junction Box (SUV 12)	33 Nos.	33 Nos.	66 Nos.	6.3.6
D.2.3.2	Thermocouple Junction Box for K-type Thermocouple (NiCrNi)	20 Nos.	20 Nos.	40 Nos.	6.3.6
D.2.3.3	Thermocouple Junction Box for T-type Thermocouple (CuCuNi)	4 Nos.	4 Nos.	8 Nos.	6.3.6
D.2.4.0	***CABLE DUCTS WITH COVERS – GI SOLID BOTTOM***				
D.2.4.1	60 x 60 x 1000 mm	180 Nos.	180 Nos.	360 Nos.	6.3.12
D.2.4.2	180 x 100 x 1000 mm	60 Nos.	60 Nos.	120 Nos.	6.3.12
D.2.4.3	250 x 100 x 1000 mm	50 Nos.	50 Nos.	100 Nos.	6.3.12
D.2.6.0	***MOUNTING FRAMES*** *Assembly and installation of Mounting Frames with loose supplied prefabricated materials of suitable size, like slotted angles, channels, base plates & fasteners etc.*				
D.2.6.1	MWK100 (1100 x 300 x 765 mm)	2 Nos.	2 Nos.	4 Nos.	6.3.14

SL.	DESCRIPTION	QTY	QTY	QTY	REFER
D.	BHEL-EDN SCOPE	Unit 3	Unit 4	Total	Clause No.
D.2.6.2	MWL100 (1100 x 1515)	2 Nos.	2 Nos.	4 Nos.	6.3.14
D.2.6.3	MFA150 (1600 x 718 x 1700 mm)	2 Nos.	2 Nos.	4 Nos.	6.3.14
D.2.6.4	MFC150 (1600 x 858 x 1700 mm)	2 Nos.	2 Nos.	4 Nos.	6.3.14
D.2.6.5	MWG250 (2600 x 470 x 1700 mm)	2 Nos.	2 Nos.	4 Nos.	6.3.14
D.3.0	**STATION C&I PACKAGE**				
D.3.1.0	*PANELS*				
D.3.1.1	Functional Group Control Panels (Suite of Two Cubicles) (CRE01&02, CRE03&04, CRE05&06, CRE07&08, CRE09&10, CRE11&12, CRE13&14, CRE15&16, CRE17&18, CRE19&20, CRE21&22, CRE23&24, CRE25&26, CRE27&28, CRE29&30) Size 1500 x 750 x 2415 mm; Approximate weight- 800 kg	15 Nos.	15 Nos.	30 Nos.	6.3.1, 6.3.8
D.3.1.2	Remote I/O Panels (CRE71&72, CRE73&74) (Suite of Two Cubicles) Size 1500 x 750 x 2415 mm; Approximate weight- 800 kg	2 Nos.	2 Nos.	4 Nos.	6.3.1, 6.3.8

SL.	DESCRIPTION	QTY	QTY	QTY	REFER
D.	BHEL-EDN SCOPE	Unit 3	Unit 4	Total	Clause No.
D.3.1.3	Relay Panels (CTE01, CTE02, CTE03, CTE04, CTE05, CTE06, CTE07) (Single Cubicle) Size 750 x 750 x 2415 mm; Approximate weight- 400 kg each	7 Nos.	7 Nos.	14 Nos.	6.3.1, 6.3.8
D.3.2.0	***CONTROL DESKS (BOP)***				
D.3.2.1	Unit Control Panel with mosaic tiles (CWD01) Size 1370 x 1000 x 2345 mm; Approx. weight-1200 kg	1 No.	1 No.	2 Nos.	6.3.1
D.3.2.2	Unit Control Panel with mosaic tiles (CWD02) Size 1250 x 1000 x 2345 mm; Approx. weight-1200 kg	1 No.	1 No.	2 Nos.	6.3.1
D.3.2.3	Generator Recorder Panel Size: 1000 x 800 x 2298 mm; Approx. weight: 1000 kg	1 No.	1 No.	2 Nos.	6.3.1
D.3.3.0	***FIELD INSTRUMENTS***				
D.3.3.1	Pressure Gauges	180 Nos.	180 Nos.	360 Nos.	6.3.2
D.3.3.2	RTDs along with thermowell	192 Nos.	192 Nos.	384 Nos.	6.3.2
D.3.3.3	Thermocouples with thermowell (K-type /R type)	124 Nos.	124 Nos.	248 Nos.	6.3.2
D.3.3.4	Temperature Gauges (capillary type) with thermowell	119 Nos.	119 Nos.	238 Nos.	6.3.2
D.3.3.5	E/P Converters	32 Nos.	32 Nos.	64 Nos.	6.3.2
D.3.3.6	Air Filter Regulators	32 Nos.	32 Nos.	64 Nos.	6.3.2

SL.	DESCRIPTION	QTY	QTY	QTY	REFER
D.	BHEL-EDN SCOPE	Unit 3	Unit 4	Total	Clause No.
D.3.3.7	Level switches (float type)	27 Nos.	27 Nos.	54 Nos.	6.3.2
D.3.3.8	Displacer Type Level Transmitter	12 Nos.	12 Nos.	12 Nos.	6.3.2
D.3.3.9	***Pressure Transmitters***	109 Nos.	108 Nos.	217 Nos.	6.3.2
D.3.3.10	***DP Transmitters***	120 Nos.	118 Nos.	238 Nos.	6.3.2
D.3.3.11	DP Gauges	9 Nos.	9 Nos.	18 Nos.	6.3.2
D.3.4.0	***SECONDARY INSTRUMENTS TO BE MOUNTED IN UCP***				
D.3.4.1	Digital Indicators (96 x 48 mm)	2 Nos.	2 Nos.	4 Nos.	6.3.2
D.3.4.2	Bar Graph Indicators	10 Nos.	10 Nos.	20 Nos.	6.3.2
.3.5.0	***GAS ANALYSERS***				
D.3.5.1	**Low temperature O2 Analyser** **Consisting of probes with JBs, Electronic Unit, Reference Air Kit, Gas regulator, instrument air connection and gas connection tubes, interconnecting power and control cables etc.**	2 sets*	2 sets*	4 sets*	6.3.2

SL.	DESCRIPTION	QTY	QTY	QTY	REFER
D.	BHEL-EDN SCOPE	Unit 3	Unit 4	Total	Clause No.
D.3.5.2	**High temperature application O2 analyser** Consisting of ZIRCONIA probe with Silicon Carbide outer protection sheath, integral 'B' type thermocouple, reference air panel with junction box, microprocessor based set point controller with communication modules and sensor verification, necessary air tubes for interface air, power & communication cable etc. including flange and fabrication, pipe, stub etc.	2 sets*	2 sets*	4 sets*	6.3.2
D.3.5.3	SO2/NOX/CO (Combined) Analyzer system along with Sample Handling System consisting of 1 No. local analyser panel, with a local air conditioner separately supplied, electrically heat traced sample line with probes, junction boxes, calibration gas cylinders, and other loose supplied accessories etc. Size of Panel: 800 x 800 x 1915 mm; 500 kg (Approx. **The analyzer is to be installed at 88 ML of chimney.**	1 set*	1 set*	2 sets*	6.3.2

SL.	DESCRIPTION	QTY	QTY	QTY	REFER
D.	BHEL-EDN SCOPE	Unit 3	Unit 4	Total	Clause No.
D.3.6.0	***STEAM AND WATER ANALYSIS SYSTEM***				
D.3.6.1	**Steam and water analysis system, SWAS** consisting of: - Primary Cooler Racks: 2 Nos. One rack of app. size 1500 x 600 x 2000 mm & weight 450 kg and the other of app. size, 600 x 600 x 2000 mm & weight 100kg - Chiller Unit : 1 No. Size 3040 x 1340 x 1800 mm; 2000 kg - Wet Panel: 1 No. Approximate size 3500 x 600 x 2100 mm; Weight 500 kg - Dry panel: 1 No. Approximate size 2500 x 700 x 2300 mm; Weight 500 kg - 2 Nos. wall mounted conductivity racks, each of size 350 x 300 x 400 mm **The Wet Panel will be supplied along with associated cooler, flow meters, indicators etc.** The Dry Panel consists of sensors, electronic instruments etc. **SWAS will have the following measurements.** ▫ Conductivity Analyser: 12 Nos. ▫ Dissolved Oxygen Analyzer : 3 Nos. ▫ Hydrazine Analyzer : 1 No.	1 set*	1 set*	2 sets*	6.3.2

SL.	DESCRIPTION	QTY	QTY	QTY	REFER
D.	BHEL-EDN SCOPE	Unit 3	Unit 4	Total	Clause No.
	▫ pH Analyzers : 7 Nos. . ▫ Phosphate Analyzers : 1 No. ▫ Silica Analyzer: 3 Nos. The scope of work includes erection of the above, including loose supplied instruments, if any, interconnection pipes between cooler, chiller and wet panel, cooling water connection pipes between cooler, chiller and wet panel etc.				
D.3.7.0	***MASTER AND SLAVE CLOCK SYSTEM***				
D.3.7.1	Master clock control panel (Common) Approximate Size: 900 x 600 x 2415 mm	1 No.	--	1 No.	6.3.1
D.3.7.2	Slave clocks, Wall mounted type Approximate Size: 500 x 200 x 400 mm	2 Nos.	2 Nos.	4 Nos.	6

SL.	DESCRIPTION	QTY	QTY	QTY	REFER
D.	BHEL-EDN SCOPE	Unit 3	Unit 4	Total	Clause No.
D.3.8.0	***MAIN UPS WITH ACDB & BATTERY***				
D.3.8.1	**2 x 40 KVA UPS with ACDB** Each set comprising of following 5 Nos. of panels: UPS 1&2, SCVS, Cable Alley Panel and ACDB <u>Approximate Size & Weight</u> Each UPS panel: 1000 x 900 x 1970 mm; 1200 kg SCVS Panel: 600 x 900 x 1970 mm; 800 kg Cable Alley Panel: 600 x 900 x 1970 mm; 600 kg. ACDB: 2000 x 350 x1970 mm; 1000 kg	2 sets*	2 sets*	4 sets*	6.3.17, 6.3.1
D.3.8.2	*UPS Battery* 360V- 300AH, High discharge performance, Tubular Battery made up of 180 cells, housed in rack made of teak wood, along with Copper cables (around 150 Sq. mm size) of suitable length. Approximate room space required for stands of each Battery set = 7000mm x 2200mm x 1700 mm Approximate Weight: 8,000 kg	2 sets*	2 sets*	4 sets*	6.3.17

SL.	DESCRIPTION	QTY	QTY	QTY	REFER
D.	BHEL-EDN SCOPE	Unit 3	Unit 4	Total	Clause No.
D.3.9.0	***24 V DC CHARGER WITH DCDB AND BATTERY***				

SL.	DESCRIPTION	QTY	QTY	QTY	REFER
D.	BHEL-EDN SCOPE	Unit 3	Unit 4	Total	Clause No.
D.3.9.1	**24V DC Battery Charger with DCDB for SG/TG and BOP** Each set comprising of the following: 425A Float Charger: 1 Panel 170A Boost Charger: 1Panel DCDB: 1 Panel Wall mounted Battery isolating box: 1 No. Overall dimension of Chargers and DCDB: 3300 x 840 x 1800mm (Suite of 3 Panels) Wall mounted Battery isolating box: 700 x 350 x 1000 mm <u>Approximate Weights:</u> Each charger panel: 1200 kg DCDB: 600 Kg. Battery Isolating Box = 200kg.	4 sets*	4 sets*	8 sets*	6.3.17

SL.	DESCRIPTION	QTY	QTY	QTY	REFER
D.	BHEL-EDN SCOPE	Unit 3	Unit 4	Total	Clause No.
D.3.9.2	**26V DC Battery for SG/TG and BOP** 1200 AH, High discharge performance, Lead Acid Tubular Battery made up of 13 cells, housed in Teak wood Battery rack. Approximate Size for Battery Rack: 2650 x 800 x 1100 mm Weight of each Battery set: 2200 kg (approx)	4 sets*	4 sets*	8 sets*	6.3.17
D.3.9.3	**24V DC Battery Charger with Integral DCDB for CW Pump** Each set comprising of 50A float Charger and 35A Boost Charger of combined Panel size 1250 x 740 x 1800 mm; 1200 kg Wall mounted Isolating Box (1 no) of size 450 x 300 x 550 mm; 100 kg	2 sets*	--	2 sets*	6.3.17

SL.	DESCRIPTION	QTY	QTY	QTY	REFER
D.	BHEL-EDN SCOPE	Unit 3	Unit 4	Total	Clause No.
D.3.9.4	**24V Battery for CW Pump** 160 AH, VRLA, SMF Battery made up of 12 cells housed in steel stack box. Approximate Size of stack box: 800 x 450 x 325 mm Weight of battery: 300 kg (approx.)	2 sets*	--	2 sets*	6.3.17
D.3.10.0	***CABLES (for BOP, SG, TG, VFD)***				
D.3.10.1	2 P x 1.5 sq. mm cable, FRLS/PVC insulated (for solenoid valves)	7000 Mtrs	7000 Mtrs	14000 Mtrs	6.3.10
	FRLS/PVC insulated, Individually & Overall Shielded, Armoured Cables				
D.3.10.2	2 pair x 0.5 sq. mm cable	3100 Mtrs	3100 Mtrs	6200 Mtrs	6.3.10
D.3.10.3	4 pair x 0.5 sq. mm cable	28,450 Mtrs	28,450 Mtrs	56,900 Mtrs	6.3.10
D.3.10.4	8 pair x 0.5 sq. mm cable	6,000 Mtrs	6,000 Mtrs	12,000 Mtrs	6.3.10

SL.	DESCRIPTION	QTY	QTY	QTY	REFER
D.	BHEL-EDN SCOPE	Unit 3	Unit 4	Total	Clause No.
D.3.10.5	12 pair x 0.5 sq. mm cable	2,600 Mtrs	2,600 Mtrs	5,200 Mtrs	6.3.10
	FRLS/PVC insulated, Overall Shielded, Armoured Cables				
D.3.10.6	2 pair x 0.5 sq. mm cable	9,680 Mtrs	9,680 Mtrs	19,360 Mtrs	6.3.10
D.3.10.7	4 pair x 0.5 sq. mm cable	9,380 Mtrs	9,380 Mtrs	18,760 Mtrs	6.3.10
D.3.10.8	8 pair x 0.5 sq. mm cable	11,440 Mtrs	11,440 Mtrs	22,880 Mtrs	6.3.10
D.3.10.9	12 pair x 0.5 sq. mm cable	9,500 Mtrs	9,500 Mtrs	19,000 Mtrs	6.3.10
D.3.10.10	14 pair x 0.5 sq. mm cable	800 Mtrs	800 Mtrs	1,600 Mtrs	6.3.10
	Compensating Cables				
D.3.10.11	2 P X 1.3 SQ. MM, Type-SX, T/C Extension Cable	5000 Mtrs	5000 Mtrs	10000 Mtrs	6.3.10
D.3.10.12	2 P X 1.3 SQ. MM, Type-SX, T/C Extension Cable	500 Mtrs	500 Mtrs	1000 Mtrs	6.3.10
D.3.11.0	***CABLE TRAYS***				
D.3.11.1	Perforated Cable Trays, 50 mm wide	2,500 Mtrs	2,500 Mtrs	5,000 Mtrs	6.3.12
D.3.11.2	Perforated Cable Trays, 100 mm wide	2,500 Mtrs	2,500 Mtrs	5,000 Mtrs	6.3.12

SL.	DESCRIPTION	QTY	QTY	QTY	REFER
D.	BHEL-EDN SCOPE	Unit 3	Unit 4	Total	Clause No.
D.3.12.0	***JUNCTION BOXES***				
D.3.12.1	24 way Junction Boxes	3 Nos.	3 Nos.	6 Nos.	6.3.6
D.3.12.2	36 way Junction Boxes	2 Nos.	2 Nos.	4 Nos.	6.3.6
D.3.12.3	48 way Junction Boxes	11 Nos.	11 Nos.	22 Nos.	6.3.6
D.3.12.4	64 way Junction Boxes	2 Nos.	2 Nos.	4 Nos.	6.3.6
D.3.12.5	72 way Junction Boxes	2 Nos.	2 Nos.	4 Nos.	6.3.6
D.3.13.0	***CJCB***				
D.3.13.1	12 way Junction Boxes	15 Nos.	15 Nos.	30 Nos.	6.3.6
D.3.13.2	24 way Junction Boxes	1 No.	1 No.	2 Nos.	6.3.6
D.3.14.0	***IMPULSE PIPES***				
D.3.14.1	A106 Gr B- 1” NB SCH 80	50 Mtrs	50 Mtrs	100 Mtrs	6.3.3
D.3.14.2	A106 Gr B- ¾” NB SCH 80	1500 Mtrs	1500 Mtrs	3000 Mtrs	6.3.3
D.3.14.3	A106 Gr C- ½” NB SCH 160	875 Mtrs	875 Mtrs	1750 Mtrs	6.3.3
D.3.14.4	A106 Gr C- ½” NB SCH 80	1500 Mtrs	1500 Mtrs	3000 Mtrs	6.3.3
D.3.14.5	A335 P22- ½” NB XXS	625 Mtrs	625 Mtrs	1250 Mtrs	6.3.3
D.3.14.6	A335 P22-¾” NB SCH 80	350 Mtrs	350 Mtrs	700 Mtrs	6.3.3

SL.	DESCRIPTION	QTY	QTY	QTY	REFER
D.	BHEL-EDN SCOPE	Unit 3	Unit 4	Total	Clause No.
D.3.14.7	A213 TP 316 – ½" NB SCH160	750 Mtrs	750 Mtrs	1500 Mtrs	6.3.3
D.3.14.8	A213 TP 316 – ½" NB SCH80	600 Mtrs	600 Mtrs	1200 Mtrs	6.3.3
D.3.15.0	***LOCAL INSTRUMENT ENCLOSURES/ RACKS (LIE/ LIRs)***				
D.3.15.1	LIE of size: 2000 x 800 x 2300 mm; Approximate weight: 350 kg each	2 Nos.	2 Nos.	4 Nos.	6.3.14
D.3.15.2	LIE of size: 1450 x 800 x 2300 mm; Approximate weight: 350 kg each	8 Nos.	8 Nos.	16 Nos.	6.3.14
D.3.15.3	LIE of size: 1100 x 800 x 2300 mm; Approximate weight: 250 kg each	11 Nos.	11 Nos.	22 Nos.	6.3.14
D.3.15.4	LIR of size 2000 x 350 x 2200 mm; Approximate weight: 225 kg each	13 Nos.	13 Nos.	26 Nos.	6.3.14
D.3.15.5	LIR of size 1650 x 350 x 2200 mm; Approximate weight: 220 kg each	6 Nos.	6 Nos.	12 Nos.	6.3.14
D.3.15.6	LIR of size 800 x 350 x 2200 mm; Approximate weight: 175 kg each	2 Nos.	2 Nos.	4 Nos.	6.3.14
D.3.16.0	***OTHER ERECTION MATERIALS***				
D.3.16.1	Angles, Channels, etc. for fabrication	13 Tonnes	13 Tonnes	26 Tonnes	6.3.13
D.3.16.2	½" heavy duty GI pipes	450 Mtrs	450 Mtrs	900 Mtrs	6.3.5

SL.	DESCRIPTION	QTY	QTY	QTY	REFER
D.	BHEL-EDN SCOPE	Unit 3	Unit 4	Total	Clause No.
D.3.16.3	1" heavy duty GI pipes	1750 Mtrs	1750 Mtrs	3500 Mtrs	6.3.5
D.3.16.4	¼" OD, PVC Coated Copper Tubes	100 Mtrs	100 Mtrs	200 Mtrs	6.3.4
D.4.0	**HMI PACKAGE**				
D.4.1	**Unit Control Desk** Unit Control Desk for housing Work Stations, CRTs, keyboards and mouse for the above etc. Approximate Total size 6700 x 900 x 750 mm, in suitable shipping sections	1 set*	1 set*	2 sets*	6.3.8, 6.3.1
D.4.2	LVS System 67" Large Video Screen along with CPU (Pentium IV PC) and other loose supplied items like keyboard, mouse, interconnecting power & communication cables, LVS Stand etc. **Note: CPU of LVS will be housed in Unit Control Desk.**	2 sets*	2 sets*	4 sets*	6.3.8, 6.3.2
D.4.3	**Computer Stations** **Pentium IV PCs along with 21" colour monitor, and other loose supplied items like keyboard, mouse, printer, interconnecting power and communication cables etc.** The PCs are for various specific functions like 'maxEngineer Stations cum Storian', 'maxOperator' Workstations, 'maxStorian' PC, 'maxLink' Station etc.	9 sets*	9 sets*	18 sets*	6.3.8

SL.	DESCRIPTION	QTY	QTY	QTY	REFER
D.	BHEL-EDN SCOPE	Unit 3	Unit 4	Total	Clause No.
D.4.4	Network Panels/ Power Distribution Panels Size: 750 x 750 x 2415 mm; weight: 400 kg each	2 Nos.	2 Nos.	4 Nos.	6.3.1, 6.3.8
	Network Cables				
D.4.5	Ethernet Cable	9,000 Mtrs	9,000 Mtrs	18,000 Mtrs	6.3.10
D.4.6	Power Cables: 3 C x 1.5 sq. mm cables	300 Mtrs	300 Mtrs	600 Mtrs	6.3.10
D.4.7	Fibre Optic Cable, along with conduit	1500 Mtrs	--	1500 Mtrs	6.3.10

SL.	DESCRIPTION	QTY	QTY	QTY	REFER
E.	BHEL-HYDERABAD SCOPE	Unit 3	Unit 4	Total	Clause No.
.1.0	**PUMPS (BFP, CEP)**				
E.1.1.0	*INSTRUMENTS*				
E.1.1.1	RTDs along with thermowells	6 Nos.	6 Nos.	12 Nos.	6.3.2
E.1.1.2	Checking healthiness of RTDs fixed on BFP & CEP motors (for bearing & winding)	66 Nos. $	66 Nos. $	132 Nos. $	6.3.9.5
E.1.2.0	***BFP- HYDRAULIC COUPLING*** ***Removal, calibration and re-fixing of following***				
E.1.2.1	Pressure Gauges	6 Nos.	6 Nos.	12 Nos.	6.3.9.7
E.1.2.2	DP Gauges	3 Nos.	3 Nos.	6 Nos.	6.3.9.7
E.1.2.3	Temperature Gauges	39 Nos.	39 Nos.	78 Nos.	6.3.9.7

SL.	DESCRIPTION	QTY	QTY	QTY	REFER
E.	BHEL-HYDERABAD SCOPE	Unit 3	Unit 4	Total	Clause No.
E.1.2.4	Pressure Transmitters	6 Nos.	6 Nos.	12 Nos.	6.3.9.7
E.1.2.6	Level Switch	3 Nos.	3 Nos.	6 Nos.	6.3.9.7
E.1.2.6	DP Transmitter with Indicator	3 Nos.	3 Nos.	6 Nos.	6.3.9.7
E.1.2.7	Temperature Elements- Duplex RTDs (Checking the healthiness only)	48 Nos. $	48 Nos. $	96 Nos. $	6.3.9.5
E.1.3	**Vibration Monitoring System for BFPs & CEPs** consisting of the following ▫ 1 No. Bently Nevada 3500 series Instrument rack (to be mounted on Panel) ▫ 18 Nos. of Vibration probes, probe extenders, proximeters, proximeter housing, flexible conduits etc. Approximate weight of Rack: 40 kg	1 set*	1 set*	2 sets*	6.3.2

SL.	DESCRIPTION	QTY	QTY	QTY	REFER
E.	BHEL-HYDERABAD SCOPE	Unit 3	Unit 4	Total	Clause No.
E.1.4.0	*LOCAL GAUGE BOARD (LGB) / LOCAL INSTRUMENT RACK (LIR)*				
E.1.4.1	**LGB Assembly including instruments, tubing, valves, fittings, junction boxes and wiring from switches to JBs. Size 1720 x 450 x 1800 mm Approximate Weight = 200 kg each.**	**7 Nos.**	**7 Nos.**	**14 Nos.**	6.3.14
E.1.4.2	**LGB Assembly including instruments, tubing, valves, fittings, junction boxes and wiring from switches to JBs. Size 1400 x 450 x 1400 mm Approximate Weight = 200 kg each.**	**1 No.**	**1 No.**	**2 Nos.**	6.3.14
E.1.4.3	**LIR Assembly including tubing, fittings, junction boxes, manifold valves, and wiring from JBs to transmitters Size 2000 x 650 x 2200 mm Approximate Weight = 300 kg each.**	**1 No.**	**1 No.**	**2 Nos.**	6.3.14
	LGB/ LIR Mounted Instruments (Removal, calibration and re-fixing only)				
E.1.4.4	**Pressure Gauges**	**42 Nos.**	**42 Nos.**	**84 Nos.**	6.3.9.7, 6.3.2
E.1.4.5	**DP Gauges**	6 Nos.	6 Nos.	12 Nos.	6.3.9.7, 6.3.2
E.1.4.6	**Temperature Gauges**	**39 Nos.**	**39 Nos.**	**78 Nos.**	6.3.9.7, 6.3.2
E.1.4.7	**Pressure Switches**	**3 Nos.**	**3 Nos.**	6 Nos.	6.3.9.7, 6.3.2
E.1.4.8	Pressure Transmitters	12 Nos.	12 Nos.	24 Nos.	6.3.9.7, 6.3.2

SL.	DESCRIPTION	QTY	QTY	QTY	REFER
E.	BHEL-HYDERABAD SCOPE	Unit 3	Unit 4	Total	Clause No.
E.1.4.9	DP Transmitters	6 Nos.	6 Nos.	12 Nos.	6.3.9.7, 6.3.2
E.1.5.0	***JUNCTION BOXES***				
E.1.5.1	Electrical Junction Box, 36 way	6 Nos.	6 Nos.	12 Nos.	6.3.6
E.1.6.0	***CABLES/ CABLE TRAYS***				
E.1.6.1	4 Triad, 0.5 sq. mm cable	500 Mtrs	500 Mtrs	1000 Mtrs	6.3.10
E.1.6.2	4 Pair, 0.5 sq. mm cable	100 Mtrs	100 Mtrs	200 Mtrs	6.3.10
E.1.6.3	Perforated cable tray, 50 mm wide	45 Mtrs	45 Mtrs	90 Mtrs	6.3.12
E.1.6.4	Perforated cable tray, 150 mm wide	75 Mtrs	75 Mtrs	150 Mtrs	6.3.12

SL.	DESCRIPTION	QTY	QTY	QTY	REFER
E.	BHEL-HYDERABAD SCOPE	Unit 3	Unit 4	Total	Clause No.
E.1.7.0	***IMPULSE TUBES***				
E.1.7.1	Impulse Tube, Dia 16 x 2.6, CS	600 Mtrs	600 Mtrs	1200 Mtrs	6.3.3
E.1.8.0	***SUPPORT MATERIALS***				
E.1.8.1	Fabrication Material (Angles, Channels etc.)	0.5 MT	0.5 MT	1 MT	6.3.13
E.2.0	**DEAERATOR INSTRUMENTS**				
E.2.1	Level Switches	11 Nos.	11 Nos.	22 Nos.	6.3.2

SL.	DESCRIPTION	QTY	QTY	QTY	REFER
E.	BHEL-HYDERABAD SCOPE	Unit 3	Unit 4	Total	Clause No.
	Pressure Gauges	03 Nos.	03 Nos.	6 Nos.	6.3.2
E.2.3	Temperature Gauges (MIST)	04 Nos.	04 Nos.	8 Nos.	6.3.2
E.3.0	**PULVERISER**				
E.3.1	RTDs along with thermowell	24 Nos.	24 Nos.	48 Nos.	6.3.2
E.3.2	**Mill Motor Bearing Temperature Indicators.** (Removal, calibration and refixing only)	6 Nos.	6 Nos.	12 Nos.	6.3.9.7, 6.3.2
E.3.3	**Level Switches**	12 Nos.	12 Nos.	24 Nos.	6.3.2
E.3.4.0	***COMMISSIONING OF FOLLOWING***				
E.3.4.1	Mill Motor RTDs - bearing/ winding (Checking healthiness only)	84 Nos. $	84 Nos. $	168 Nos. $	6.3.9.5

SL.	DESCRIPTION	QTY	QTY	QTY	REFER
E.	BHEL-HYDERABAD SCOPE	Unit 3	Unit 4	Total	Clause No.
	Commissioning of Pneumatic Actuators of On/Off type				
E.3.4.2	Purge Air to Pulveriser Coal pipes	6 Nos. $	6 Nos. $	12 Nos. $	6.3.9.1
E.3.4.3	Mill Discharge Damper	24 Nos. $	24 Nos. $	48 Nos. $	6.3.9.1
E.3.4.4	**Pulveriser Lub Oil Skid** Removal, calibration and re-fixing of following instruments, meggering, improving IR value of motors, checking of wiring from skid junction box to equipment in lub oil skid ***Equipment per set*** **DP Switch – 1 No. Pressure Switch – 4 Nos.** **Temperature Switches- 2 Nos.** **Pressure Gauge- 2 Nos.** **Temperature Gauges- 2 Nos.** DP Gauge – 1 No. Flow Indicator- 2 Nos. RTD – 1 No. LT Motors – 2 Nos.	6 sets*$	6 sets*$	12 sets*$	6.3.9.7, 6.3.2

SL.	DESCRIPTION	QTY	QTY	QTY	REFER
F.	BHEL-PEM SCOPE	Unit 3	Unit 4	Total	Clause No.
F.1.0	**PANELS/ INSTRUMENTS**				
F.1.1	PLC panel for Plant Water system, along with monitor, keyboard etc. Approximate size: 1200 x 600 x 1800 mm; Weight: 600 kg	1 No.	--	1 No.	6.3.8, 6.3.1
F.1.2	Flow Transmitter (Annubar type) along with Impact head type element, protective cover	2 sets*	2 sets*	4 sets*	6.3.2
F.2.0	**INSTRUMENTATION CABLES**				
	Individual Pair & Overall Shielded, Twisted Pair, Armoured cables				
F.2.1	2 Pair x 0.5 mm^2	25,000 Mtrs	25,000 Mtrs	50,000 Mtrs	6.3.10
F.2.2	4 Pair x 0.5 mm^2	16,000 Mtrs	16,000 Mtrs	32,000 Mtrs	6.3.10
F.2.3	8 Pair x 0.5 mm^2	7,500 Mtrs	7,500 Mtrs	15,000 Mtrs	6.3.10

SL.	DESCRIPTION	QTY	QTY	QTY	REFER
F.	BHEL-PEM SCOPE	Unit 3	Unit 4	Total	Clause No.
F.2.4	16 Pair x 0.5 mm^2	10,000 Mtrs	10,000 Mtrs	20,000 Mtrs	6.3.10
F.2.5	1 Pair x 1.5 mm^2	2,500 Mtrs	2,500 Mtrs	5,000 Mtrs	6.3.10
F.2.6	4 Pair x 1.5 mm^2	4,000 Mtrs	4,000 Mtrs	8,000 Mtrs	6.3.10
	Overall Screened, Twisted Pair, Armoured cables				
F.2.7	4 Core x 0.5 mm^2	32,500 Mtrs	32,500 Mtrs	65,000 Mtrs	6.3.10
F.2.8	7 Core x 0.5 mm^2	10,000 Mtrs	10,000 Mtrs	20,000 Mtrs	6.3.10
F.2.9	16 Core x 0.5 mm^2	8,000 Mtrs	8,000 Mtrs	16,000 Mtrs	6.3.10
F.2.10	4 Core x 0.5 mm^2	30,000 Mtrs	30,000 Mtrs	60,000 Mtrs	6.3.10

SL.	DESCRIPTION	QTY	QTY	QTY	REFER
F.	BHEL-PEM SCOPE	Unit 3	Unit 4	Total	Clause No.
F.3.0	**TUBE CLEANING SYSTEM**				
F.3.1	PLC panel for Tube Cleaning system, along with monitor, keyboard etc. Approximate size: 1200 x 600 x 1800 mm; Weight: 600 kg	1 No.	1 No.	2 Nos.	6.3.8, 6.3.1
F.3.2	Pressure Gauges	4 Nos.	4 Nos.	8 Nos.	6.3.2
F.3.3	DP Gauges	2 Nos.	2 Nos.	4 Nos.	6.3.2
F.3.4	DP Transmitters	2 Nos.	2 Nos.	4 Nos.	6.3.2
F.3.5	DP Switches	2 Nos.	2 Nos.	4 Nos.	6.3.2
F.3.6	Pressure Switches	2 Nos.	2 Nos.	4 Nos.	6.3.2
F.4.0	**COMMISSIONING OF THE FOLLOWING**				
F.4.1	Control Valves	22 Nos.[$]	22 Nos.[$]	44 Nos.[$]	6.3.9.1
F.4.2	Loop Checking of Electrical Actuators (this covers Actuators supplied by Hyderabad/ Hardwar/Piping Centre also)	131 Nos.[$]	131 Nos.[$]	262 Nos.[$]	6.3.7

SL.	DESCRIPTION	QTY	QTY	QTY	REFER
G.	BHEL-HARDWAR SCOPE	Unit 3	Unit 4	Total	Clause No.
G.1.0	**GENERATOR**				
G.1.1	***GENERATOR AUXILIARY CONTROL CABINETS***				
G.1.1.1	Generator Instrumentation Cabinet (CXW01B) Dimension & weight: 1000 x 800 x 2200 mm; 450 k	1 No.	1 No.	2 Nos.	6.3.1
G.1.1.2	Gas Analyser Cabinet including sensors, analysers etc. (CWX01C) Dimension & weight: 1000 x 800 x 2200 mm; 400 kg	1 No.	1 No.	2 Nos.	6.3.1
G.1.1.3	Annunciation Cabinet (CWX01E) Approx. Dimension & weight: 1000 x 800 x 2200 mm; 400 kg	1 No.	1 No.	2 Nos.	6.3.1
G.1.2.0	***GENERATOR INSTRUMENTS:***				
G.1.2.1	Pressure Gauges	7 Nos.	7 Nos.	14 Nos.	6.3.2
G.1.2.2	Temperature Gauges	6 Nos.	6 Nos.	12 Nos.	6.3.2

SL.	DESCRIPTION	QTY	QTY	QTY	REFER
G.	BHEL-HARDWAR SCOPE	Unit 3	Unit 4	Total	Clause No.
G.1.2.3	Pressure Transmitters	1 No.	1 No.	2 Nos.	6.3.2
G.1.2.4	Pressure Switches	1 No.	1 No.	2 Nos.	6.3.2
G.1.2.5	Level Switches (capacitance type)	10 Nos.	10 Nos.	20 Nos.	6.3.2
G.1.2.6	Thermostats	1 No.	1 No.	2 Nos.	6.3.2

SL.	DESCRIPTION	QTY	QTY	QTY	REFER
G.	BHEL-HARDWAR SCOPE	Unit 3	Unit 4	Total	Clause No.
G.1.2.7	RTDs (Gas Drier Heater Temperature: 1 No. Air temp. in Gas exhaust of drier: 2 Nos. Temp for H2 side Seal Oil Drain : 2 Nos. Temp for Air side Seal Oil Drain :1 Nos. CW Temp at I/L to Air Cooler : 1 Nos. CW Temp at O/L from Air Cooler : 2 Nos. CW Temp to H2 Cooler : 1 Nos. CW Temp at O/L of H2 Cooler : 4 Nos.)	14 Nos.	14 Nos.	28 Nos.	6.3.2

SL.	DESCRIPTION	QTY	QTY	QTY	REFER
G.	BHEL-HARDWAR SCOPE	Unit 3	Unit 4	Total	Clause No.
G.1.2.8	Thermocouples (NiCrNi) (Generator Bearing Temp-: 8 Nos. Exciter Bearing Temp: 4 Nos.)	12 Nos.	12 Nos.	24 Nos.	6.3.2
G. 1.3.0	***GENERATOR INSTRUMENTS:*** ***(Removal, Calibration and Re-fixing only)***				
G.1.3.1	Pressure Gauges	5 Nos.	5 Nos.	10 Nos.	6.3.9.7, 6.3.2
G.1.3.2	Temperature Gauge	1 No.	1 No.	2 Nos.	6.3.9.7, 6.3.2
G.1.3.3	Pressure Transmitter	1 No.	1 No.	2 Nos.	6.3.9.7, 6.3.2
G.1.3.4	Pressure Switch	1 No.	1 No.	2 Nos.	6.3.9.7, 6.3.2
G.1.3.5	Level Switches	2 Nos.	2 Nos.	4 Nos.	6.3.9.3, 6.3.2
G.1.3.6	Flow Meters (commissioning only)	4 Nos.	4 Nos.	8 Nos.	6.3.9.2

SL.	DESCRIPTION	QTY	QTY	QTY	REFER
G.	BHEL-HARDWAR SCOPE	Unit 3	Unit 4	Total	Clause No.
	RTDs / THERMOCOUPLES MOUNTED ON EQUIPMENT (Checking the healthiness only)				
G.1.3.7	Temperature- Stator Core (TC CuCuNi)	24 Nos.$	24 Nos.$	48 Nos	6.3.9.5
G.1.3.8	Temperature- Stator Winding(Pt 100 RTD)	24 Nos.$	24 Nos.$	48 Nos$.	6.3.9.5
G.1.3.9	Temp- Cold Gas after Coolers (Pt 100 RTD)	12 Nos.$	12 Nos.$	24 Nos.$	6.3.9.5
G.1.3.10	Temp- Hot Gas before Coolers (Pt 100 RTD)	8 Nos$.	8 Nos$.	16 Nos.$	6.3.9.5
G.1.3.11	Temp- Cold Air to Main Exciter (Pt 100 RTD)	4 Nos.$	4 Nos.$	8 Nos$.	6.3.9.5
G.1.3.12	Temp- Hot Air after Main Exciter (Pt 100 RTD)	4 Nos.$	4 Nos.$	8 Nos$.	6.3.9.5
G.1.3.13	Temp- Hot Air after Rectifier Wheel (Pt 100 RTD)	4 Nos.$	4 Nos.$	8 Nos$.	6.3.9.5

SL.	DESCRIPTION	QTY	QTY	QTY	REFER
G.	BHEL-HARDWAR SCOPE	Unit 3	Unit 4	Total	Clause No.
G.1.3.14	Seal Oil Temp before SO Cooler (Pt 100 RTD)	2 Nos. $	2 Nos. $	4 Nos. $	6.3.9.5
G.1.3.15	Seal Oil Temp after Duplex filter (Pt 100 RTD)	8 Nos. $	8 Nos. $	16 Nos. $	6.3.9.5
G.1.4.0	***LOOSE ITEMS TO BE MOUNTED ON UCP***				
G.1.4.1	Digital Indicators	2 Nos.	2 Nos.	4 Nos.	6.3.2
G.1.5.0	***COMMISSIONING OF THE FOLLOWING***				
G.1.5.1	Control Valve	1 No. $	1 No. $	2 Nos. $	6.3.9.1

SL.	DESCRIPTION	QTY	QTY	QTY	REFER
G.	BHEL-HARDWAR SCOPE	Unit 3	Unit 4	Total	Clause No.
G.2.0	**STEAM TURBINE**				
G.2.1.0	***GAUGES AND SENSORS***				
G.2.1.1	Pressure Transmitters	20 Nos.	20 Nos.	40 Nos.	6.3.2
G.2.1.2	Diff. Pressure Transmitter	3 Nos.	3 Nos.	6 Nos.	6.3.2
G.2.1.3	Pressure Gauges	34 Nos.	34 Nos.	68 Nos.	6.3.2
G.2.1.4	Temperature Gauges	9 Nos.	9 Nos.	18 Nos.	6.3.2
G.2.1.5	Pressure Switches	48 Nos.	48 Nos.	96 Nos.	6.3.2
G.2.1.6	DP Switches	5 Nos.	5 Nos.	10 Nos.	6.3.2
G.2.1.7	Level Switches with amplifier, bar probe including interconnecting cable	3 sets*	3 sets*	6 sets*	6.3.2
G.2.1.8	Level transmitters with amplifier, bar probe	3 sets*	3 sets*	6 sets*	6.3.2

SL.	DESCRIPTION	QTY	QTY	QTY	REFER
G.	BHEL-HARDWAR SCOPE	Unit 3	Unit 4	Total	Clause No.
G.2.1.9	RTDs	14 Nos.	14 Nos.	28 Nos.	6.3.2
G.2.1.10	Thermocouples	61 Nos.	61 Nos.	122 Nos.	6.3.2
G.2.1.11	Speed Sensors	4 Nos.	4 Nos.	8 Nos.	6.3.2
G.2.1.12	Limit Switches (checking only)	63 Nos.	63 Nos.	126 Nos.	6.3.9.3
G.2.1.13	Position Transmitters	6 Nos.	6 Nos.	12 Nos.	6.3.2
G.2.1.14	Position Transmitters (calibration and commissioning only)	16 Nos. $	16 Nos. $	32 Nos. $	6.3.2

SL.	DESCRIPTION	QTY	QTY	QTY	REFER
G.	BHEL-HARDWAR SCOPE	Unit 3	Unit 4	Total	Clause No.
.2.2.0	***RACK MOUNTED INSTRUMENTS*** Removal, calibration and refixing of rack mounted instruments, checking solenoid valves, drives, including wiring on the rack etc.				
G.2.2.1	Governing Rack (LR1) The approximate quantity of instruments is as below: ▫ Pressure Gauges : 13 Nos. ▫ Pressure Switches : 4 Nos. ▫ Limit Switch : 20 Nos. ▫ Position Transmitter: 3 Nos.	1 set*$	1 set*$	2 sets*$	6.3.9.7, 6.3.2
G.2.2.2	**LP Bypass Control Rack (LR2)** The approximate quantity of instruments is as below: ▫ Pressure Gauges : 11 Nos. ▫ Pressure Switch : 1 No. ▫ Limit Switch : 4 Nos. ▫ Position Transmitter: 1 No.	1 set*$	1 set*$	2 sets*$	6.3.9.7, 6.3.2

SL.	DESCRIPTION	QTY	QTY	QTY	REFER
G.	BHEL-HARDWAR SCOPE	Unit 3	Unit 4	Total	Clause No.
G.2.3	***PRESSURE INSTRUMENTS RACKS (IR1 to IR7)*** Assembly/ welding and installation of Instrument Racks with loose supplied prefabricated materials of suitable size like equal/unequal angles, canopy mounting plates, LHS/RHS stands etc., necessary welding, fixing with fasteners and grouting. Approx. Total wt. of loose supplied items (for 7 Nos. racks): 2 Tonnes	7 Nos.	7 Nos.	14 Nos.	6.3.14
G.2.4.0	***JUNCTION BOXES***				
G.2.4.1	80 pt. Junction Box	2 Nos.	2 Nos.	4 Nos.	6.3.6
G.2.4.2	48 pt. junction box	4 Nos.	4 Nos.	8 Nos.	6.3.6

SL.	DESCRIPTION	QTY	QTY	QTY	REFER
G.	BHEL-HARDWAR SCOPE	Unit 3	Unit 4	Total	Clause No.
G.2.5.0	***IMPULSE PIPES***				
G.2.5.1	Alloy Steel tube D=13.5 x 2.6	430 Mtrs	430 Mtrs	860 Mtrs	6.3.3
G.2.5.2	Carbon Steel Tube, D=13.5 x 2.9	580 Mtrs	580 Mtrs	1160 Mtrs	6.3.3
G.2.5.3	Carbon Steel Tube, D=17.2 x 1.8	400 Mtrs	400 Mtrs	800 Mtrs	6.3.3
G.2.6	***STRUCTURAL STEEL*** (for both turbine and generator instruments)	1.0 Tonnes	1.0 Tonnes	2.0 Tonnes	6.3.13

SL.	DESCRIPTION	QTY	QTY	QTY	REFER
G.	BHEL-HARDWAR SCOPE	Unit 3	Unit 4	Total	Clause No.
G.2.7.0	***INSTRUMENTS FOR HEAT EXCHANGERS (CONDENSER, GSC, LP HEATER, TOC, EJECTOR)***				
G.2.7.1	Level Switches	18 Nos.	18 Nos.	36 Nos.	6.3.2
G.2.7.2	Pressure Gauges	6 Nos.	6 Nos.	12 Nos.	6.3.2
G.2.7.3	Temperature Gauges with thermowell (capillary type)	19 Nos.	19 Nos.	38 Nos.	6.3.2
G.2.7.4	Temperature Gauges with thermowell (stem type)	10 Nos.	10 Nos.	20 Nos.	6.3.2

SL.	DESCRIPTION	QTY	QTY	QTY	REFER
G.	BHEL-HARDWAR SCOPE	Unit 3	Unit 4	Total	Clause No.
G.3.0	**COMMISSIONING OF THE FOLLOWING**				
G.3.1	**Condenser Vacuum pump** Removal, calibration and commissioning of CVP skid mounted instruments including CVP PLC and motor mounted on the skid. The approximate quantity of skid mounted instruments shall be Pressure Indicators – 2 Flow Indicator – 1 Level Switches – 2 Pressure Switch – 1 DP Switch – 1 Flow Switch – 1 Temperature Switch – 1 Temp. Indicators – 4 Solenoid Valve – 2	1 set*$	1 set*$	2 sets*$	6.3.9.7, 6.3.2

SL.	DESCRIPTION	QTY	QTY	QTY	REFER
G.	BHEL-HARDWAR SCOPE	Unit 3	Unit 4	Total	Clause No.
G.3.2	Oil Centrifuge Unit The job includes removal, calibration and refixing of all instruments mounted on centrifugal unit, checking and commissioning of the system.	2 Nos. $	2 Nos. $	4 Nos. $	6.3.9.7
G.3.5	NRV Valves, Stop Valves, Control Valves, HP/LP Bypass Valves	30 Nos. $	30 Nos. $	60 Nos. $	6.3.9.1
G.3.6	Solenoid Valves (only checking)	28 Nos. $	28 Nos. $	56 Nos. $	6.3.9.4

SL.	DESCRIPTION	QTY	QTY	QTY	REFER
H.	BHEL-BHOPAL SCOPE	Unit 3	Unit 4	Total	Clause No.
H.1.0	**HP HEATERS PACKAGE**				
H.1.1	Pressure Gauges	4 Nos.	4 Nos.	8 Nos.	6.3.2
H.1.2	Temperature Gauges	4 Nos.	4 Nos.	8 Nos.	6.3.2
H.1.3	Level Switches	8 Nos.	8 Nos.	16 Nos.	6.3.2