TENDER SPECIFICATION

BHEL:PSSR:SCT: 1243

FOR

Handling at Site Stores / Storage Yard
Transportation to site of work, Erection, Testing and
Providing Commissioning assistance for
Control & Instrumentation System
for Unit -1 of 2x 1000 MWe Nuclear Power Plant
at KudanKulam, Tamilnadu

For

Nuclear Power Corporation of India Limited
KudanKulam , Tirunelveli Dist
Tamilnadu .

PART – I TECHNICAL BID

BOOK NO :

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

INDEX SCT : 1243 – NPCIL –KUDANKULAM C&I PACKAGE

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: 1243

Messrs Date:

Dear Sir,

SUB: Handling at Site Stores / Storage yard, Transportation to site of work, Erection, Testing and Providing Commissioning assistance for Control & Instrumentation System for Unit -1 of 1000 MWe Nuclear Power Plant at KudanKulam, Tamilnadu

Please find enclosed one set of non-transferable tender Specification documents containing - 137 - pages along with general conditions of contract Booklet , separate books of BOQ and Rate schedule for the above work.

You are requested to go through the tender documents, GCC Booklet and offer your most competitive rate and submit the tender documents duly filled in as per procedure indicated in the tender specification along with requisite EMD of **Rs. 1,50,000/- (Rupees One lakh Fifty thousand only)** in the form Demand Draft drawn in favour of M/s.Bharat Heavy Electrical Limited Chennai - 35. **Bids with Deviations from the tender conditions will be rejected**.

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

The completed quotations shall reach the office of the under signed on or before 12.09.2007 at 15.00 Hrs. The Technical bids, will be opened on the same day at 15.30 hrs.

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

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

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

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

Thanking you,

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

ADDITIONAL 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 (GCC) t 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 possess the experience of having completed successfully Boiler / TG C&I system and other related works like field instruments, Impulse piping, Instrument Air piping, trays, tray supports, cabling, earthing, etc. for a Thermal power Project, of minimum 210 MW rating in 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 31.02.2006.

The bidder must have earned profit in any one of the last three financial years ending 31.03.2006 and should have positive net worth as on 31.03.2006.
The bidder should submit audited balance sheet and profit and loss account of the company for the last three years ending 31.03.2006 in support of above requirement.

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

d) Approval of agency by customer.

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

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

16. SAFETY PLAN

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

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

PROCEDURE FOR SUBMISSION OF SEALED BIDS

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

Part I (Technical Bid) Cover I :

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

Part II (Price Bid) Cover II :

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

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

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

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

EMD amount for this Tender is **Rs.1,50,000/- (Rupees One lakh Fifty thousand 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.

Additional General Manager/Contracts.

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

TENDER NOTICE

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

Tender Specification No. BHEL:PSSR:SCT: **1243**

Description	EMD
Handling at Site Stores / Storage Yard Transportation to site of work, Erection, Testing and Providing Commissioning assistance for Control & Instrumentation System for Unit -1 of 2x 1000 MWe Nuclear Power Plant at KudanKulam, Tamilnadu	Rs.**1,50,000/-** **(Rs.One lakh Fifty Thousand)**

Cost of Tender Documents (Including all Taxes)	:	**Rs.1040/-**	
Sale Starts on	:	**23.08.2007**	
Sale closes on	:	**10.09.2007**	
Due date and Time for Submission	:	**12.09.2007**	**15.00 Hrs.**
Date and time for opening Of Technical Bids	:	**12.09.2007**	**15.30 Hrs.**

QUALIFICATION REQUIREMENT

a) The bidders should possess the experience of having completed successfully Boiler / TG C&I system and other related works like field instruments, Impulse piping, Instrument Air piping, trays, tray supports, cabling, earthing, etc. for a Thermal power Project, of minimum 210 MW rating in 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 31.03.2006.

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

d) The bidder should submit audited balance sheet and profit and loss account of the company for the last three years ending 31.03.2006 in support of above requirement.

e) 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.

f) Approval of agency by customer

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

Interested parties can get the Tender documents from the office of the Additional General Manager / Contracts on all working days 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 there for.

ADDITIONAL GENERAL MANAGER/CONTRACTS

TENDER SPECIFICATION : BHEL:PSSR:SCT:1243

CERTIFICATE FOR NO DEVIATION

I, Of M/s.

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

SIGNATURE OF THE TENDERER

OFFER OF CONTRACTOR

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

Sir,

I/We hereby offer to carry out the work detailed in Tender Specification No.BHEL:PSSR:SCT:1243 issued by Bharat Heavy Electricals Limited, Power Sector : Southern Region, in accordance with the terms and conditions thereof.

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

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

I/We have deposited/forwarded herewith the Earnest Money Deposit/a sum of Rs.**1,50,000/- (Rupees One lakh Fifty thousand only)** vide DD.No. Dt. which shall be refunded should our offer not be accepted. Should our offer be accepted, I/We further agree to deposit such additional sum which along with the sum of **Rs.1,50,000/- (Rupees One lakh Fifty thousand only)** mentioned above, to make up the Security Deposit for the work as provided for in the Tender Specification within the stipulated time as may be indicated by BHEL, Power Sector : Southern Region, Chennai – 600 035.

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

DATE: CONTRACTOR:

PLACE: ADDRESS:

Witness with their address

Signature Name Address

PROJECT INFORMATION

01	**Owner**	**Nuclear Power Corporation of India Ltd , KudanKulam (NPCIL)**
02	**Project Title**	**2 x1000 MWe Nuclear Power Plant**
03	**Location**	**KudanKulam Village RadhaPuram Taluk TIrunelveli Dt TamilNadu Longitude 80 degree 15' E**
04	**Power Station Site**	**Elevation above Mean Sea Level (MSL) 3.5 Meters**
05	**Nearest Railway Station**	**KanyaKumari or Valliyur 27 KM**
06	**Nearest City**	**North east of Kanyakumari -27 Km**
07	**Nearest Air port**	**Trivandrum – 100 Km**
08	**Road Approach**	**Available**

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

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

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

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

3.1.5 Completion of work in time.

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

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

3.2.0 FACILITIES TO BE PROVIDED BY BHEL:

3.2.1 OPEN SPACE

Minimum Open space for building of 1 No temporary office / store shed will be provided free of charges. Contractor has to make his own arrangements for labour colony.

3.2.2 ELECTRICITY

For construction purpose and for contractor's office and store sheds electricity will be provided at one single point **on chargeable basis**. (The current rate of **Electricity charge is Rs. 5/- unit and Rs.300/- per KVA/Month. The rate is subject to variation as levied by Project Authority or by TNEB)** Further distribution shall be arranged by the contractor at his own cost including supply of energy meter with calibration certificate.

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

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

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

The contractor has to maintain the Power Factor as stipulated by Customer, by providing suitable capacitor banks / equipment. Any levy or penalty for not maintaining the PF imposed by Customer will be proportionally recovered from the contractor.

3.2.3 WATER

For construction purpose, water will have to be arranged by the contractor at his cost. It may be noted that water is scarce at the Project site and is to be brought or arranged from other places. Any further distribution shall be arranged by the contractor at his own cost. For drinking purpose also the contractor has to make his own arrangement at his cost.

3.2.4 TOOL AND TACKLES

All the Tools & Plants and instruments required for the complete erection of components shall be arranged by the contractor. For Impulse pipe welding ,one number Orbital Welding machine will be provided by BHEL to the contractor, free of cost. (Please refer to Clause 6.2.4.6 for further details).

3.2.5 CONSUMABLES

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

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

3.3.1 CIVIL CONSTRUCTION

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

3.3.2 WATER DISTRIBUTION

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

3.3.3 ELECTRICITY DISTRIBUTION

Distribution of electrical power from the given single central common point to the required places with proper distribution boards, approved cable and cable laying including, supply of all materials like cables, switch boards, pipes etc. Observing the safety rules laid down by electrical authority of the State / BHEL / their customer with appropriate statutory requirements shall be the responsibility of the tenderer / contractor. Any duty, deposit involved in getting the electricity shall be borne by the bidder. As regards contractors office shed also all such expenditure shall be borne by the contractor. Necessary meters for recording consumption of power for cost calculation purpose and maintenance of the same during execution period shall be contractor's responsibility.

3.3.4 POSSESSION OF GENERATORS

As there are bound to be interruptions in regular power supply power cut/load shedding in any construction site due to inherent power shortage in State , suitable extension of time if found necessary only be given on this account and Contractor is not entitled for any compensation. It shall be the responsibility of the tenderer / contractor to provide maintain the complete installation on the load side of the supply with due regard to safety requirements at site. The contractor shall adjust his working shifts accordingly and deploy additional manpower, if necessary to achieve the target.

3.3.5 LIGHTING FACILITIES

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

3.3.6 POWER REQUIRMENT

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

3.3.7 CONTRACTOR'S OBLIGATION ON COMPLETION

On completion of work all the temporary buildings, structures, pipelines, cable etc. shall be dismantled and levelled and debris shall be removed as per instruction of BHEL, by the Contractor at his cost. In the event of his failure to do so BHEL will undertake such work and the cost of the same will be recovered from the Contractor including overhead charges. The decision of BHEL. Engineer in this regard is final.

3.4.0 GASES

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

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

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

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

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

3.5.0 ELECTRODES & FILLER WIRES

3.5.1 All required electrodes shall be arranged by contractor at his cost. It shall be the responsibility of the contractor to obtain prior approval of BHEL, before procurement regarding suppliers, type of electrodes etc. On receipt of the electrodes at site, it shall be subject to inspection and approval of BHEL. The contractor shall inform BHEL details regarding type of electrodes, batch number and date of expiry.

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

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

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

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

3.6.0 TOOLS & TACKLES

3.6.1 All T & P required for the satisfactory execution of work shall be arranged by contractor at his cost. As per clause 3.2.4. above, only Orbital welding machine will be provided by BHEL Free of cost.

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

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

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

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

3.7.0 SUPERVISORY STAFF AND WORKMEN

3.7.1 The Contractor shall supply all the skilled workmen like Welders, Gas cutters, electricians, Riggers, Serangs, Erectors, carpenters, fitters etc. in addition to other skilled, semi-skilled and unskilled workmen required for all the works of handling and transportation from site stores/storage yard to erection site, transportation, erection, testing and commissioning envisaged under this specification. Only fully trained and competent men with previous experience on the job shall be employed. They shall hold valid certificates wherever necessary.

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

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

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

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

3.7.5 The contractor's supervisory staff shall execute the work in the most substantial and workman like manner in the stipulated time. Accuracy of work, good workmanship and aesthetic finish are essential part of this contract. The contractor shall be responsible to ensure that assembly and workmanship conform to the dimensions and tolerances given in the drawings/instructions given by BHEL Engineers from time to time. Wherever finish or tolerances are not specified in drawings/documents, BHEL Engineers instruction are taken as final.

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

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

3.7.8 If the contractor or his workmen or employees shall break, deface, injure or destroy any part of a building, road, kerb, fence, enclosure, water pipes, cables, drains, electric or telephone posts or wires, trees or any other property or to any part of the erected components etc, the contractor shall make the same good at his own expense or in default, BHEL may cause the same to be made good by other workmen or by other means and deduct the expenses (of which BHEL's decision is final) from any money due to the contractor.

3.8.0 CIVIL WORKS

3.8.1 Foundations of all equipments and plants and necessary civil works shall be provided by BHEL. The dimensions of the foundation and anchor bolt pits shall be checked by the contractor for their correctness as per drawings. Further top elevation of foundations shall be checked with respect to bench mark etc. All minor adjustments upto 25 mm of foundation level, dressing, chipping of foundation surface enlarging the pockets in foundations and grouting of equipments etc. as may be required for the erection of equipment/plants shall be carried out by the Contractor. All the materials like cement, sand, gravel etc. and cleaning consumables shall also be arranged by the contractor at his cost. Wherever required, Special cement like CONBEXTRA-GP2 and SHRINKOMP N 30 etc or its equivalent grade cement for grouting of columns, equipments etc. shall be

arranged by the contractor at his cost. The contractor should also arrange required nos. of mixing machines and vibrators at his cost.

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

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

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

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

3.9.0 SCOPE OF MATERIAL HANDLING AND SITE STORAGE AND OTHER RESPONSIBILITIES

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

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

3.9.3 It shall be contractor's responsibility to arrange necessary cranes/tractors, trailor or trucks/slings/tools and tackles/labour including operators Fuel lubricants etc., for loading from storage yard and on to transport equipment, move it to erection site/pre-assembly yard and unload the same at pre-assembly yard/ erection site and the quoted rate shall include the same.

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

3.9.6.1 Any loss/damage to materials issued to contractor shall be made good by him or BHEL will arrange for replacement at cost recovery basis and decision of BHEL shall be final.

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

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

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

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

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

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

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

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

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

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

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

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

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

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

3.10.0 PRESERVATION OF COMPONENTS

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

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

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

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

3.11.0 DRAWINGS AND DOCUMENTS

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

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

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

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

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

3.12.0 SITE CLEANLINESS AND SAFETY REQUIREMENTS

3.12.1 Contractor shall strictly follow all safety regulations/conditions as per clause 2.15 and its sub clauses of general conditions of contract booklet enclosed with this tender, including specification of Health, Safety and Environment (HSE) management of customer / consultant.

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

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

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

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

3.13.0 PROGRESS OF WORK

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

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

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

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

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

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

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

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

SPECIFIC REQUIREMENTS FOR ISO 9001 - 2000

3.14.0 IMPORTANT NOTE

Contractors shall ensure that all their Staff/Employees are exposed to periodical training programme conducted by qualified agencies/ personnel on ISO 9002 Standards.

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

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

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

3.15.0 INSPECTION / QUALITY ASSURANCE / QUALITY CONTROL STATUTORY INSPECTION

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

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

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

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

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

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

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

3.16.0 STAGE INSPECTION BY FES / QA ENGINEERS

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

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

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

3.16.4 Any major Rectification or Major Repair / Major Rework of Defective work found out during stage Inspection verification / checking, But not attributable to contractor shall also be carried out. Claims of contractor if any, shall be dealt as applicable.

3.17.0 STATUTORY INSPECTION

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

All fees connected with the contractors for Testing his Welders/Men / Works and Testing, Inspection, calibrating his instruments and equipments, shall be paid by the contractor. It shall be contractor's responsibility to obtain approval of Statutory Authorities, Wherever Applicable, for the conducting of Any work which comes under the Purview of these Authorities. Any cost arising from this shall be contractor's Account.

However, BHEL shall pay all other Fees (FEES FOR VISITS, INSPECTION FEES, REGISTRATION FEES, ETC.) In case these Inspections have to be repeated due to Default/Fault of the Contractor and Fees have to be paid again, the Contractor shall have to bear the charges. These would be deducted from his Bills.

HSE SPECIFIC REQUIREMENT

OCCUPATIONAL HEALTH & SAFETY MANAGEMENT SYSTEM

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

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

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

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

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

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

SUB CONTRACTOR TO ENSURE COMPLIANCE OF THE FOLLOWING SAFETY RELATED POINTS

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

OTHER HSE REQUIREMENTS TO BE COMPLIED BY SUB CONTRACTOR

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

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

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

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

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

KUDANKULAM NUCLEAR POWER PROJECT

(2 X 1000 MWe) – UNIT 1

SECTION VI

CONTROLS & INSTRUMENTATION PACKAGE

SCOPE OF WORK AND SPECIAL CONDITIONS

6.1.0 GENERAL

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

Identification of equipments at M/s NPCIL storage yard, technical assistance for checking and making the shortage/damage reports, taking delivery at storage yard and pre-assembly of equipment wherever required, calibration, handling, transportation to site of work, erection, aligning, fastening, supporting, cleaning, checking, testing, along with the supply of materials and consumables, tools and tackles and testing instruments, as indicated and providing assistance for commissioning, troubleshooting, carrying out statutory tests as required, till completion of contract period.

6.1.2 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 shall be deemed to have been included in the scope of the work.

6.1.3 All the work shall be carried out as per instructions of BHEL/ NPCIL engineer. Decision of BHEL/ NPCIL regarding the correctness of the work and method of working shall be final and binding on the contractor.

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

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

6.1.6 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

6.1.7 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.

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

6.1.9 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. Loads of scrap 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.

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

6.1.11 All the instruments and hardwares will be supplied in various containers / wooden boxes along with the respective Mechanical Equipment. The contractor shall coordinate with the BHEL/ NPCIL Engineers/ respective Mechanical contractor to identify the same and shift to the place of erection, after making due store receipt voucher.

6.1.12 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.

6.1.13 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.

6.1.14 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.

6.1.15 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 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, subject to extra works clause.

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

6.1.18 The contractor shall, provide assistance for commissioning and trial run of the connected equipment under overall guidance of BHEL and shall locate any cause of malfunction and rectify any erection defects for proper operation. Testing shall also include any additional tests, which NPCIL feels necessary to meet statutory requirements.

6.1.19 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

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

6.1.21 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

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

6.1.23 If any item or equipment is not covered but requires to be erected/commissioned, the 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.

6.1.24 The quantity of various instruments/ hardwares indicated in the BOQ is approximate only. Payments shall be made on unit rate basis.

Note:

1. **The detailed scope of work for various items are covered under Clause 6.2.0 and the relevant sub-clause is indicated against each item in BOQ. The bidder shall go through all the clauses before filling the rate schedule.**
2. **For Erection & Testing procedures of various instruments / hardwares, refer section VII.**
3. **Before start of work the contractor shall obtain approval from customer for the erection procedure that is to be followed.**

6.2.0 SCOPE OF WORK

1. The scope of C&I works for equipments like Steam Turbine, Generator, Condenser, BFP and Condenser Tube Cleaning system covers installation of all instruments, Panels, JBs, racks, associated tubing and cabling upto JB/ cabinet supplied along with equipment, as detailed in the BOM
2. **For equipments other than those mentioned above, especially pipeline instruments, the scope of work is only installation of impulse tubing and welding from tapping points to Instrument Rack or Instrument.**
3. The Scope of C&I work is covered in the following packages /System.

    a. All Types of Field Instruments like Temperature, Pressure and Flow instruments (local & remote)

    b. All types of Control room mounted instruments

    c. PLC Systems

    d. Erection of Hardware like impulse pipes, trays & tray supports etc.

    e. Erection & Testing of instrumentation/ control cables upto JB etc.

    f. Turbovisory system Panels.

    g. Erection of light channels (perforated trays), structural material, etc. as detailed in BOQ.

4. EXCLUSIONS

The following are specific exclusions from this work

a. Erection of electrical actuators, HT/LT drives

b. Welding of thermowells, flow nozzles, orifice plates and control valves

c. Root valves on the instruments tapping points

d. Functionality check of instrument

e. Installation of pipe mounted instruments such as RTDs, Thermocouples, PGs, TGs etc., instrument racks for pipeline instruments.

NOTE:

The above exclusions are for general guidelines. However BHEL reserves the right to exclude or to include any other items which is not required/ 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.

6.2.1 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, & providing assistance for commissioning, loop checking and 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.

6.2.2 SCOPE OF WORK FOR INSTRUMENTS & CONTROL PANELS/CONTROL DESK:

6.2.2.1 The different types of Microprocessor based panels like PLC Panels, Instrument Panels, control panel etc. are covered in the scope of work for erection and commissioning assistance.

6.2.2.2 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 may have to be grouted on the concrete floor or have to be tag welded on the embedded insert plates.

6.2.2.3 The panels supplied for various control systems may have to be erected at various operating floors/ locations as per site layout. The contractor shall take the panels to the desired locations either through floor openings or temporary openings. No claims shall be entertained for taking the panels to the location owing to change of route or non-availability of openings as per nearest route.

6.2.2.4 All the panels and JBs shall be electrically earthed to the nearest earth grid by means of GI flat /wire.

6.2.2.5 The unit rate quoted for Installation of control panels, shall include 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.

6.2.2.6 The base frames shall 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 shall 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.

6.2.2.7 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.

6.2.2.8 Painting of fabricated parts and earthing conductors of panels shall be part of the work. Touch up painting for panels, if required, shall be carried out by the contractor within the quoted rate ..

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

6.2.2.10 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 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.

6.2.2.11 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%, rate 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.

6.2.3 **SCOPE OF WORK FOR INSTRUMENTS:**

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

i) All types of transmitters like temperature, pressure, flow, level 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) Panel mounted Instruments like indicators, recorder, electronic modules etc.

6.2.3.2 Prior to installation, all the Instruments (local & remote), thermocouples and RTDs, I/P converters, etc. shall be calibrated. Similarly, limit switches, flow switches, level switches, solenoid valves, etc. shall be checked for proper operation.

6.2.3.3 The unit rate quoted for each instruments shall include calibration, installation, and putting them into operation and providing assistance for commissioning, and troubleshooting till the end of contract period. In case any instrument requires recalibration to achieve the expected performance, the same shall be carried out at 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 no extra cost.

6.2.3.4 The instruments shall be supplied as loose items (as detailed in Clause 6.1.31) or as mounted on the main equipment. The scope of work will be identifying the material from the packages, calibration, erection and commissioning or Removal, calibration and refixing as the case may be. Irrespective of whether the instruments are supplied as loose or as mounted on the equipment, uniform rate will be applicable for E&C.

6.2.3.5 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 on extra works basis This activity is to be coordinated by contractor separately and the manpower for the above activities shall not be availed from commissioning manpower.

6.2.3.6 The unit rate quoted for erection of pressure/differential pressure transmitters, gauges, switches, I/P converters, position transmitter ,probes etc includes fixing the instruments on the racks / supports along with manifolds, and associated fittings and clamps. No separate rate shall be paid for various accessories associated with each instrument. 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 as part of supply materials by contractor as per BOQ. The unit rate shall also cover marking Tag numbers of instruments/Racks, either by paint or a separate tag plate as per BHEL Engineer's directive.

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

6.2.3.8 The unit rate quoted for erection of Casing temperature thermocouple shall cover laying, dressing and clamping, supply and fixing of tag plates, etc. Necessary supports for routing of thermocouples shall be arranged by contractor.

6.2.3.9 The unit rate quoted for erection and commissioning of temperature switches, gauges, thermocouple, RTD etc shall include cleaning of thermowells and inner threads, and supply and fixing of tag plates. For capillary type temperature Gauges suitable support shall be fabricated at site using steel plates and angles, and rates shall be on tonnage basis. The unit rate shall also cover marking Tag numbers of instruments, The tag plate shall be anodized aluminium size 15 x 100 x 1.5 mm tied securely by SS wire as per BHEL Engineer's directive.

6.2.3.10 The unit rate quoted for erection and commissioning of PH/conductively/H2 measuring instruments includes erection & integration of loose supplied items like sensors, Electronic items, sampling systems, coolers ,cables etc, and putting them into service.

6.2.3.11 Level switches supplied shall be of different types- float type or fixed contact type (Electronic type). The scope of work for float type Level switches shall include fixing of switches on float chambers and fixing of float chambers on stand pipe, providing supports wherever required etc. The scope of work for 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. Uniform unit rate shall be quoted for Erection and commissioning of various types of level switches, irrespective of their type.

6.2.3.12 Unit rate quoted for erection/commissioning of special instruments such as PLC system, PH/conductive/H2 measuring instruments, Vibration Monitoring System etc. shall include installation of all loose items which are not explicitly mentioned, but comes as part of the system, assistance for integration of total system. and putting them into service. Lump sum rate shall be quoted as mentioned in the BOQ. No separate rate shall be payable for loose items including furniture. The quantity of loose supplied items are approximate only. No proportional rate shall be applicable for any variation in quantity or for any additional items supplied as part of equipments.

6.2.3.13 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.

6.2.3.14 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.

6.2.3.15 Canopy shall be provided for field-mounted instruments as per site requirements. The fabrication and installation shall be done on tonnage basis as per rates in BOQ.

6.2.3.16 Any temporary protection by thermocol / polythene sheets / GI sheets shall be provided by contractor for safe guarding the instruments against damages. The protective materials shall be supplied at no extra cost by contractor.

6.2.3.17 Fasteners such as bolts, nuts, etc. for fixing of instruments and Anchor fasteners for fixing of supports hardware, wherever required, shall be arranged by contractor at no extra cost. Tentative quantity of fasteners required is given in Clause 6.10

6.2.4 **SCOPE OF WORK FOR IMPULSE PIPES:**

6.2.4.1 Stainless steel/ Carbon steel impulse pipes of different sizes and thickness shall be supplied along with accessories like condensing pots and siphons, coupling, sockets, root valves, drain valves, manifold, tees, bends, nut and tail piece etc.

6.2.4.2 Unit rate quoted for impulse piping shall include site routing, cold bending, fixing of all accessories like connector, Nuts and tail pieces, sockets, nipples, equal tees, couplings, root valves, isolation valves etc., fixing of manifolds and supporting with suitable fixtures and SS ‘U’ clamps as per BHEL/Customer specification. No separate rate shall be paid for the Impulse pipe fittings. The unit rate also includes supply of fasteners, Tag plates, as required..

6.2.4.3 Impulse pipes shall be supported on light channels (trays) and these light channels, in turn, will be supported using GI clamps as shown in the Reference drawing. Wherever required, angles and channels shall also be used for supporting light channels.

6.2.4.4 The supports shall be welded on the existing EP or fixed using Hilti/ Fischer anchor fasteners. The rate for fabrication and installation of support using angle and channel shall be paid on tonnage basis. The rate for fabrication also includes supply of paints and painting as specified in the painting clause, Supply of Hilti / Fischer anchor fasteners etc.

6.2.4.5 The unit rate for erection of light channel shall be on tonnage basis and the same shall include erection of all associated accessories like clamps, bends, base plates etc., as well as painting if required. Any fasteners like nut, bolts, anchor fasteners (Hilti/ Fischer make) required for erection of light channels shall also be supplied by the contractor at no extra cost.

6.2.4.6 Before commencing impulse pipe routing, the contractor shall obtain necessary approval for the routing / support arrangements from BHEL/ NPCIL.

6.2.4.6.1 Welding of impulse pipe shall be carried out using Automatic tube welding machine, without using filler wire, in Argon gas atmosphere, as per the approved procedure, by High Pressure welder to X ray quality. Welding machine shall be supplied by BHEL. The scope of work includes supply of Argon gas of purity 99.999%, qualified welders etc. **Regarding the scope of supply of T&P for orbital welding, the following shall be supplied by BHEL to contractor free of cost :**

1. Auto Tube Orbital Welding M/C and accessories-viz

- Cereated / Thoriated Tungsten Electrode, Tube centering Gauge, Arc Gap Gauge, Tube fixtures, welding Head, , Paper chart recorder with paper(consumables).

2. **Contractor to arrange at his Cost the following :**

- High Purity Argon gas (99.9993%) with regulator, Power supply, manometer, dentist mirror, marking tools, marker pen, deburring tools, emery paper, and Tube cutters, Tubesquaring M/C, squaring bits etc. for the orbital welding machine.

6.2.4.7 Unit rate quoted for welding shall be on Number basis and includes supply of consumables like gas and conducting necessary DPT and hydraulic tests. The scope of welding starts after the root valves of the tapping points, up to the end fitting of the instruments..

6.2.4.8 All equipment except orbital welding machines(Ref clause 6.2.4.6.1) , such as bending machines, Hydraulic testing pumps, DPT kits etc. required for erection and testing of impulse pipes shall be arranged by the contractor at no extra cost.

6.2.4.9 Wherever tube welding is not possible by Auto tube welding machine, manual welding (TIG welding) may be carried out with Argon gas atmosphere using approved welding electrode as per approved procedure. For manual welding, contractor shall arrange TIG welding sets, welding transformer/ generator and consumables such as welding electrodes/ filler wire, gas, tungsten rods at no extra cost. Before carrying out manual welding, contractor shall obtain prior approval from BHEL/NPCIL. The contractor shall obtain necessary approval for welding electrodes, from BHEL welding engineer at site and required test certificates shall be arranged.

6.2.4.10 The guidelines for routing and welding of impulse pipe, as given in Section VII, shall be strictly followed.

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

6.2.4.12 Hydraulic test shall be conducted for all impulse pipes after completion of erection as per site engineer's directive, at no extra cost.

6.2.4.13 The impulse lines shall be clamped with SS 'U' clamps.

6.2.4.14 As far as possible the pipes shall be prefabricated in fabrication shop. Each length of prefabricated pipe shall have the line number on it for proper identification.

6.2.4.15 The prefabricated pipe shall be bundled layer wise by using either SS strips wrapped with polythene sheets. Then this shall be transported to site.

6.2.4.16 Standard type stainless steel clamps shall be used to clamp the pipes.

6.2.5 **SCOPE OF WORK FOR COPPER/SS TUBES: (if applicable)**

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

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

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

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

6.2.6 **SCOPE OF WORK FOR JUNCTION BOXES/PUSH BUTTON BOXES:**

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

6.2.6.2 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 Anchor fasteners (Hilti/Fischer) as required for mounting the junction box/push button.

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

6.2.6.4 Welding of JB supports on the EP shall be strictly according to the existing welding procedure.

6.2.7 **SCOPE OF WORK OF PLC PACKAGE WITH RELATED INSTRUMENTATION:**

6.2.7.1 The scope of PLC system includes erection of sophisticated microprocessor based systems PLC panels, workstations, CRTs, printers, portable UPS, furniture and interconnecting cables like Ethernet/Fibre-optic and electronic earthing of the PLC panels etc.

6.2.7.2 Unit rate quoted for PLC system 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.

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

6.2.8 **SCOPE OF COMMISSIONING OF EQUIPMENT ERECTED BY THE MECHANICAL CONTRACTOR.**

6.2.8.1 ELECTRICAL (ALL TYPES OF DRIVES AND MOTOR OPERATED VALVES)-(if applicable)

a) Cable identification, checking and meggering.

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

c) Dry out all the motors if required to improve IR value.

d) Limit switch and torque switch setting

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

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

g) Attending to any defects till the contract period.

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

6.2.8.2 FLOW METERS/SWITCHES

a) Checking the calibration and servicing if required.

b) Setting the alarm value

c) Replacement of defective components if any

6.2.8.3 LIMIT SWITCHES & LEVEL SWITCHES

a) Checking the operation

b) Replacing defective components if required

6.2.8.4 SOLENOID VALVES

a) Checking the healthiness of coil

b) Checking the operation

c) Replacement of defective components if required.

6.2.8.5 TEMPERATURE ELEMENTS (MOTORS AND GENERATORS WINDING AND BEARING)

a) Checking the healthiness

b) Replacement of defective element (only for bearing)

6.2.8.6 PNEUMATIC CONTROL VALVES

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.

f) Attending to any defects till the contract period.

6.2.9 **SCOPE OF WORK FOR CABLES:**

6.2.9.1 NPCIL/ BHEL shall supply LT 1.1 kV power & control cables of armoured/ unarmoured, Copper PVC FRLS insulation, screened cables of different sizes and also special cables like Compensating cable, Ethernet cables and Fibre-optic cable. The scope of work for cables covered in this tender is as below.

6.2.9.2 The scope includes laying & termination of cables, fixing of glands, ferrules, tag plates etc., including dressing and clamping of cable.

6.2.9.3 Rates quoted for the cabling apart from above work shall also include supply of clamping materials (such as Aluminium/GI strips, PVC ties etc.), ferrules, tag plates, lugs up to 2.5 sq. mm., The technical specification for contractor's scope of supply shall be as detailed elsewhere in Section VI.

6.2.9.4 Cables shall be laid generally on light channels (cable trays). However, some of the cables may be routed through main cable trays. if the cables are to be routed through or laid in duct bank, conduits, cable shafts etc., the same unit rate shall be paid.

6.2.9.5 If Ethernet cables and Fibre optic cables are to be laid, the same shall be isolated from other cables and laid in a separate cable tray/conduits. Wherever required I/O Box shall be installed for Ethernet cable termination and punch down crimping tools shall be used for Ethernet cable termination. The unit rate quoted for Ethernet cables shall include fixing of I/O box also. Separate rate shall be applicable for laying of conduits.

6.2.9.6 All tools/ equipment required for the connections and termination of all type of cables shall be arranged by the contractor at no extra cost.

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

a- Enlargement of cable entry holes, if necessary, by chipping/tapping or any modification required fixing of cable glands

b- Drilling of gland plates of equipment if not done already.

6.2.9.8 While testing and commissioning, if the equipment to which the cabling is connected is observed to be not functioning, it is the responsibility of the contractor to check, establish and demonstrate, in close coordination with the commissioning agencies, that there is no defect in the cabling. The contractor shall depute his supervisor and workmen to assist the commissioning agencies to check the interconnecting cables.

6.2.9.9 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.

6.2.9.10 Most of the cables will be laid from the instrument to the Local JB. The approximate route length of the cables may be assumed as 20 Mtrs for the purpose of estimation.

6.2.9.11 Printed ferrules are to be used and necessary ferrules printer to be made available at site to improve the quality of job & save time & manpower.

6.2.9.12 The scope of termination shall include, termination of cables on various panels/ JBs/ Pushbuttons etc. installed by other agencies. The contractor shall co-ordinate with such agencies and do the termination, including drilling of gland plates for fixing cable glands, if required.

6.2.10 **SCOPE OF WORK FOR CONDUITS/ FLEXIBLE CONDUITS/ HOSE :**

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

6.2.10.2 The unit rate quoted for flexible conduit on metre basis includes drilling of holes on the plates, fixing of end connectors, providing suitable supports and fixing tag plates as required by BHEL. Supply of suitable clamps, fasteners and tag plates are covered in the unit rate.

6.2.10.3 In the case of flexible conduit end connectors, no separate payment shall be made for fixing the end connectors.

6.2.11 **SCOPE OF WORK FOR FABRICATION MATERIALS & STRUCTURAL STEEL:**

6.2.11.1 The fabrication works generally includes supports for instruments, impulse pipes, mounting frames for JB, Control Box/Panel, canopy for local instruments and local instrument rack (only for TG instruments) etc. wherever required.

6.2.11.2 The fabrication steel materials such as angles, channels, shall be supplied by BHEL free of cost to the contractor.

6.2.11.3 Fabrication & erection works include fabrication, cutting, welding , fabrication, installation of steel supports , trays, etc, minor chipping and grouting, painting and supply of paints and consumables, etc.

6.2.11.4 If nuts, bolts, anchor fasteners (Hilti/ Fischer) is required for fixing the racks or frames the same shall be arranged by the contractor no extra cost, as part of erection.

6.2.11.5 Wherever welding is carried out on GI materials, the welded surface shall be painted with zinc rich primer before going for regular painting. 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.

6.2.11.6 Supply of all cement, sand etc. if required for grouting of supports is part of the unit rate quoted.

6.2.12 **SCOPE OF WORK FOR PRE-FABRICATED INSTRUMENT RACKS (only for TG Instruments) & SUPPORTS**

6.2.12.1 Instrument racks and supports shall be supplied as prefabricated items of different sizes and the same shall be erected, grouted and painted.

6.2.12.2 The unit rate quoted for erection of above such pre-fabricated stands includes installation, grouting and painting, including supply of paints, nuts, bolts, anchor fasteners as required for fixing the racks

6.2.13 **SCOPE OF PAINTING:**

6.2.13.1 The scope of painting generally includes for all the steel fabrication works such as supports, racks, frames, canopy, impulse pipes etc.

6.2.13.2 The scope of painting includes supply of epoxy paints and primers (as specified in Clause 6.10) , consumables like brushes, emery papers, thinner etc.

6.2.13.3 The painting shall include two coats of Red oxide primer and two coats of final painting of epoxy paint of colour approved by BHEL/NPCIL.

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

6.2.13.5 Touch up paints generally requires for trays, control panels, junction boxes and full painting shall be required only for specific equipments as specified elsewhere in this document.

6.2.13.6 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

6.2.14 **SCOPE OF CALIBRATION AND TESTING:**

6.2.14.1 Contractor shall calibrate the instruments erected by him.

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

6.2.14.3 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/NPCL Engineer for his verification and approval.

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

6.2.14.5 BHEL shall provide vendors supports for proprietary type of instruments which require software loading and programmer etc. The contractor shall provide all supports like manpower, standard T&P, Instruments etc for calibration and testing of above proprietary type instruments

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

6.2.15 **SCOPE OF CIVIL WORKS**

Minor civil works like drilling, chipping, punching holes and brickwalls and grouting, for the works related to installation of Racks and supports as required are .These works shall be part of erection of above racks and supports and no separate payment is applicable. The scope also includes supply of grouting material.

6.2.16 **SCOPE OF EARTHING**

6.2.16.1 The scope of earthing covered in this contract is above ground earthing which covers earthing of panels, Instruments racks,, JBs and Branch trays, etc. to the nearest earth grid. After welding to the nearest earth grid, the welded portion shall be painted

6.2.16.2 The unit rate shall be quoted for earthing on meter basis. The rate shall cover supply of fasteners, lugs, minor civil works, painting the welded joint etc.

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

6.2.17.1 The scope of commissioning works covers commissioning of all instruments covered in the BOQ and providing assistance for establishing the operation of instruments /systems to meet plant commissioning/operation. BHEL shall provide vendor supports for proprietary type instruments and contractor engineers/supervisors shall associate with the vendors and provide necessary manpower, T&P etc.

6.2.17.2 Scope of commissioning starts with the commissioning of various instruments 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:

a. Trial run of various equipment.

b. Turbine barring gear.

c. Turbine rolling .

d. First synchronization of unit.

e. Full load operation of unit.

f. Performance guarantee test of TG

g. Gross load and net load rejection tests.

During the above activities contractor shall provide necessary assistance of man power and T&P till satisfactory results are obtained to the satisfaction of customer.

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

6.2.17.3 Wherever necessary Contractor shall provide assistance by employing commissioning engineers, supervisors including electricians/instrument mechanics to be associated with BHEL commissioning staff. Contractor shall earmark separate manpower for commissioning assistance 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

6.2.17.4 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. If at any time the requisite manpower, consumables, T & P are not arranged then BHEL shall make alternate arrangements and necessary recoveries with overhead cost shall be made from the bills of the contractor.

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

6.2.17.6 In case any rework/repair/rectification/modification/fabrication etc. is required because of contractor's faulty erection which is noticed during commissioning or 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 extra work clause covered elsewhere.

6.2.17.7 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 has to carry out the erection of the same. After completion of activities the temporary systems have to be removed and returned to stores. Claims if any, for such works from the contractor shall be governed by extra work clause covered elsewhere.

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

Engineer (Elec/C&I)	1 No.
Supervisor (Electrical)	1 No.
Supervisor (C&I)	1 No.
Technician (C&I/ Elec)	5 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.

6.2.17.9 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.)

6.2.17.10 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 shall 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.

6.2.17.11 The scope of commissioning shall also covers providing assistance for commissioning of the equipment/drives erected by the mechanical contractors. (as detailed in the BOQ)

6.3 TIME SCHEDULE

6.3.1 The contractor shall mobilise his resources and work force within two weeks from the date of telegraphic LOI , or in consultation with by BHEL site engineer for the commencement of work in such a manner that the entire C&I work covered in his scope is completed to match the following commissioning programme.

		UNIT I
1)	Barring gear	Nov 2007
2)	Synchronisation	June 2008

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.

6.3.2 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.

6.3.3 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.

6.3.4 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.

6.3.5 The entire scope of work erection, testing and commissioning shall be completed within **12 months** from the date of commencement of work as detailed in overall erection and commissioning programme.

6.3.6 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.

6.3.7 During the tenure of contract, if BHEL is not satisfied with the progress of work, BHEL have the right to withdraw any portion of work / balance work and get the same done through other agency at the risk & cost of the Contractor.

6.4 OVER RUN CHARGES

6.4.1 In case due to reasons not attributable to the contractor, the work gets delayed and completion time gets extended beyond 12 months from the date of commencement of the work, the contractor shall not be entitled for any over run compensation (ORC) for **a grace period of 2 months**. In case ORC arises, the same shall apply @ **Rs.40,000/- (Rupees forty thousand only) per month beyond 14 (12+2) months** as stated above duly taking into account the balance work at the end of that period.

6.4.2 The period of over run shall have to be ascertained before the commencement of grace period.

6.4.3 During the period of over run targets shall 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 shall be proportionately reduced.

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

6.5 MEASUREMENTS, WASTAGE & CUTTING ALLOWANCES:

6.5.1 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.

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

6.5.3 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.

6.5.4 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.

6.5.5 While carrying out material appropriation with contractor, all the above points shall 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) shall 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.

6.5.6 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.

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

6.5.8 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.

6.5.9 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	2
5.	GI pipes/SS&copper tube	1

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

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

6.5.12 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.

6.6 STORAGE

6.6.1 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.

6.6.2 The wooden pallet provided for packing itself can be retained for raised platform to protect equipment from ground damps, sinking into around and to circulate air under the stored equipment. This shall also help in lifting the packing wIth fort lift truck.

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

6.6.4 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.

6.6.5 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.

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

6.6.7 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.

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

6.6.9 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.

6.6.10 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.

6.7 TOOLS AND PLANT TO BE ARRANGED BY THE CONTRACTOR

6.7.1 Equipment, vehicles, tools and plants and materials brought to site by the contractor from his resources shall have distinctive identification marks and the contractor shall intimate the description and quantity to BHEL in writing.

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

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

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

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

6.8 TERMS OF PAYMENT

6.8.1 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**. 90 % of the value shall be paid –prorata -against progressive running bills as detailed below:**

6.8.2 FOR ALL TYPE OF INSTRUMENTS .

a.	Receipt, transport to erection site, assembly, checking, calibration, fixing and clamping Adjustment, Alignment, on pro rata basis	75%
b.	Pre-commissioning tests, checks, and making ready for energisation pro rata basis and protocol signed	15%

6.8.3 FOR PLC system and all types of control panels.:

a.	Receipt, transport to erection site Placement, assembly fixing and clamping Adjustment, Alignment, grouting and electrical interconnections on pro rata basis	75%
b.	Pre-commissioning tests, checks, and making ready for energisation on pro rata basis and protocol signed	15%

6.8.4 For Cable Laying & Cable Termination

a.	Laying /tagging /termination on pro rata basis	75%
b.	Checking/dressing on pro rata basis and protocol signed	15%

6.8.5 For fabrication and installation of Instrument Support Racks (ISS)

a	After fabrication &installation and applying of primer on pro rata basis	75%
b.	On completion of painting and protocol signed	15%

6.8.6 For supply, and erection of steel materials/ GI light channels

a	On fabrication &installation and applying of primer on pro rata basis	85%
b.	On completion of painting and protocol signed	5%

6.8.7 For 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%

6.8.8 For Impulse Pipes routing :

a.	On Laying on light channels with supports on pro rata basis	75%
b.	On Clamping and painting on pro rata basis and protocol signed	15%

6.8.9 For Impulse Pipes welding :

a.	On welding and Hydro test on pro rata basis	85%
b.	On charging on pro rata basis and protocol signed	5%

6.8.10 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 and protocol signed on pro rata basis.

6.8.11 5 % of the value shall be paid on submission and acceptance of Final bill , and on completion of pending points and submission of as built drawings/Protocols wherever required.

6.8.12 The last 5% payment will be released after completion of guarantee period.

6.9 GUARANTEE PERIOD

6.9.1 The 5 % payment towards guarantee shall be released after a guarantee period of **12 months**. The guarantee period shall **start from the date of handing over of the unit to Customer or 6 months from the date of first synchronisation of the unit, which ever is earlier.**

However this 5 % payment can be released against submission of a matching Bank Guarantee valid for the 12 month guarantee period from a Nationalised /Scheduled Bank in the prescribed proforma of BHEL. .

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

6.10 MATERIALS/ CONSUMABLES TO BE ARRANGED BY THE CONTRACTOR FOR ERECTION AND COMMISSIONING AS PART OF THE SCOPE AT NO EXTRA COST

6.10.1 Contractor shall arrange the following materials at no extra cost as part of erection rate.

6.10.2 All the materials with their reports shall be submitted to site Engineer for inspection prior to actual usage in the field

6.10.3 Quantity accepted thus shall be entered into log books maintained for the purpose duly countersigned by site engineer or his authorized representative.

6.10.4 Material found unacceptable shall be removed from the site immediately. Failing to act immediately, BHEL shall remove the material at the cost and risk of the contractor

6.10.5 Supply and installation of anchor fasteners (wherever embedded fasteners/ plates are not available) are in the scope of the contractor and will be considered as part of support and equipment erection. No extra payment will be applicable for supply and installation of anchor fasteners. Anchor fastener should be Hilti/ Fischer or any other make approved by Engineer or indicated in the drawing.

Sl. No	Description of Items	Recommended Make	App. Quantities
1	Anodised Aluminium tag Plates. Markings: Engraving/ Embossing/ Printing	---	3500 Nos
2	Anchor fastener M8 M10 M12	Hilti / Fischer	 2,000 Nos 1,000 Nos 500 Nos
3	MS Cadmium plated screws / bolts with Nuts and spring washers in sizes M5, M8 and M10	---	As required.
4	Polythene bags and sheets	---	As required.
5	Epoxy Paints	CF-641 of Asian Paints, GNP. HB Epoxy – ISC – 6 of Nerolac, Amerlok – 400 of Nerolac Emite Epoxy of Gareware 0.3-104 of Duco paint or any other approved brand.	As required.
6	Thinner	Suitable for the paint being uased.	As required.
7	Acetone (Lab grade)	---	50 Litres
8	PVC caps Suitable for the tube sizes.	---	As required.
9	NA		
10	Welding Electrode E 7018, 6013	Advani oerlikon, D&H Sechaeron, Modi Arc, Hanover electrode	As required.
11	NA		
12	SS shims 0.5/1 mm thick	---	As required.
13	Brass shims 0.5/1mm thick	--	As required.
14	2 mm dia nylon fishing thread	--	5 rolls of 30 mtrs
15	Lint free flannel cloth	--	75 mtrs
16	Soap solution	ICI, Lisapol NX3	40 litres
17	High purity Argon gas	Hydro gas	As required.
18	Emery papers	--	As required.
19	Tube welding Electrode – 2% Thoriated / cereated tungsten or approved type electrode.	As recommended by the welding machine manufacturer	As required.
20	Insulation tape.		
21	Teflon tape for GI pipe coupling.		

22	Solder wire (Lead) -(60/40)		
23	Panel Sealing compound material (for cable entry from bottom/Top of Panel).		
24	PVC cable tie, Aluminium or GI strips and fasteners for clamping of cables and other dressing materials required for cable dressing grommet		
25	Ferrules, sleeves for cables Colour of ferrules: Yellow/White Colour of engraving: Black		
26	Lugs upto 2.5 sqmm Solderless crimping type Material: Tinned Copper/ Aluminium Thickness of tinning: 10 microns Applicable Standard for LT Cables: IS:8309		
27	Binding wire		
28	Provision for Temporary Scaffoldings.		
29	Protocol/Calibration report sheets as per BHEL Format.		

6.11 SUPPLY, RECEIPT AND STORAGE OF MATERIALS SUPPLIED BY THE CONTRACTOR

6.11.1 Contractor shall arrange the supply items as per BOQ and the same is to be endorsed by BHEL Stores before taking for erection. BHEL's endorsement or Stores Receipt Voucher shall be submitted along with bills for payment of Supply Items.

6.11.2 The quantities given in the BOQ for Supply Items are indicative only. **The quantity to be supplied will be strictly as per site requirement only**, in consultation with Engineer- In-Charge. The payment will be made for the actual quantity supplied/erected only. The contractor shall consult the Engineer-In-Charge regarding quantity required before supplying the same.

6.11.3 Any excess materials supplied for which payment has not been made can be taken back by the contractor as per Customer procedure. For taking out balance surplus materials, the contractor shall have to furnish proof of entry of such materials inside the Plant Job Site and certification of customer in this regard.

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

6.11.5 Contractor shall arrange necessary material handling equipment for transporting supply items to stores and also for taking delivery from stores to work place at his cost.

6.11.6 The scope of supply materials mainly covers supply of light channels and structural steel for supports as per quantity indicated in BOQ. Light channels shall be used for routing of impulse pipes as well as routing of cables from instruments to JBs/ LCPs.

6.11.7 Refer Section VII for specification of light channels and structural steel.

6.11.8 All necessary test certificates, as per NPCIL requirement shall be submitted for the above.

6.11.9 Recommended make for Structural Steel (ISA, ISMC, ISMB, Plate, Flats etc.) for fabrication of supports/ brackets for light channel/ impulse pipe erection: TISCO/ SAIL

6.12 PRICE ESCALATION:

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

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

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

P0 = Billing amount calculated as per ate schedule

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

F0 = All India CPI published by Labour Bureau, Simla Government of India for Industrial workers (Base 2001- 100) applicable for the month of commencement of work.

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

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

6.12.4 PVC is not payable for 5 % payment applicable against final bill submission and 5% final payment towards guarantee period.

6.12.5 Payment of PVC shall be restricted to 10% of the contract value.

6.13 PROGRESS AND MONITORING OF WORK

6.13.1 It shall be 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.

6.13.2 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 CONTRACT VARIATION

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

6.15 EXTRA WORK CHARGES FOR MODIFICATION AND RECTIFICATION WORK

6.15.1 BHEL may consider payment for extra works on man hour 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 decision of BHEL in this regard shall be final and binding on the contractor. The contractor may submit his work claim bills specifically agreed by BHEL Engineer along with the labour sheet duly certified by BHEL engineer at site. But BHEL also got the option to get those work done through other agencies if they so desire.

6.15.3 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 shall 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 shall be applicable for modification/rectification work.

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

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 works are broadly defined as below:

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

6.15.9 However prior to carryout the repair/rework administrative approval with the estimate to be obtained by Site.

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

6.15.11 Transit storage and erection insurance repairing damages BHEL has an insurance cover, inter-alia, for C&I and piping under a transit and storage cum erection policy covering liability against damages/losses etc.

6.16 REPORTING DAMAGES AND CARRYING OUT REPAIRS.

6.16.1 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.

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

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

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

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

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

6.17 TAXES

6.17.1 Value Added Tax (VAT) for the works

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

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

In case the Bidder decides to include any VAT element along with the quoted price, they shall specify the value of VAT included in the quote, the rate of VAT adopted and also reason for such inclusion as additional information. If no VAT element isI included in the price, the same shall be indicated in the quote.

6.17.2 Service Tax

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

6.17.3 Other Taxes & Levies

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

6.17.4 New Levies / Taxes

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

6.17.5 Statutory variations

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

6.17.6 Direct Tax

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

6.18 IMPORTANT CONDITIONS FOR PAYMENT

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

1 PF Regn. No.

2. Labour License No.

3 Workmen Insurance Policy No.

4 Unqualified acceptance for detailed LOI

5 Initial 50 % Security deposit

6 Rs. 100/- Stamp paper for preparation of contract agreement

6.19.1 PROVIDENT FUND & MINIMUM WAGES

1. Contractor is required to extent the benefit of Provident Fund to the labour employed by him in connection with this contract as per the Employees Provident Fund and Miscellaneous Provisions Act 1952. For due implementation of the same, Contractor is required to get himself registered with the Provident Fund authorities for the purpose of reconciliation of PF dues and furnish to BHEL the code number allotted to him by the Provident Fund authorities within one month from the date of issue of this letter of intent. In case the contractor is e exempted from such remittance an attested copy of authority for such exemption is to be furnished. It may be noted that in the event of failure to comply with the provisions of said Act, if recoveries therefore are enforced from payments due to BHEL by the customer or paid to statutory authorities by us, such amount will be recovered from payments due to the contractor.
2. The contractor shall ensure the payments of minimum labour wages to the workmen under him as per the rules applicable from time to time in the state.
3. The final bill amount would be released only on production of clearance certificate from PF/ESI and labour authorities as applicable.

6.20 OTHER STATUTORY REQUIREMENT

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

2 The contractor shall submit first running bill along with copies of monthly wages (of the preceding month) u/r 78(a)(1) of Contract Labour Rules ,copies of monthly return of PF contribution with remittance challans under Employees Provident Fund Act 1952 and copy of renewed WC Insurance policy or copies of monthly return of ESI Contribution with Challans under ESI act 1948 (if applicable) in respect of workmen engaged by him.

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

4 The contractor shall submit copies of Final settlement of disbursal of retrenchment benefits on retrenchment of each workmen under ID act 1948, copies of Form 6-A (annual return of PF Contribution) along with copies of PF contribution card of each member under PF Act andcopies of monthly return on ESI contribution-Dorm 6 under ESI act 1948 (if applicable) to BHEL along with Final Bill.

5 In case of any dispute pending before the appropriate authority under ID act 1948, WC Act 1948 and PF Act 1952, BHEL reserves the right to hold such amounts from the final bills of the contractor , which will be released on submission of proof of settlement of such issues from the appropriate authority under the act.

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

6.21 DETAILS TO BE FURNISHED BY THE TENDERERS

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

2 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.

3 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.

4 HQ Organisation chart & Site Organisation Chart Covering various function

5 Month wise Manpower deployment plan

6 T&P deployment plan

6.22 DOCUMENTATION

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

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

3. As built drawings:

   After successful completion, testing and commissioning of installation work, all the E&C drawings/documents shall be updated in line with the actual work carried out and as built drawings/documents shall be submitted by the contractor as agreed for the project.

6.23 MANPOWER REQUIREMENT

6.23.1 The erection of equipments are to be carried out as per drawing and Russian standard. During erection, certain methods/ inspection may be different when compared to erection in other power plants. Certain technical requirements may have to be fulfilled as specified by the designers.

6.23.2 The contractor shall deploy man power as per the scope of work like Site in charge, Engineers/Supervisors/Technicians etc. Site In-charge shall have minimum one erection engineer with adequate supervisors and Technicians. Similarly commissioning Engineers also shall be identified separately for each package and the minimum requirement shall be as indicated in the Tender Specification Section VI. Besides the above, there shall be separate engineers for Planning, Safety and Quality. Site-In-charge shall be provided with a PC and good communication facilities.

6.23.3 Please Refer Appendix VI-A for more details regarding deployment of manpower.

6.23.4 The contractor shall also provide skilled manpower like Engineers/ Supervisors/ Technicians to carry out works that are not covered in his scope of work/ specified in the BOQ. The contractor shall quote rate on man month basis for such additional works, as called for in the rate schedule. This rate shall be inclusive of all standard T&P, test and calibration instruments etc as required for the works. The man month rates quoted will not be taken into account for evaluation of the offer but shall be an optional item .The lowest rate for this optional item shall be the contracted rate for the successful bidder for operation of this item.. The bidders shall take note of this aspect and quote accordingly.

6.23.5 Above such works shall be identified by BHEL/ NPCIL Engineers and a separate logbook indicating the nature of work, duration, date etc. shall be maintained, duly signed by BHEL Engineers. The format will be decided by bHEL Engineer.

6.23.6 In case any rectification/ modification is required for works that are already specified in the BOQ, then the extra charges as detailed in Clause 6.15 shall be applicable.

LIST OF RECOMMENDED INSTRUMENTS FOR E & C

SL NO	DESCRIPTION	QUANTITY
01	Dead Weight tester rated 250 Kg/Sq.cm with weights & test gauges facility	01 No.
02	Oil temperature bath suitable to calibrate upto 400 Deg C	01 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 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 400 Deg C	02 No.

SL NO	DESCRIPTION	QUANTITY
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	Portable air compressor with drier and regulator rated for 10 Kg/Sq.cm	01 No.
09	Vacuum pump with standard vacuum gauge	01 No.
10	Standard Milliamps Source (Digital)	02 Nos.
11	Standard Millivolts Source (Digital)	01 Nos.
12	Mercury Manometer different range	04 Nos.
13	DC Power Supply , 24 V ; 5A	03 Nos.
14	Single Phase Variac 250V; 10A	01 Nos.
15	Glass Thermometers of ranges in Deg C as below : 0-120 ; 0-200; 0-600	02 Nos. (Each)
16	Tong tester AC 5/10/25 ; KEW Snap Make	01 No. (Each)
17	Function Generator	01 No.
18	Hand Operated Megger 500V ; 2.5 KV / 100 M Ohms	Each type As required
19	Torque wrench	As required
20	AC Voltmeter 0-125 ; 250 ; 625V	01 No. (Each)
21	AC Ammeter 0-2A ; 10A	1 No. (Each)
22	Analog Multimeter Motwane Make	031 Nos.
23	Digital Multimeter 3 1/2 Digit	04 Nos.
24	Digital Multimeter 4 1/2 Digit	02 Nos.

6.24 LIST OF TOOLS & PLANTS TO BE ARRANGED BY CONTRACTOR

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	Ttube 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 with energy meter	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

6.25 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
		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%
04	Hand operated Megger 500V/1000V	Upto 200 m Ohms	± 5% at Centre scale
05	Standard Pressure Gauges	0 to 1 kg/Cm^2	±0.25% Lc–0.02 kg/cm^2 10”
		0 to 10 kg/Cm^2	±0.25% Lc–0.02 kg/cm^2 10”
		0 to 25 kg/Cm^2	±0.25% Lc–0.25 kg/cm^2 10”
		0 to 60 kg/Cm^2	±0.25% Lc–0.1 kg/cm^2 10”
		0 to 250 kg/Cm^2	±0.25% Lc–2.5 kg/cm^2 10”
		0 to 6 kg/Cm^2	±0.25% Lc–0.1 kg/cm^2 10”
06	Dead Weight Tester	0 to 400	Lc – 5 kg/cm^2

07	Standard Hg in glass Thermometer	0 to 100^0C	Lc - 1^0C
		0 to 110^0C	Lc - 1^0C
		0 to 250^0C	Lc - 1^0C
		0 to 150^0C	Lc - 1^0C
		0 to 360^0C	Lc - 1^0C
		0 to 420^0C	Lc - 1^0C
08	Single Phase Variac	15A Capacity	N/A
09	Power Pack	0 to 50V DC, 3A	$\pm$ 2%
10	Vibration Measuring Equipments	Velocity upto 50 mm/sec.	$\pm$ 0.5% mm/sec
		Displacement upto 300 microns	$\pm$ 2 microns
11	a) Tongue tester	0/300/600A AC	$\pm$ 5%
	b) Tongue tester	0 to 300A DC	$\pm$ 5%
12	Tacho Meter (Hand held	0 to 4000 rpm	$\pm$ 5%
13	Phase Sequence Meter		N/A
14	Earth Megger (Tester)	0 to 1, 10, 100 Ohms	$\pm$ 5% at Centre Scale range
15	DC Ammeter	0 to 300 A	$\pm$ 10%
16	DC Voltmeter	0 to 500 V	$\pm$ 10%

6.26 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 shall 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 shall 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 shall 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 Erection Engineers for Planning/ Safety	
03	Supervisors a. Impulse line b. Welding c. cabling d. panels e. 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 shall 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 shall have to be arranged by the contractor for meeting various schedules/targets set by BHEL without any additional compensation.

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

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

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

CALIBRATION RECORD OF SUB-CONTRACTOR'S INSTRUMENTS

Name of Site :

Name of Sub-contractor :

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

SIGN OF SITE CIC

7.1.0 GENERAL GUIDELINES FOR INSTALLATION OF C & I EQUIPMENTS

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.

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

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

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

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

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

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

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

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

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

11. Compensating cables should be connected directly to instruments, i.e. no junction boxes shall be used.

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

13. 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.

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

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

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

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

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

19. 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 PROCEDURE FOR INSTALLATION OF INSTRUMENTS

1. Purpose:

To provide guidelines for installation of various instruments,

i. To meet the design intent,

ii. To ensure proper workmanship.

iii. To ensure proper maintainability. '

2. Applicability:

This procedure is applicable to all instrumentation installations. In case manufacturer instructions are available and found to be more stringent, the same shall prevail.

3. Responsibility:

Responsibility of implementation of this procedure lies with Instrumentatio Package Contractor.

4. Reference:

i) Instrument catalogues.

ii) Manufacturer's instruction manuals (MI).

iii) Standard practice followed in Nuclear Power Plant

5. Prerequisite:

Instruments. Drawings, Instrument Support Stands, Field Panels. Drill / Hammer, Drill machine, Cinch Anchor / Hilti bolts. all fastening hardwares, Structural steel for support fabrication. Tag plates. Hydraulic sealants, Teflon tape. Polyethene cover bags. Epoxy paints. Acetone. Thinner, PVC lugs and caps, PVC. Tape, Ring and Plug gauges. Tap sets & Toolbox.

6. Description:

Transportation of Instruments:

a. Before collecting an instrument from the stores, Contractor shall check for

- Model and Tag No.
- Any physical damages;
- Completeness of the accessories as per purchase order / Suppliers Instructions.
- Calibration label on the body of instrument. Instruments that do not have such label or observed with deficiencies / damages, if any, should be brought to the notice of the Engineer immediately.

b. Instruments shall be transported with their original packing from the stores to work site carefully. In rainy season, polythene cover shall be put on the items being transported.

c. After unpacking at the work site, packing material shall be disposed of as per the instructions from Engineer.

d. Supplier's instruction manual if any received along with instrument shall be handed over to the Engineer.

e. All threaded openings of the instruments shall be protected by suitable plastic plugs or caps.

f. Instruments shall be covered with polythene bags except during work on the instruments.

g. All the instruments shall be tagged as per drawing with an instrument number punched on an Anodized Aluminum tag of size 15 x 100 x 1.5 mm. tied securely by SS wire.

Installation of Instruments:

a. Common Specification for Installation of Instruments:

Instrument Support Stands (ISS) / Field panels and brackets shall be transported to the location as shown in the drawings or as decided by the Engineer and shall be installed on floors, RCC columns and walls as classified below.

b. Safety Related:

- By welding with EP structures.
- By M 10 or HSC Hilti bolts.
- By bolting to typical Instrumentation EPs provided in RB especially for instrument installations, having provision for bolting of 4 nos. Ml 6 bolts. On these EPs, items shall be installed using bolts only, welding, is not permitted.

c. Non Safety Related:

- By welding with EP / structures.
- By M10 or ½ anchor fasteners.
- By bolting to typical instrumentation EP's provided in RB.

d. Qualified welders as per approved procedure shall do welding on EP/ structures. After welding, the slag on weld surface shall be removed and one coat of self-priming epoxy paint shall be applied over the weld and near by affected surface.

e. Small support brackets required for the installation of any instrument If not supplied along with instruments shall be fabricated as per technical specification and shall form part of instrument installation.

f. All the required precautions, supplier's instructions and instructions mentioned in the drawings shall be strictly followed during installation.

g. Instruments shall be so located that they are as far as possible near the process point and easy to approach for operation and maintenance.

h. All indicating instruments shall be so located that their scales are conveniently visible to plant operator.

i. Instruments shall not be supported on the impulse lines, handrail or other removable or vibrating structures.

j. NPT threads of instruments shall be checked with ring and plug gauges in the shop & corrected by thread taps if necessary.

k.

Transmitters:

- Transmitters shall be mounted on the ISS or on panels as shown in drawings or as per the instructions given by the Engineer.
- All the precautions required as per Supplier's instructions and instructions mentioned in the drawings supplied by the engineer should be strictly followed during the installation.

Pressure Gauges:

- Pressure gauges are to be installed as per drawings directly on the pipe stand or with the help of suitable bracket on structure' column or as per the instructions given by the Engineer.

- Blow out disc if any at the rear should not flush against the wall or other flat surface.

- Gauge should be mounted such that its scale is conveniently visible to plant operator.

Pressure Switches:

- Pressure switches are to be installed as per drawing or sketch supplied by the Engineer.

- Pressure switches shall be mounted such that its cover can be removed without obstruction and there will not be any problem in glanding the cable later on.

Solenoid Valves:

- Solenoid valves shall be installed near the Control valve / related equipment as decided by the Engineer on support brackets by 2 Nos. Cadmium plated bolts, nuts and washers. Coil of the valve' shall remain in vertical position. Sufficient space should be left around the instruments for installation and removal of pipe and pipe fittings.

- Pipe connected to exhaust port shall point downwards.

- Spare port should be plugged.

Three Way Valve Manifolds:

- Directly mounted type of 3-way valve manifolds shall be installed directly on the Transmitters by removing the process shoes from the Transmitters.

- Supplier's instructions regarding "0" rings, tightening of bolts etc. shall be followed strictly.

- Separately mounted type 3-way manifolds shall be installed on the bracket with the hardware supplied as per the drawing or as per the instructions given by the Engineer.

- All the threaded openings shall be protected by suitable plastic plugs or caps.

- Sufficient space should be left around the instruments for easy maintenance.

Isolating Valves:

- NPT Brass CS valves used as isolating valves, drain valves shall be screwed with suitable fittings; on the instrument or installed with the help of suitable bracket and clamp.

- Threads of the valves shall be thoroughly cleaned of all foreign matter, oil, grease etc. Any thread that has become burred or deformed shall be repaired prior to assembling the joint.

- Prior to installation, threads shall be covered with one layer of' Teflon tape with a minimum of overlap. Tape shall be applied to male threads only and shall not project beyond the thread. When joints are removed, old tape shall be removed before reapplication.

- Sufficient space should be left around the instruments for installation and removal of pipe and pipe fittings.

Electro Pneumatic Signal Converters (E/P Converters):

- E/P Converters shall be mounted on the instrument mounting stands as per ES drawing or as per the instructions given by the Engineer.

- All the precautions required as per Suppliers' instructions and instructions mentioned in the drawings supplied by the Engineer shall be strictly followed during the installation.

Pressure Regulating Valves (PRVs)

- Pressure Regulating Valve shall be installed such that its drain point is at bottom.

Snubbers :

- These are installed either for Pressure gauges or Pressure switches. Most of the snubbers are direct on-line mounted between process take off point and the Instrument.

Conductivity Elements (KEs) :

- This instrument is used to sense the conductivity of the fluid and will be inserted in the pipe line like Thermowell. While installing due care shall be taken to protect the tip.

Air Manifolds :

- 50mm dia X 450 mm long air manifolds as shown in drawings shall be installed at locations as per the layout drawings or otherwise decided by the Engineer with "U" clamps, nuts and washers on two number "L" shape brackets such that drain point is at the bottom. "L" shape brackets shall be mounted on wall, column etc. by using 38" Anchor fasteners or on the steel structures by drilling suitable holes and using 3/8" bolts, nuts and washers.

Temperature Gauges:

- Temperature gauges with capillary & bulb shall be installed as per drawing with the help of suitable brackets on the stand or on the nearby structure or as per the instructions given by the Engineer.

- Temperature gauge shall be mounted such that its scale is conveniently visible to plant operator.

- Capillary pipe shall be carefully straightened by hand or using a Rubber mallet before laying. It should be laid carefully and there shall not be any sharp bend. It shall be clamped at 0.6 m intervals and near bend points with suitable clamp and shall be protected by installing light channel. Excess length shall be coiled at the end near the gauge and damped.

- Bulb of the capillary pipe shall be inserted and screwed in Thermowell such that its tip Ls in contact with the bottom of the Thermowell.

- After installation front glass shall be protected by suitable cover of Thermocol or GI sheet.

Level Gauges, Condensing Pots etc.

- Level gauges and condensing pots shall be installed as per the drawings or as per the instructions given by the Engineer.

Surface Mounted RTDs:

- The surface mounted RTD's are supplied with quick connection disconnection type snap action clamps.

- Clean the surface where RTDs are to be installed using acetone and emery paper to have a smooth finish of the surface to have a firm RTD contact.

- Install the RTD and its clamp.

- RTDs cable shall be laid and clamped rigidly.

- The RTDs cable shall be straightened properly after the clamp to avoid any tension on the RTD clement which may lead to improper contact with the feeder surface.

- The RTDs cable shall be physically separated from the pipes and feeders.

7. Acceptance Criteria:

Identification tags, Fasteners duly locked out and tightened to required torque, adequate supporting and good quality workmanship.

8. Records:

Job shall be offered to QA in enclosed format.

9. Precaution:

All the drawing mentioned in this procedure shall be checked for its latest frozen revision.

Handling of instrument shall be done in such a way that it is protected from water, dust and mechanical damages.
After installation proper protection shall be provided.
Instruments with glass cover viz. PG, TG etc. shall be protected with Thermocol cover or GI sheet.
Instrument shall always be kept covered with Polythene bags sheet.

7.3.0 PROCEDURE FOR INSTALLATION OF PANELS, JUNCTION BOXES AND INSTRUMENT SUPPORT STAND

1. Purpose:

To provide guidelines for installation of various panels, JBs, Instruments Support Stands

i. To meet the design intent,

ii. To ensure proper workmanship,

iii. To ensure proper maintainability.

2. Applicability:

This procedure is applicable to all Instrumentation installations.

3. Responsibility :

Responsibility of implementation of this procedure lies with Instrumentation Erection Package Contractor.

4. Reference :

i) Drawings,

ii) Standard practices followed in Nuclear Power Plants.

5. Prerequisite:

Panels, JBs, Terminal blocks its rail and fixing screws, ISS, Drill Hammer, Drill machines. Cinch Anchors Hilti bolls, Brackets for JBs, Fork lift (can be hired) Chain pulley. Uncrating tools. Crowbars, Rollers, Measuring tape. Plum-bob, Water level, Spirit level. Welding machine and Electrodes, Applicable drawings, Epoxy paints and Blush, Polythene covers / Tarpaulin / GI sheet for protection from dust water.

6. Description:

Installation of Panels

(a) The panel shall be transported from stores to unloading bay in the vertical position. Care shall be taken such that the switches, lamps, instrument mounted on the panel will not get damaged during transit.

(b) In the unloading bay the panel shall be unloaded after providing adequate sling arrangement so that there will not be any damage during unloading.

(c) Uncrating: During uncrating proper tools shall be used to remove the nails and any packing slip should be taken in possession for future reference. Packing material should be deposited back to Central Store.

(d) Proper sling arrangement should be made to lift the panel in vertical position and while putting the sling adequate care should be taken for any damage for the instruments mounted on the panel. Wherever required packing should be provided.

(e) Unload the panel near to the working area carefully.

(f) Shift the panel by using rolling support or Hydraulic Fork lift to the location where the panel is to be Anchored/ welded.

(g) Refer the GA drawing for the location where the panel is to be installed and mark the location on the floor/wall as applicable with respect to the reference column Shown in GA drawing. If there is any deviation in the EP provided and the GA drawing dimensions, bring it to the notice of FE and QA.

(h) Shift the panel to the marked location and cross check for its location.

(i) Check the verticality of the panel with the help of spirit level/ Plumb bob and if deviation is observed suitable shims may be provided.

(j) Do the welding at all the four columns. Again check for location and verticality if small deviation is there repeat the step h & i. After alignment, tack welding can be changed to stitch welding. Welding should be as per IS-816 and ASME SECTION - IX and should be done as per procedures welder qualified by QA

(k) Wherever EP is not available Panel is to be anchored by Maxi bolt. Hilti bolt.

(l) If EP is not flushing with the floor i.e. sunk from the floor level a structure of similar size will be welded to EP and the panel will be welded on to the new EP.

(m) Check-list which is enclosed with this procedure may be completed for record.

Installation of Junction Boxes:

(a) Prior to installation of JB in field, terminal blocks are to be installed inside JB as follows.

Assemble the terminal on rail in 20's and 50's and make a terminal block. Terminal Blocks (Radiation Resistant type and Non-Radiation Resistant type) for JBs are Rail Mounting type. Fixing of Terminal Blocks shall include sizing, cutting and fixing of Mounting Rail/Channels (including supply of Cadmium plated hardware like bolt (screw) and washers etc. of required size). fixing of Terminal Blocks (clamp-on stackable type), end clamps and end plates on mounting rails/channels as required. For details of Terminal Blocks and accessories refer the relevant specifications.

In 20T and 50T JB having single row Terminal Block, the Trunk or field cable entering from bottom shall be terminated to the right hand side of the Terminal Block and the field cable shall be terminated to the left hand side of the Terminal Block.

In 100T and 200T JBs there are two rows and four rows respectively and the first two rows are considered as one pair and the second two rows are considered as second pair. Trunk cables entering from bottom shall be terminated to inner side of the two rows and field cables entering from sides are connected to the outside of the two rows.

Generally JBs are installed on wall, column, permanent structure or on JB stand on the floor. To the extent possible the center of JB shall be maintained at 1.5 meter above the floor elevation. Or the permanent structure is the case may be and shall have at least 4 inch space between JB and wall structure after installation.

Generally Anchor Plate EPs have been provided in Walls/columns at required locations in entire Plant. JB Mounting Brackets shall be welded to these EPs. Wherever EPs with suitable spacing are available, mounting brackets shall be directly welded to EPs. Where the EPs are not suitably spaced or EPs are of smaller size (i.e. at locations where required spacing between the mounting brackets for fixing of JBs cannot be achieved by direct welding to EPs) additional M.S. Flat suitable size shall be welded to these M.S. Flats.

Mounting brackets can be installed with the help of Cinch Anchors / Hilti bolts of required size only at locations where no EPs are available.

Welding shall be strictly according to the existing welding procedure for load bearing structure IS-816 and ASME Section-IX under supervision as per QAP.

Floor mounted JBs are required to be installed on free standing structure fabricated as per JB support stand details enclosed in tender drawings.

JB number shall be provided on the front cover either by engraved number plate or by painting the number with suitable colour.
Check list which is enclosed with this procedure may be completed for record.

7. Acceptance Criteria:

Good quality workmanship, proper support & anchoring / welding, identifications.

8. Records:

Job shall be offered to QA in enclosed format.

7.4.0 INSTALLATION OF TUBING AND IMPULSE PIPING

1. S.S. / CS impulse pipes / tubes shall be inspected at the time of transportation, storage, cleaning, fabrication, erection as per the QAP.

2. Impulse pipe installation includes laying of impulse pipes from the piping take off points upto the field instrument rack / field including installation of all impulse line components such as isolation valves, control valves, tees, fitting etc. and their welding including the final welding prior to instrument isolation valve in the field rack / field instrument.

3. Wherever required, tubes shall be jointed by butt – welding. (As per PNAEG-7-009-89) Butt welding shall be carried out at valve ends, tube to tube joints, tube to tee joints and Tungsten Arc welding process without adding filler wire, in Argon atmosphere by means of Auto Tube welding machine through qualified welder as per approved welding procedure. Each welding machine requires 2 nos. Argon gas (moisture free, 99.999%) cylinders simultaneously, one for Arc welding and another for backup gas.

4. After initial qualification of welding machine, the welding machine is to be qualified before every shift on the basis of sample welds made.

5. All welds are to be identified with number and records are to be maintained. The same shall be transferred to the as built information also.

6. Recorder is connected to record the weld current. The record of weld current as obtained with weld no. and date of weld made is also required to be maintained. Such records are also required for daily qualification of welds.

7. All fabrication and erection of pipes shall be as per NPCIL specifications. Pipe welding shall be carried out as per weld procedure approved by NPCIL as per the relevant GOST standards specified in the working documents.

8. Bending shall be done using formed “dies”. “Compression” bending shall be used for thick wall pipes and large radius bends. “Draw” bending shall be used for thin wall pipes and small radius bends. Hot bending is not permitted. At any section of formed pipe, the wall thickness shall not be less than 87.5% of the nominal wall thickness.

9. Wherever, weld joints are specified, NPCIL approved weld procedure / GOST standard specified in the working documents shall be followed.

10. In bolting of gasket – flanged joints, the contact faces of the flanges shall bear uniformly on the gasket and gasket shall be properly compressed in accordance with the design principles, applicable to the type of gasket used. Torque wrenches shall be used for tightening bolts to ensure controlled tightening.

11. All the tubes shall be identified by passing the air from one end before making final weld joints.

12. All the impulse lines shall be pneumatically and Hydrostatically (Helium Leak Test, if specified) tested along with the testing of main system piping, after disconnecting the instruments. Installation and pressure test jobs shall be offered by the Contractor to QA in prescribed format / check list. In case it is not possible to test impulse lines with main system, arrangement shall be made to carry out the pressure test independently.

13. Impulse tubes shall have minimum continuous slope of 1/20 from tapping point to the instruments or as given in the working documentation.

14. Typical impulse tubing layouts for different types of instruments are provided in the enclosed drawings. Sufficient slack length (minimum 0.5 meters) shall be provided at the instrument end of tube to facilitate rework required if any. Free ends of tubes at the instrument end shall be sealed with caps to prevent entry of dirt / foreign materials.

7.5.0 WELDING OF SS/CS IMPULSE PIPE/TUBES WITH AUTO TUBE WELDING MACHINE:

1. For make straight joints in SS/CS impulse pipes/tubes, laid for instrument process hook – up, welding is to be done using Automatic Tube Welding Machine without filler metal. Refer the procedure is detailed elsewhere in this document..

2. High purity argon gas, electrode, and all other consumables required for carrying out the welding shall be in the contractor scope of supply as part of tube laying.

3. Wherever tube welding is not possible by Auto tube welding machine, manual welding may be carried out with Argon gas atmosphere using approved welding electrode as per approved procedure

4. TESTING:

   The work covered by this contract shall be subjected to inspection and testing. The contractor shall provide all services to establish and maintain quality of workmanship in his works to ensure the mechanical of components, compliance with drawings, identification.

   Among other tests, test procedure shall also cover the following:-

   Mechanical Inspection: Installation practices of Pipe/Tube/Equipment shall be carried out as per the approved drawings. Inspection shall conform to the approved standards / requirements given in the approved working documents.

Pneumatic testing and Hydro testing of the instruments installed shall be carried out along with the testing of main system piping.
The Contractor shall attend all test or inspection as called upon by the Engineer and shall supply such labour as may be required to assist in the execution of the various tests and shall without delay, rectify and make good without any extra cost to NPCIL any of his work which does not satisfy the requirements of any such inspection and or tests.
The contractor shall assist the Commissioning Engineer or his representative in the inspection and testing of the various installations for final commissioning of system.

7.6.0 PROCEDURE FOR SS/ CS IMPULSE PIPE/ TUBE CLEANING, STORAGE, LAYING AND FABRICATION

1. **Purpose:**

   This procedure describes the method of Handling, Transportation, Cleaning, Fabrication, Laying, Clamping and Testing for S.S. Pipes to be used for process hook-up of Instruments.

2. **Applicability**:

   This procedure is applicable to Instrumentation Erection Work.

3. **Responsibility**:

   Responsibility of implementation of this procedure lies with Instrumentation Erection Package Contractor.

4. **Personnel**:

   All personnel performing various piping works shall be duly qualified meeting the pipe laying work requirements.

5. **Reference**:

   1) Standard practices followed in Nuclear Power Plant.
   2) Manufacturers Catalogue for Seamless austenitic stainless steel piping.

6. **Pre-Requisite:**

   S.S. Pipes, S.S. / Brass Shims, Nylon fishing thread of 2 mm dia., Acetone (Industrial Grade). Lint free flannel cloth. Scissors, Shim cutters. Pipe storage racks. Pipe cutters. Pipe benders, Pipe clamps, Spacers, M5 screws, Nut & washers. Installed light channels and supports, Process tapping points, Tag plates & S.S. wire, Plastic caps, Stickers, Marker pens, 1mm thick Polythene sheet, Ladder and Scaffolding, Soap solution and Spray bottles.

7. **Description**:

Transportation And Cleaning of SS/ CS Pipe.

SS/ CS Pipes are available in 6-8 m length and are to be stored in covered shed. Transportation of these shall be carried out in Aluminum PVC fixture to

avoid sagging and bending of the mill length pipes by 3 or 4 persons or in any other suitable way so that pipes do not appreciably sag, and shall not be subjected to scratch. Handling of S.S. Pipes should be properly supervised to avoid the above mentioned pitfalls. Lint free flannel cloth, usually available in 1 mtr. width roll, should be cut into square pieces of 30mm x 30mm size (approx.) Pipes shall be cleaned with lint free flannel cloth dipped in Acetone and pulled through the pipe, using Nylon thread 3 or 4 times or till all dirt/dust is removed to the satisfaction of the Engineer. As a check for thorough cleaning of pipes, a lint free cloth shall be pulled through the pipe and it shall come out clean. This is to be done in presence of the representative of Engineer. Outer surface of the pipes shall be cleaned by rubbing the pipes manually with lint free cloth soaked in acetone. Cleaned pipe shall be capped tightly all the time. Stickers shall be put on cleaned pipe, for identification. THESE STICKERS IDENTIFICATION SHALL BE REMOVED ONCE THE PIPES ARE LAID IN POSITION.

Cleaned Pipe Storage

Cleaned pipes shall be stored on properly established pipe storage racks. While storing, the pipes shall be supported at intervals not exceeding 1.75 Mtrs. Also the S.S. Pipes should not come in contact with any M.S. items of storage racks. M.S. parts of racks shall be covered with Polythene sheets or any soft material viz. Plywood, Thermocol etc. Clean room condition shall be maintained in the storage and prefabrication area.

Fabrication and Laying of S.S. Pipe

S.S. Pipe shall be laid as per the applicable drawings. Drawing shall be used only for guidance and detailed routing shall be finalized in consultation with the Engineer. Changes made shall be incorporated in the as built drawings.
Prior to undertaking actual execution a pipe layout diagram shall be prepared to determine the number of pipes in the pipe bundles, then length and location of pipe joints. Proper care shall be taken to minimise the pipe wastage during fabrication and laying of pipes. Care in determining the pipe run will save time and possible re-running at later date. While finalising the routes, care should be taken for possible physical damage, which can occur due to inadvertent working of individuals over it, falling of heavy material or using them as support for climbing.

As far as practicable pipes shall be prefabricated in the fabrication shop. The fabrication shop shall be clean and dust free and polythene sheets shall be spread wherever pipes are handled.

Pipe cutting shall be carried using approved brand of Pipe cutters. Pipe cutting shall not create any flattening or ovality of piping at the point of cutting.

Approved brand of pipe benders of appropriate size shall be used for bending of different sizes of pipes. Table is given for minimum bending radius for different sizes of pipes. Brand of Pipe benders shall be approved by NPCIL or their authorized representative.

TABLE NO. 1

PIPE SIZE	MINIMUM BENDING RADIUS
14 MM	56 mm
16 mm	64 mm
20 mm	76 mm
¾ inch	3 inch
1 inch	3½ inch

Bends shall be made very carefully to the exact angle required. No flattening is allowed at the bends. Opening of the bends shall not be permitted in any case and any pipe, which has been wrongly bent, shall be scrapped. The Contractor shall store scrap pipes separately for his accounting.

Each length of prefabricated pipe shall have the line number on it (line number written on paper and stuck to the pipe with transparent adhesive tapes) for proper identification.

The prefabricated pipe shall be bundled layer wise by using either S.S. strips wrapped with polythene sheets. Then this shall be transported to site for laying.

All the prefabrication involving cutting and bending shall be as per applicable drawings. Prefabrication shall be done in such a way that when laid in the field there shall be at least 150 mm overlap between adjacent sections of the pipes or between pipes and instruments/ equipment where it will be terminated to facilitate cutting and edge preparation. As already stated. cutting shall be so planned (and shall be dictated only by restrictions to transportation and laying) to keep the number of joints bare minimum.

Field fabrication and fabrication after laying shall be kept to the barest minimum.

Slope shall be maintained as per the instructions provided in the drawings. Downward slope from the take-off point to the instrument is maintained for liquid and steam, upward slope from take-off point to the instrument for gaseous fluid. If me instructions regarding slope is not given in the pipe lay out drawing, at least 1:20 slope either upward or downward as the case may be should maintained. Instructions mentioned in the drawing or any other instruction given by the Engineer shall be strictly followed.

Pipes shall always be laid preferably in light channel in vertical plane.

Pipe projection in air shall be kept minimum.

If joints coming in pipe bundles are of swaged type, then all those joints shall be properly staggered to facilitate easy assembly and disassembly in future.

No bend shall be made in the close proximity of welded joint and minimum 3 D clearance shall be provided from the welded joint while making bends.

Clamping of Pipes

Standard type of SS clamps shall be used to clamp the pipes. These clamps shall be used at distance not more than 1 Mtr. But near the Tees, take-off points, termination points, near pipe bends and offsets, clamps shall be fixed to avoid mutual separation of pipes. 0.5/ 1 mm thick SS shims shall be installed below impulse pipe layer at all clamping points. For CS pipe installation, brass shims shall be used.

Crimping of Spare tubes

Spare tubes laid in the pipe bundles for future usage will be crimped at the end. Proper identification tags should be provided prominently on spares tubes.

Butt Welding of SS/ CS Piping by Auto Tube Welding Machine

Jointing between successive lengths of pipes and termination at the equipment/ instrument end and take-off points are by butt welding. More details are covered in "Procedure for Welding of S.S. Tubes with Auto Tube Welding Machine"

Tagging of Piping

The piping shall be tagged with pipe numbers punched on Anodised Aluminum tag of 8cm x 1cm x 0.5 cm thick and tied to the piping using Stainless steel wire at take-off points and near Instruments/ equipment. If pipe number or line number is not allotted in the drawing, only equipment number is to be punched on the Aluminum tag. If the pipe is passing through EP sleeve or bore through connectors, the Tag Nos. shall be painted on nearby wall or equipment to identify the same.

Pipe Identification

:Long pipes are to be identified by blowing air through the pipes before making the final weld to ensure and certify the proper connection to their respective Instruments or take-off points and identified pipes will be tagged. However this will be further cross-checked before final weld by purging Argon gas, if final joint is butt weld type.

8. Acceptance Criteria:

a) Pneumatic Testing:

All the process hook-up lines are to be checked for their integrity. For this, lines will be subjected to air hold test. The pressure shall be held after isolating the supply point and pressure drop over a period of 10 minutes observed, shall be within 4% of test pressure. After the leak testing, the soap solution applied shall be cleaned by wiping with wet cloth dipped in DM water. If the drop is more than the above prescribed limit, leaks will be searched by keeping the line constantly pressurised and applying the soap solution to the potential leak points viz. Swaged joints, gasket joints etc. On identification of leaks, the same will be rectified and tests repeated all over again for the clearance of the line. The soap solution to be used shall be Lissopol NX -3.

.A diagram showing all pipe welds Joints shall be submitted to QA before pneumatic leak test. Here terminal points on the line shall be clearly marked to identify the bop.

c Helium & Hydro Test of the S.S. Pipes:

Helium leak test shall be carried out wherever applicable along with the main system circuits.

After final connection to the respective Instrument / process take-off points, Hydro test will be carried out in presence of QA representative. During hydro test, instrument should be isolated from the test loop by closing 3-way valve manifold or instrument isolating valve to avoid the damage of Instrument. This test, may be carried out along with process circuit Hydro test or separately by pumping water with the help of Hydraulic pump.

Testing shall be carried out after the installation of Instrument with primary impulse piping is complete in all respects. Test procedure shall be approved by engineer.

.Primary / impulse piping shall be tested hydraulically to 1.5 times the maximum operating pressure after thorough flushing. Flushing of the instrument lines can be carried out while the main line is pressurized after isolating the Instrument. Where there is no separate isolation the connection near the Instrument shall be opened so that no dirt enters the Instrument.

.In case of impulse lines on low pressure systems such as vacuum and draughts, lines shall be flushed with compressed air prior to system commissioning. All connections and interconnections between Instruments shall be tested for proper connections before loop test is to be commenced.

c) Inspection of Pipe, Handling, Cleaning, Pre-fabrication and Erection

SS/ CS pipe shall be inspected at the time of Transportation, Storage, Cleaning Fabrication, and Erection as per the approved QAP.

9. Records:

Installation and pressure tests job shall be offered by the Contractor to QA in prescribed format / check list.

10. Precautions:

- Piping shall be run clear of access doors, bolts and equipments and must have access for maintenance.
- When piping is attached to an item that may occasionally be removed for repair or maintenance, the method of connecting and running the piping should permit easy removal. .
- Piping should be kept clear of any controlling devices and should not impede the operator's access to control.
- Where possible, avoid running piping where it would be convenient for people to step or climb on it or use it for a hand hold etc.
- Piping shall be supported in long runs to prevent sagging. Fluid density and pipe size determine the frequency of support. Generally such support shall allow free

axial movement of the piping and only support the weight of the piping. The piping shall not support the weight of valves, filters, regulators etc.

- Valves or other devices that require torque to be exerted in their operation. should be mounted so that a twisting movement is not transmitted to the piping in valve operation.

- Fittings should be staggered by giving offset in pipes that are laid in bundle to provide easier installation and ease of maintenance in future.

- Expansion loops should be installed to prevent tension, stresses and allow for temperature expansion.

- Trays should be used to route the pipes and also as protection cover. Standard pipe clamp shall be used for clamping the pipes.

- Piping shall be arranged so that union can be tightened without distorting the lines.

- Pipe runs shall be neatly dressed on the light channels/ trays. For pipes which are to be terminated on the instruments /equipment which may be subjected to vibrations during operation, a semi circular loop shall be formed on the pipe near the termination point to avoid damage to the pipes during operation.

- All such instruments/ equipment shall be identified in consultation with the Engineer before terminating the pipes.

7.7.0 PROCEDURE FOR WELDING OF S.S. TUBES WITH AUTO TUBE WELDING MACHINE.

1. Purpose:

Making straight through joints in SS /CS impulse pipes/tubes laid for instrument process hook-up. Impulse pipe welding is to be carried out using Automatic Tube Welding Machine without filler metal. All the instrument process hook up pipes/tubes will come under the scope of this procedure.

2. Applicability:

This procedure is applicable to I&C impulse pipe/tube erection work.

3. Responsibility:

Responsibility of implementation of this procedure lies with Instrumentation Erection Package Contractor.

Contractor has to qualify the welding procedure, welding machine and daily weld using the Auto Tube Welding machine.

4. Reference:

Standard practices followed in Nuclear Power Plant.

5. Pre-Requisite:

Auto tube welding machine and its accessories viz. Cereated / thoriated Tungsten Electrode, Tube centering Gauge, Arc Gap Gauge, Tube Fixtures, Welding Head, Tube Cutters, Tube Squaring machine, squaring bits, High purity (99.9993%) Argon Gas & regulator, paper chart recorder, availability of construction power supply, manometer, dentist mirror, marking tools, marker pen, deburring tools, emery paper etc.

6. Description:

Base metal : Sl. 08X 18H lOT / St.20

Thickness and Dia. :	O.D.	WALL THICKNESS
	14 mm	2.0 mm
	16 mm	2.0 mm
	18 mm	2.5 mm
	20mm	2.5 mm

Process: Single Pass Automatic Gas Tungsten Arc Welding in Argon gas atmosphere.

Filler metal: NIL

Position: ALL

Process :

Butt Welding of Austenitic stainless steel/ Carbon steel impulse pipe/ tubes by gas tungsten arc welding process without adding filler metal in argon atmosphere by means of a rotating electrode in an automatic tube welding machine.

Mode of Qualification:

As per auto tube welding machine manufacturer's specification.

Shielding and Purging:

Shielding and purging gas shall be argon of 99.9993% pure (min) and general1y conforming to IS-5760-1969. Initial1y and after any extended period of interruption in the work progression, the gas hoses have to be purged with a minimum of 3 volumes or for 2 to 3 minutes whichever is more to remove all air from the hoses.

To maintain the internal purge gas pressure is of prime importance in achieving a satisfactory weld profile, the following procedure shall be followed.

Connect the internal purge manometer.

Connect a purge gas pressure control valve (V2) at the outlet end of the tube being welded and keep it in full open position.

Open the purge gas cylinder valve (V1) and pressure regulator valve slowly to achieve the required flow rate.

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Adjust the valve V2 so that the required height of water column is indicated in the manometer.

Close the valve V1

Now the "Tee" connection is removed along with the manometer and reconnected between the tube and valve V1. Both the ends of tubes are clamped into the weld head.

Open the valve V1 completely.

Without disturbing any valve setting the joint is ready for welding.

NOTE :

In cases where backing gas pressure cannot be achieved due to design configuration of the system, the internal purge flow rate shall be determined by means of Trail/ Mock up. In case of a short tube welded to a pipe the manometer pressure setting is ineffective. In this case the flow rate of the gas shall be kept 12.51/min. (25 scfh).

Edge Preparation Of Tubes:

The tubing shall be handled throughout carefully so that no injurious marks are left on the tubing. The tube ends shall be square cut with hand operated tube cutter and tube squaring machine. Burr shall be removed by suitable means keeping the tube face downwards.

Electrodes:

2% thoriated or cereated tungsten electrode or as approved by ENC of size as recommended by M/C

Different length electrodes for different size of SS /CS tubes must be used as per guidance given by manufacturer. As per Swagelock, electrode of size 27.94mm x 1.57 mm is the standard size to be used for tube size from 6mm up to 25mm OD.

Electrodes shall be replaced after 30 welds or immediately after contamination / deformation.

Electrical Characteristics:

The Process works on DC straight polarity.

Electrode - VE

Work Piece +VE

Cleaning:

Both the tube beds shall be cleaned thoroughly using acetone or any other approved solvent just before assembling the tube joint in the weld head.

Electrode Fitting:

As per M/C manufacturer guidelines.

Tube Fit Up :

Unscrew both the clamps of the tube fixture.

From right hand end insert the tube aligned gauge and clamp it.

Using the Marking pen, marks at a distance of 2D from the ends are made on both the tube ends to be welded.

From the other end of the fixture, insert one end of the tube, match with the gauge and clamp it.

Unscrew the right hand side clamp and remove gauge.

Insert the other tube end from right hand side, match with the first tube and clamp.

Radial misalignment should not be more than that specified in the requirements of welding machine for the tube sizes 14mm and 16mm.

Assemble the Electrode assembly over the tube joint and insert into it the welding head.

Check the positioning of the weld head with the help of head aligned gauge.

Welding Technique:

Microprocessor based Auto tube orbital welding M/C come with readymade weld program. However general idea is given herein.

The machine shall be programmed as per Table - I. These settings shall not be changed without informing to C&I and QA representatives of NPCIL.

Adjust the purge gas flow rate and purge gas pressure as outlines in Table clause 2.0 & 3.0 so that the values indicated in table I are achieved. Now close valve V I so that gas is not wasted.

Remove the manometer along with Tee connection.

Clean the tube ends with Acetone or any approved solvents.

Align the two tubes in the welding head.

Connect the back up gas hose to the tube end and start the back up gas by opening the valve V1.

Check the following Switches:

High frequency Arc Starter switch 'ON' position.

Gas test switch 'OFF' (control panel and pendant box)

Set up Remote panel switch in panel position (control panel and remote pendant)

Mode switch in PULSE position (control panel only). In this PULSE position of the switch, Auto Tube welding power source is kept in PULSED current mode.

Keep the power supply in energized condition by operating main AC circuit breaker (control panel). See that emergency stop and sequence stop push button switch lamps are glowing (control panel and pendant box) Now the machine is ready for welding.

Open organ gas cylinder and adjusted to the required flow rate of Arc shielding gas by the purge rotameter.

Program the welding machine as per the welding parameters given in TABLE – I or simply run readymade programme supplied by M/C manufacturer.

Push the sequence start push button in control panel. See that the sequence start gas test push button switch lamps are 'ON' and the sequence stop switch lamp is 'OFF' motor jog switch lamp goes 'ON' as motor starts rotating.

Note that the Arc is struck and welding carried out smoothly as indicated by the connected recorder. Also the pre purge, rotation delay, constant speed, unslope speed, finish slope speed and post purge lamps glow successively to indicate the welding sequence. As soon as finish slope is over, observe that, rotation delay, constant speed and up slope speed lamps go 'OFF'. Motor jog push button switch lamp also goes OFF indicating that electrode rotation is over.

Wait till the sequence stop/reset push button lamp glow, indicating that welding is over. At the same time finish slope lamp, gas out lamp and sequence start lamp go OFF.

Remove the welding head by unclamping its spring ends split the bevel gear with gloved hands and remove it. Then, remove the tube alignment Fixture by unscrewing the clamps.

Test for Qualification of Equipments

After the machine has been commissioned, 15 welds for each size of tubing and each position (2G and 5G) shall be made in one un-interrupted sequence and examined as follows.

All the welds shall be examined visually and evaluated according to clause 8.1

Six welds shall be sectioned for internal examination and shall be evaluated as per clause8.2

Three welds shall be subjected to tensile test. For acceptance, the specimen shall not break in welded area and shall break in the base metal. The maximum tensile strength shall be recorded.

Six welds shall be subjected to bend test and examined as per clause 8.3

Qualification of Welding Operator:

To ascertain that the operator is familiar with the connections and operation of the equipment, recorder and interpretation of graphs, trade test as follows shall be conducted.

For each position and size of tubing, three test pieces shall be made by the operator. Two of these shall be cut open and subjected to internal examination and bend test as per clause 8.2 & 8.3 respectively.

Tests prior to, during and at the end of the Production Welding:

1. Daily test prior to production welding (Daily Machine Qualification):

   The welder shall produce two satisfactory weld samples, one in each position, for specified size of tubing before start of work. Test welds will be longitudinally cut for internal examination. This will be the part of daily machine qualification.

2. Testing during production:

   No test will be made during production. But the steady behavior of the machine can be checked with hard copy of the welding parameters. Also uniformity of production weld can thus be inferred. QA Inspector, however, may visually check the joints for (1) Weld bead width to ascertain proper fusion and (2) Centering of the bead to ascertain arc wandering, if at all it has taken place and (3) bulging or depression in the weld bead. The inspector then has to decide whether the quality is of acceptable level. In case of much deviation, Inspector can ask for re-qualification of the machine.

3. Testing at the end:

At the end of production welding, one sample welds will be made and produced before Inspector. This will be required if total production welds are more than 30 Nos in a day, Otherwise end samples will be waived off. Also whenever argon cylinder is being changed, two samples will be made before starting actual production.

Welding procedure Specification (WPS) and Procedure Qualification Record (PQR) for welding and weld testing works under para 7.9, 7.10, 7.11 and 7.12 shall be maintained as required.

7. Acceptance Criteria:

Inspection:

All welds shall be examined visually and acceptance standards shall be as follows:

- The weld bead shall be of uniform width indicating that the current was programmed properly maintaining requisite heat input for atleast 360 degree of electrode rotation. The current is tapered out during the overlapping phase, whereby an end crater due to arc extinguishing is prevented. This can be further ascertained with hard copy of the welding parameters settings which will be produced at time of weld inspection.
- The weld bead evenly centered, ensuring complete fusion of both the tube ends and absence of arc wander. The weld width tolerance shall be in accordance with the specifications of the tube-welding machine.
- The weld bead shall be smooth and uniform indicating a correct electrode travel speed.
- The weld bead shall be free of oxidation, indicating inert gas coverage until the molten puddle has sufficiently cooled.
- The bead shall be neither concave nor convex indicating that proper pressure of internal purge has been applied.
- The heat-affected zones shall be within 12mm from the joint indicating that the weld Bead was not excessively hot before or during welding.
- The tubes shall not be misaligned beyond the tolerance given under "Fit up" indicating that the tube ends were straight and the weld head clamps were clamped properly.

Internal Visual Examination At The Time Of Daily M/C Qualification:

- The samples shall cut open longitudinally through the weld joint and examined.
- The weld shall have complete penetration resolution in an internal bead width which is nearly equal to the external bead width. However there shall not be any penetration which results in reduction of the internal diameter (drop in through), limits of which shall be as specified by manufacturer of Auto tube welding machine. .
- There shall not be any visible sign of tool marks due to end penetration.
- With Tubes which arc welded in the horizontal position, gravity may cause a concave weld at the top and convex weld at the bottom. This is acceptable as long as the reduction in internal diameter is not more than 20% of the wall thickness. For 6mm Tubes, no reduction in internal diameter is pem1itted.

Bend Test:

- Samples for bend test shall be at least 150mm long with the weld in center. The tube shall be cut open at the center longitudinally and bent 180 Deg. Around a mandrel having diameter equal to 8 times the OD of the tube in such a way that the root of the weld is in tension. Root pass should not open up in the process. If it is achieved, the test is cleared. This will be done on 10 of samples at the time of initial qualification of the machine.
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8. Records:

DOCUMENTATION

A recorder. with two pens shall record graphically Weld Current V/S Time and arc voltage V/S Time for each joint welded. The graph shall be identified with joint number. The graph shall be examined by inspector to verify the Clause 10.0.

9. Precautions:

- The equipment functioned properly with respect to each phase of welding cycle.
- The current variation is not larger than + or - 2A for time periods larger than 5% of the weld times.
- Current variation between two successive peaks (in pulse mode) should not be greater than + 0.5A.
- The weld speed is in concurrence with the approved value.
- All the detailed recording of the welded joints shall be entered in a register.

7.8.0 PROCEDURE FOR LAYING OF MS LIGHT CHANNEL

1. **Purpose:**

   The Light Channels are installed to provide support and protection to SS/CS pipes, Copper pipes and field cables. It is also used as protective covers.

2. **Applicability:**

   This procedure is applicable to Instrumentation installation works.

3. **Responsibility**:

   Responsibility of implementation of this procedure lies with Instrumentation Package Contractor.

4. **Reference:**

   Standard practices followed in Nuclear Power Plants.

5. **Prerequisite:**

   Hot dipped galvanized MS light channels, MS Support (ISMC-75 to 100) Drill Hammer, Drill Machine, welding machine, Hilti/ Fischer Anchor bolts, Hacksaw and other required tools

6. **Description**:

   Light channel field route shall be finalised with system engineer as per QA plan.
   The light channel shall be supported at every one meter length, by ISMC-75/ 100 with length equal to width of light channel. Wherever light channels are to be routed on floor/ ceiling, the length shall be decided based on the height at which the impulse pipes are to be routed. Wherever supports are to be installed on the floor or ceiling, min. 5 mm thick base plate shall be used for the supports for anchoring purpose.

   The supports shall be welded with EPs, mechanical structure provided for this purpose or shall be installed using min. two nos. of M8/ M10/ M12 'HILTI'/ Fischer anchor fastener.

   The supports shall be properly painted by two coats of priming epoxy paint and painting thickness shall not be less that 80 microns.

   The light channel shall be installed on these supports with M8/ M10 size screws. Welding should be avoided.

Proper bends, riser, reducer, splitters should be used for light channel routing.

Light channels are usually available in 2.5 meter lengths and their joining shall be done with coupler plate.

Light channel size shall depend upon the size and no. of layers of pipes and cables to be supported. Following sizes are standardized for C & I use.

20 x 50 x 20 x 2 mm

20 x 90 x 20 x 2 mm

20 x 125 x 20 x 2 mm

40 x 150x40x2 mm

Channels shall preferably be installed with its major dimensions (width) in vertical plane rather than in horizontal plane to avoid deposition of dirt and corrosive fluid.

7. Acceptance Criteria:

Good workmanship, proper support / anchoring, proper fasteners.

8. Precaution:

Use of hand rails and process pipes to support the light channels shall be avoided unless approved by Field Engineer (FE).

7.9.0 PROCEDURE FOR FABRICATION, PAINTING AND INSTALLATION OF MS SUPPORTS / STRUCTURES

1. Purpose:

Guideline for fabrication all type of MS supports/structures.

2. Applicability:

This procedure is applicable to Instrumentation installation works.

3. Responsibility:
Responsibility of implementation of this procedure lies with Instrumentation Package Contractor.

4. Reference:

I) ES, GA, DD drawings

II) Standard practices followed in Nuclear Power Plants.

III) ASME Section IX

5. Prerequisite:

Structural steel as per drawing specification, welding machine and electrodes, as Cutting equipments, all workshop tools.

6. Description:

FABRICATION:

All structural steel members / parts as per drawings specification shall be cut by grinded and assembled as per drawing. Assembled parts shall be tack welded and checked for conformance with drawing. Unless otherwise specified on the drawing the tolerances shall not exceed +/-3 mm and the same shall not be cumulative. Any deviation in excess of 3 mm from that required on the drawing shall be brought to the notice of Engineer. After clearance from Engineer the assembly shall be fillet welded.

PROCEDURE OF FILLET WELDING

(a) MATERIAL AND PROCESS

Procedure for the fillet welding for ISS fabricate panel base frame to EP in plant, for welding steel conforming to IS 2062 by metal arc welding procedure.

(b) QUALIFICATION OF WELDERS

Welder shall be qualified for fillet welding in all position (2F, 3F, 4F)

(c) APPROVED ELECTRODES

Electrodes duly approved by NPCIL in accordance ASME only shall be used.
NOTE : Any change in brand electrodes and use of this procedure shall be done by the prior approval of QA Section, TAPP

(d) AC or DC reverse polarity for SMAW process

Electrode	Dia	Range Amp.	Voltage
2.5 mm		50 to 90	18 to 22
3.25 mm		90 to 140	18 to 22
4.0 mm		140 to 190	18 to 22

(e) STORAGE OF ELECTRODES:

Electrodes shall be stored in their original container and under dry condition. Prior to welding the, electrodes shall be kept in oven and backed up to 150 deg. C for at least 2 hours or as recommended by manufacturer of brands listed in this procedure. Before welding is commenced the lots shall be transferred to a portable oven with constant temperature of above 70 deg. C.

(f) Surface for welding and its adjacent area shall be cleaned up to 100 mm surrounding, if required approved solvent shall be used to clean the surface for welding.

(g) WELDING TECHNIQUE & SEQUENCE OF OPERATION:

- Welding machine shall be in good working condition and shall have good capacity for the welding procedure laid down.
- Current control shall be maintained as per the electrodes size specified.
- For accuracy, fit – up of the parts to be welded by tack welding by a qualified welder. Any tack weld found defective shall be removed completely.
- The root pass shall be free from all defects like porosity, blow holes, pin holes, cracks etc.
- The welding shall be inspected for completeness, re-enforcement, overlapping, pinholes, blow holes, cracks, undercuts etc, the re- enforcement shall merge with parent metal.
- Fillet weld shall be done without disturbing the fit-up.
- ARC MANIPULATION

  Arc manipulation shall be done by.
  (a) Full penetration
  (b) Full fusion into the proceeding layer.
  (c) Uniformity of surface in both single run pass and multiplayer passes.

- INTERLAYER CLEANING :

  All traces of flux and slag shall be removed by wire brush before successive layers are deposited.

7. Painting:

The supports shall be properly painted with two coats of self priming epoxy and the coating thickness shall not be less than 80 micron.

8. Installation :

Installation of supports shall be carried out by welding to existing EPs or by anchoring using M8/M10/M12 Hilti/Fisher anchor fasteners.

9. Acceptance Criteria:

(a) Welds shall be free from pin holes, porosity, cracks, slag under cutting etc.
(b) All welds shall be cleaned with wire brush to remove slags, and abrasion.

10. Records:

Records shall be generated as per the approved check list.

11. Precaution:

- No welding shall be done on surfaces which are wet or exposed to rain or excessive draft. Surface to be welded shall be free from paint, rust, oil grease dust of any other contamination. Cloth used for cleaning shall be free with hemmed edges. Weld edge preparations shall be cleaned only by approved solvents.

- Welds shall be cleaned between passes to remove all traces of slag and flux before successive beads or layers are deposited. Completed weldments shall be cleaned to the same extent. The craters at the starting and stopping points of each individual bead shall be carefully examined and any defects shall be removed grinding. Grinding wheels, wire brushes, chisels etc. for use on stainless steel shall not be used on any other material. The grinding wheels should be iron free and the wore brushes should be austenitic stainless steel to avoid from contamination of the stainless steel surface.

- Peening shall not be permitted.

- Welding techniques shall be followed such that a sound and acceptable weld achieved.

  (a) Haphazard striking of the electrodes on the base metal in establishing the are shall not be permitted. The are should be struck either in the joint where metal surface will be fused into the weld or a starting tab made of the same materials or a material compatible with the base metal being welded.

  (b) When welding carbon steel with covered electrodes, the width of the deposited pass shall be not exceed three times the nominal core wire diameter.

  (c) Fillet welds shall preferably be slightly convex and shall be free from under cutting and overlap at the toe of the weld. Convexity shall not exceed 1.6 mm. Full fusion shall be obtained at the root of the fillet and in no case shall the leg length of the fillet be less than the nominal

weld size stated in the drawings or specification. The leg length shall not exceed the specified size by more than 1.6 mm.

7.10.0 PROCEDURE FOR INSTALLATION AND MAINTENANCE OF DOUBLE FERRULE S.S. (SWAGELOK/PARKER) FITTINGS

1. Purpose:

Installation of Swagelok fittings in Heavy water, Helium and Water systems are to be carried out by a qualified Swagelok fitter. Swagelok fittings have widely been used for pipe joints. It is essential that all fittings joints are leak tight. While Swagelok fittings are considered to be of very good quality and, there is no such known case where trouble has come about due to defective fittings, a poor workmanship may result in leaking installation. The intention of this procedure is to serve as a guide to Tradesman for the installation and maintenance.

2. Applicability:

This procedure is applicable to Instrumentation Erection Work.

3. Responsibility:

Responsibility of implementation of this procedure lies with Instrumentation Erection package Contractor.

Duly qualified Fitters and Personnel shall be deployed on the S.S. Pipe swaging work.

4. Reference:

1. Standard practices followed in Nuclear Power Plant

2. Crawford Fitting Co. "Swagelok Pipe Fitting and Installation Manual".

5. Prerequisite:

S.S. Compression fitting assembly. Pipe Cutters. Pipe Squaring Machines, Never Seize Compound, Teflon Tape, Emery paper, Deburring tool. Acetone, installed S.S. pipes, D- spanner. Torque wherever round files, Bench vice, Gap gauge (NO-GO).

6. Description:

Fitters Training:

To qualify, fitters have to undergo qualification test (Written as well as practical) to be conducted by the QA Engineer of the department. Fitter shall requalify once in every twelve months and after lay off from the work for 3 months.

Components and working of a Swagelok fittings.

A Swagelok fitting consists of the following parts as illustrated below.

- Main body NPT threads for process tapping and strength thread to take n NUT.
- NUT: Screws on to the body of the fitting and holds the pipe to the fitting.
- Front ferrule covers the pipe and acts as seal between the smoothly machined surface of the fitting body and the pipe.
- Back Ferrule is placed between the Front Ferrule and the nut. Its rolling action creates indentation -in the pipe so that both Ferrules together grip hold the pipe and make a tight seal.

Swagelok Fittings coding System:

Swagelok fittings have a system of code number to denote its material, pipe size, fittings series (Metric or functional), component, type of fitting and reduced size or type of other end connection (see the table given on the next page).

Lubricant of the Fittings:

Swagelok fittings are supplied without lubricant, and must be lubricated prior to use by "Never Seize" Nickel special NS-165. The lubricant shall be applied only to the threads of the pipe nut to body joints and to the back flat surface of the Back Ferrule.

The use of all "GOOPS" available from Swagelok Co. is forbidden because they have significant halogen content. Lubricant shall be under the control of the Installation Inspector and used sparingly. The lubricant shall be Never Size Nickel special NS-165. No other lubricant or sealant shall be used without prior approval of the NPCI1. QA Engineer.

Storage of Fittings :

Fittings shall be stored in the assembled condition in clean storage. If it is found necessary to remove parts, these fittings shall be kept separately until they can be re-assembled.

When fittings are drawn from stores care in handling shall be observed. Unless necessary such as for pre-swaging, they shall not be taken apart. If they are taken apart care shall be taken to ensure that they are kept free of dirt and damage and Ferrules are properly placed on re-assembly.

Pipe Preparation:

It may be necessary to dress the end of the pipe on the outside diameter back from the end to remove metal protrude of the O.D. by the action of Pipe Cutting Wheel. Under no circumstances shall the outer surface of the pipe be abraded

or polished in any manner beyond the quarter diameter distance. Emery cloth shall not be used to dress the pipe end O.D. level. The inside edge can be debarred by a scrapper or half round file.

Bending the Pipe:

Pipe bending should be performed as per SS pipe laying procedure IEK-5 before connecting the fining so that bend can be prevented from entering the fitting. If bending is necessary after connecting to a fitting care should be taken that the fitting is not used as an anchor or holding device for bending. Improper pipe bending close to a fitting may be source of leakage.

Inspection Before Installation:

Since the fittings have already been checked before storing, it is not required to take then apart for checking prior to installation. Dis-assembly before use can result in dirt or other foreign material getting into the fitting and causing leaks. However, visual inspection must be done by looking into the pipe entrance of the fitting to ensure that both Ferrules are in place correctly. No spaces should be seen and the fitting should be clear. Alternately, a piece of piping may be inserted into the fitting and the nut and ferrules are slid" back along the pipe for inspection of ferrules.

Fitting Installation:

Pipe threads of the swagelok finings are to be covered by teflon tape or paste leaving first two threads bare, prior to installation on the instruments/equipments/process take off points, this is to prevent teflon intrusion inside process pipe.

Three simple steps are required to install the fitting on the pipe.

- Insert the pipe into the fitting until it seats firmly on the shoulder of the fitting.
- Turn the nut by hand till the pipe is gripped into the fitting and properly snugged. The snug position is defined as the point where the pipe has been gripped just enough that the pipe cannot easily be rotated, relative movement. Some times in snug position, nut may be tighter than finger tight and a wrench may have to be used, the nut shall be rotated with a wrench one flat more and this position is defined as the "Snug" position.
- The nut should then be tightened 1 & ¼ turns past the snug position. Care must be taken to minimize forces being transmitted to adjacent piping or equipment. The amount of tightening (1.25 rum past snug position) may be ensured by making a mark on the body and the nut in the snug position at the bottom 6:00 O'clock position and watching the mark, turn one complete revolution and past to the 9:00 "0" clock position. This tightened position should again he marked for inspection purpose. While no special tool is required to assemble Swagelok fittings the Swagelok ratchet wrench should be used, it' available. Other wise ordinary spanners may be used; but they should not have spread jaws or worn teeth (if it is a box spanner). Adjustable crescent wrenches or pipe wrenches should not he used. Gap gauge (NO-GO) shall not be used to check for proper swaging.

Swagelok Orifice Assemblies:

These are similar to Swagelok male connector or union assembly excepting that they have flow direction. While installing direction shall be followed. Arrow shall be in the flow direction only.

Dis-assembling and Re-assembling :

For various reasons some joints will have to be taken apart and put together. Care should be taken not to damage the fitting and the pipe during disassembling and reassembling. It is essential to obtain information's about. pressure, temperature and type of the fluid in the pipe before disassembling. The fitting should not be taken apart if the fluid inside is under high temperature and or pressure.

If it is necessary to work on fitting under such conditions, suitable precautions should be taken for personnel safety. Care should also be taken about the possible hazards from harmful liquids, gases and fumes. If the liquid is heavy water, care should be taken against spillage and tritium hazards.
Reassembling consists of 3 steps:

- Insert the preswaged piping into the fitting until the front seats in the filling.
- Tighten the nut by hand and snug up.
- Tighten with a D-spanner while holding the body steady with a back up D-spanner.

On each reassembly the nut should be advanced by a small amount not more than 1/16".

Plugging a Line:

The new style of plugs have the ferrules machined as a part of the "Pipe-piece" and as good as pre-swaged fitting. So nut of the new style of plug should not be tightened by 1¼" turns. Rather is must be just "Snugged up" tightly.

If plugs are necessary and the new style plug is not available then they can be made up from a short length of pipe with one end crimped and welded closed and the other end inserted through ferrules and nut and assembled in the normal manner.

7. Other Compression Type Fittings :

Other than Swagelok, Parker double compression fittings are also used for impulse lines. Brass single compression type fittings are used in pneumatic lines on Copper pipes. Single compression type fitting is same as Swagelok compression type fitting except Back Ferrule does not exist. Instructions and maintenance instructions for these fittings are same as that of Swagelok fittings.

8. Acceptance Criteria:

- All the swaged joints shall be offered for inspection through the Contractors/NPCIL quality surveillance Engineer. Any defects revealed during the inspection shall be removed at free of cost to the entire satisfaction of the QS Engineer .

- Completed fittings should be inspected by taking the joint apart and making the following checks in presence of the inspector.

- The nuts should slide back from the Ferrules The nut may not always slide back easily as the swaging action may result in a slight belling of the pipe behind the Back Ferrule.

- The pipe should protrude through the Ferrules by an amount which is approximately equal to the diameter of the pipe.

- The front ferrule may rotate but not easily on the pipe and should not slide axially on the pipe.

- The Ferrules should not be cracked or excessively deformed.

- The Ferrules should be in place correctly with some space between them.

- There should be no galling or damage to any surfaces of the fitting and no dirt of on any part of it.

- The visible pipe end should be free from burrs, file marks or other sign of poor workmanship.

- The fining body and ferrule should appear to be made of the correct materials.

- The fitting should then be reassembled as described in the next section.

- Installation is also checked by helium leak detector.

Pressure Testing :

During Pneumatic /Helium / Hydrostatic testing all the screwed and swaged joints shall be probed for leak using "Lissapol NX-3" (ICI Brand) of soap solution. All leaks notices during Hydro / Helium / Pneumatic testing shall be rectified by the contractor and these joints shall be retested. All the joints isolated shall be tested at working pressure after restoration. Also these pipes shall be Helium leak tested along with main system. Any leakage noticed shall be attended to the satisfaction of Engineers representative. All air lines shall be pneumatically checked at operating pressure.

9. Records:

The contractor shall keep a proper record of all installed fittings. A line sketch for each line shall be made and marked with joints number and enter in a register with date of installation. This record shall be submitted to Q.A. representative for

inspection and signature and finally handed over to the Engineer with inspection report.

10. Precautions:

Maintenance

Maintenance of the Swagelok and oilier compression type fittings consists proper care of the fittings while working on or around them. Recommended procedures should be followed while dis-assembling and re-assembling. Following table may be used as a guide in case of any trouble with the fittings.

Troubl e	Possible Cause	Recommended Corrective Measures
Piping will not fit into fitting	(a) Burrs on piping Due to cutting operation.	Debur
	(b) Flattened piping while pipe cutting by hack saw	Do not use Hacksaw for pipe cutting. Only pipe cutter shall be used.
	. (c) Piping out of round improper bending due to.	Wage fittings are manufactured to tolerances to accept the upper limit of allowed piping dia meters used in piping manufacture. If piping is bent to far out of round by improper bending the piping will not fit into the pipe fitting. Use caution with bends when near the end of the piping
	d) Piping is of the wrong size for fitting .This seldom occurs but inter frequently. A piece of 10 mm Piping maybe attempted to be used with a 3/8” fitting by mistake .	Make sure to use the proper size fitting for each diameter piping .
Fitting cannot be pulled up one and one quarter turns	(a) Galling or seizing is taking place due to material characteristics and dry assembly.	Use lubricant (Never seize Nickel special NS-165)
Leakage at Pipe	(a) Fitting not sufficiently tightened into female pipe thread	Tighten fitting.

Troubl e	Possible Cause	Recommended Corrective Measures
	(b) Experience indicates that most pipe thread make poor seals, especially on higher pressure applications.	Teflon tape or paste should be used NPT side of the fining and tightened with torque wrench with a pressure showing on the gauge not less than 3. lbs.
Leak at the fitting	(a) Cracked or missing ferrule.	Reinstall the fitting after removing the front of the piping and using new ferrules. Fittings also may be changed if necessary.
Piping leaks at fining after initial installation	(a) Fittings not pulled up properly.	Follow installation instructions. Check for hard piping or galling. Use NS-165. Lubricant when torques are high.
	b) Piping has deep longitudinal scratches.	Handle piping with care. Replace piping or cut off damaged section and reconnect.
	(c) Fitting body was tubed, instead of nut, galling seat and or Front Ferrule	Always connect fittings by turning the nut while holding body stationary.
	(d) Fitting not tightened one and one quarter turns because of in accessible location.	Pre-swage then snug up in accessible location
	(e) Fitting was used as vise or anchor to hand bend piping	Replace piping. Never use the fining as a holding device for bending. This will deform the piping inside of the fitting and pull the pipe away from the seal.
Piping leaks at titling after system operation	(a) Damage caused by mechanical means outside the system.	Replace piping & fining & relocate where damage is likely to be less.
	(b) Corrosion is eating away fitting or piping	Inspect connection for corrosion. If present check compatibility of fluids piping & fitting materials, consider galvanic action as a possible cause.

Troubl e	Possible Cause	Recommended Corrective Measures
Copper Piping	(a) Copper piping becomes very weak above 500°F. this is disadvantage of the material and not a function of fitting performance, code limit copper piping to 406° F	Heavier wall copper piping will help in some cases. If not, steel or stainless steel piping & fittings should be used.
Piping leaks at Filling after reconnecting following maintenance	(a) Fitting not properly retightened.	Follow retightening instructions.
	(b) Dirt got into fitting or on ferrules while disconnected.	Observe cleanliness practice whenever disconnecting and reconnecting, clean out foreign material and inspect fitting for damage. If ferrules or seat are damaged replace the damaged parts.
Flows are too low in system.	(a) Obstruction in system.	When assembling a system be cautious so that gravel or other foreign material does not get in piping or finings.
	(b) System sizes too small.	Check to determine if system should be constructed of a larger diameter piping.

7.11.0 PROCEDURE FOR COPPER TUBE AND HOSE LAYING

1. **Purpose:**

   This procedure describes the requirements for laying of Copper tubes and Hoses and their termination by Compression fittings and testing

2. **Applicability:**

   This procedure is applicable to Instrumentation Erection Work.

3. **Responsibility**:

   Responsibility of implementation of this procedure lies with Instrumentation Erection Package Contractor.

4. **Reference**:

Standard practices followed in Nuclear Power Plants.

5. Prerequisite

Copper tubes, Hoses, Brass Compression fittings, Tube clamps. Brass shims. Brass strips (thick) for clamp fabrication. Structural steel items for fabrication of support, 2mm screws: Brass mils. Consumable items like Teflon tape. Soap solution for testing of Copper tubing, Anodised Aluminum tags and Stainless steel wire for tagging the tubes, Tube cutter, Tube bender, PVC tube caps and plugs. Ladder, Scaffolding, Emery paper, Epoxy paint. Hammer Drill machine. Drill machine. Anchor fasteners.

6. Description

Copper Tube and Hose Laying:

Copper tubes Hoses will be supplied in coils of fixed lengths. Dry and dust free shall be blown through each length to clean the tube/hose. Only cleaned tubes hoses shall be straightened by rubber / nylon mallets before laying.

Tube bends shall be made with approved and appropriate sizes of tube benders depending on the size of the tube. Bends shall be of uniform curvatures and smooth and shall he free from wrinkles flattening and kinks. Use of filler material during bending is prohibited. Hot bending is also not permitted.

Tube and Hoses laying and termination shall be done preferably by I.T.I qualified fitter of having previous experience for similar type of job.

Copper tubes and hoses shall be laid as per various drawings. Drawings shall be used only for guidance and detailed routing of the tubing shall be finalized in consultation with the Engineer.

While laying tubes of different channel a minimum separation of 75 mm shall be maintained.

It is to be ensured that the valves, SV, Booster etc. does not transfer any load to the tubes and the same shall be adequately supported.

Tubes and hoses shall be routed on the walls columns and in channels. Use of hand rails and process tubes to support the tubes and hoses shall be avoided unless approved by the Engineer specifically. The tubing shall be run in such a manner as to provide maximum protection against mechanical damages. Tubing runs shall be grouped together wherever possible.

Tubes and hoses runs shall be neatly dressed on the walls and trays. For tubes that are to be terminated on the instruments/equipment, may be subjected to vibrations during operation, a semi circular loop shall be formed on the tube near the termination point to avoid damages to the tubes during operation. All such instruments equipments shall be identified in consultation with the Engineer before termination of the tubes.

Tagging:

After laying each length of copper tube or hose it shall be tagged at both ends by line number 'equipment number to which it is terminated by anodised aluminium tags of rectangular size and shall be tied to the tube by 16 gauge stainless steel wire.

Tube and Hose Termination and Joints:

Tube and Hose termination and joints wherever required shall be done with brass compression or hose fittings. At the place of termination / joints tubes or hoses shall be cut with squared edge and burrs, if any shall be removed by fine emery paper without reducing the wall thickness of the tubes. Tubes shall be cut with approved brand of tube cutler only. Compression fittings at the termination points shall be installed on the instruments equipment by screwed joints and the threads on the fittings shall be wrapped by teflon tape with minimum one layer of over lapping. The first 2 leading threads shall be left bare and covering with teflon should be avoided. If length of tubing to be run is longer than the standard lengths of the tubes supplied, tubes -shall be jointed by brass compressions unions. At joints an offset of around six inches (3 inches on either side of the joint) shall be given on the tube run, so that the fitting will be away from the surface of the tube support having free access for tightening and checking of leaks during test. Joints on adjacent tubes in bundle shall be staggered suitable to avoid interference.

7. Acceptance Criteria:

Pressure Testing:

All the signal and air supply lines and impulse tubing shall be identified. Identity of isolating valves on air manifolds shall also be made.

All the Main air supply lines, signal lines and instrument air supply lines shall be tested for blockage by blowing air.

All the lines shall be pneumatically tested after disconnecting the instruments which are not rated for system test pressure. Before conducting the test, contractor shall obtain the list of instruments from the Engineer which are to be disconnected. Contractor shall submit a line diagram / sketch for testing with test release report.

During pneumatic test all the compression joints and screwed joint shall be probed for leak by applying approved brand of soap solution. All leaking joints shall be rectified and tested again.

Tubing shall be pneumatically tested at working compressed air pressure for no leaks.

7. Records:

Inspection shall be carried out by the Engineer or his representative during the various stages of laying and termination of copper tubes and hoses. Contractor shall provide the facility for the same. Any defects revealed during the inspection shall be removed free of cost, to the entire satisfaction of the Engineer or his representative without delay. A Check as enclosed shall be filled & signed by all.

7.12.0 PROCEDURE FOR CONTROL CABLE LAYING AND GLANDING

1. Purpose:

This specification describes the requirement for laying and termination of various sizes of armoured and PVC control cables including laying of conduits for cable routing.

2. Applicability:

This procedure is applicable to Instrumentation Erection Work.

3. Responsibility:

Responsibility of implementation of this procedure lies with Instrumentation Erection Package Contractor.

4. Reference:

Standard practices followed in Nuclear Power Plants.

5. Prerequisite:

Cables, Double Compression Cable glands, Rigid and flexible conduits, conduit fittings. PVC bushes for conduit end, structural steel such as -MS angle, channel, strips etc. Plated screws, nuts etc. 20 mm (W) x 2mm thick Aluminum strips for making cable clamps, Anodized black aluminium lags size 65 x 15 x 2mm thick PVC ties for lying cable tags. Anchor fasteners sizes M8". Ladder scaffolding materials. Multimeter, Meggers (Analog digital) with readability upto 100 Mohm at 500 V DC knock out punches (Hydraulic Manual) hole-saw cutters, all other tools and tackles required for the job.

6. Description:

Guidelines For Control Cable Laying And Termination:

The control cables will be supplied in drums. Before cutting the cables detailed measurement shall be taken in the field as per routes given in the cable schedule or as per Site conditions. The quantity indicated in the cable schedule is only tentative. Cutting the cable for different length shall be such that wastage is minimum.

Cables are to be routed as per the cable and conduit schedule.

Cables used from instrument to Junction Box/ LCPs shall be routed through suitable size of Light channels.

Each length of the cable shall be checked for continuity and Insulation Resistance using Megger after laying.

All control cables shall enter into Junction box and LCPs from the bottom. If bottom entry on the JB is not feasible, side entry shall be attempted. However, to the extent possible cable entry from top of JBs shall be avoided.

All cables shall be terminated on a JB/LCP through glands. Separate glands shall be used for each and every cable.

The length of cable to be dressed inside the JB/LCP shall be such that, it will facilitate termination on any possible terminals if changes are incorporated.

Wherever Glands are used for cable termination suitable size of Nickel Plated Brass double compression cable glands shall be used.

Wherever conduits are used for routing control cables, internal dia of the conduit shall be at least twice of the cable diameter.

Cable glands shall be secured to the JB/LCP by lockout and Neoprene Rubber gaskets.

Metal tag bearing the cable number shall be provided to the cable on the entry of JB/ instrument. The cable no shall be punched clearly on anodised aluminium rectangular tags and tied to the cable by black PVC sleeve at both ends. Cable tags shall be provided at an interval of 30 m.

Conduit bend radius shall be as per standard practice i.e. at least 10 times the diameter of the conduits with a minimum of 7.5 cm as per IS-732 (Part-II).

All cables running upto a height of 1.5 m from the floor level shall be routed in conduits. Cable bundles must be routed through connecting trays from main cable pan as per the size of cable bundle.

7. Acceptance Criteria:

Good workmanship in laying, glanding and proper clamping.

8. Records:

Records shall be generated as per enclosed inspection report.

9. Precautions:

Following general precaution should be taken in routing the cables:

- While laying the cables underground, depth of laying is 900 mm from the surface.
- Power and control cables shall be laid in separate conduits / trays.
- All cables screens wherever provided shall be earthed at one point only.
- Care should be taken to avoid sharp, bending and linking of conduits, damaging of insulation and stripping the cable beyond the pulling force. Minimum radius of formed bend of an insulated cable shall be 12D for unarmoured cable and 15D for Armoured Cable where D is the outer diameter of the cable.

- While terminating the cable at the Instruments end an extra length in the form of a loop shall be provided to facilitate easy removal of the Instrument.

7.13.0 PROCEDURE FOR SCREWED TERMINATIONS IN JB'S AND PANELS

1. Purpose:

In a centralised control and instrumentation system many thousand of connections have to be made from the field sensors to the equipment in the central Control room area for each generating unit. Such large number of connections come across considerable problems with the installation of the cables and the connections of the cables and these have caused delays in power station construction.

All cables are fundamentally similar in that they contain conductor for carrying current insulation surrounding the conductor and some have over all covering having metallic and or non metallic components to provide mechanical protection and possible corrosion protection to ensure that the insulation may continue to operate satisfactorily throughout the life of the cable once the cables has been installed.

2. Applicability:

This procedure is applicable to Instrumentation Erection Work.

3. Responsibility:

Responsibility of implementation of this procedure lies with Instrumentation Erection Package Contractor.

4. Reference:

Standard Practice followed in Nuclear Power Plant

5. Prerequisite:

Glanded Cables, shorting links (All free issue). Multimeter, Megger, Torque Screw Driver, Lugs, Crimping tool, Wire Stripper, 1 mm black sleeve, wire no. sleeve heat shrink sleeve.

6. Description:

This procedure describes the requirement for screwed termination of various sizes of control cables.

Control cable wires arc to be connected to the terminal block. Basically the terminal block is a component which interconnects two wires and screws as a junction point. The inter connection may be done whether by means of clamping screws or by means of soldering. All the terminal blocks shall be individual snap on type arrow width blocks which can be stocked on a mounting channel.

Each terminal block shall have one open end and one insulated side when stacked on mounting channel, the terminal block shall be automatically insulated against each other by their insulated sides. An end plate is required to seal and insulate the open end of the unit so that the complete unit of terminal block shall remain fixed in its position on the mounting channel. Wherever necessary cross connection of adjacent terminals are achieved by shorting link. After removing the knockouts provided on the insulating casing these cross connections are screwed to the conductor clamping assembly by means of screws specifically provided for the purpose.

7. Applicable Standards:

IEE-384-1981 - IEEE standard criteria for independence of clause IE equipment and circuits. Equipment and circuit are those that are essential to emergency reactor shutdown containment isolation, reactor core cooling and containment and reactor heal removal or are otherwise essential in preventing a significant release of radio activity material to the environment.

IEE-344-1975 seismic qualification for class IE equipments for nuclear power generating stations.

Common for Panel and JB Termination:

Connect wires to terminals as per the colour code order relative to sequential terminal no. on numbered terminal with first wire of twisted pair.

Cables entering to JB from bottom/side of the JB, the wire should run to the top of the JB behind the terminal block and then connected to terminal block to provide extra length for changes in wiring modification m future where as in panels cable entering from top the panel should run to sufficient length such that any changes in future can be taken care of.

Wiring Termination of the Field Mounted Instruments:

Field cabling wires shall be connected to the field instruments using suitable lugs. Multistrand wires shall be tinned before crimping to the lugs. Approved type wire identifications shall be provided for instruments having flying leads. Suitable terminal block will be provided in a circular junction box and field wires shall be terminated in the terminal block with wire identification.

8. Acceptance Criteria :

Continuity checking and wire stripping:

All wires shall be checked fur proper identification continuity and for any damage before taking up wiring connection. For removing the insulation of wires before termination, wire stripper having adjustment facility for various gauges of wires shall be used. Insulation of wires shall, not be removed by any other, means.

8. Records

Records shall be generated as per the checklist provided by NPCIL.

7.14.0 EARTHING INSTALLATION

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

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.

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.

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

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

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

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

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

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 aluminum paint should be given.

7.15.0 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 specified by NPCIL

In case any clause of contradictory nature arises between standards and this specification, the regulations specified by NPCIL shall prevail.

7.16.0 DESIGN REQUIREMENTS FOR SUPPLY ITEMS

1. LIGHT CHANNELS:

Light channels shall be made of 2 mm thk MS sheet and hot dip galvanized. Manufacturing and supply of light channels shall conform to the following Indian Standards (IS)

a) Raw material	:	IS 1079 GR 0
b) Fabrication	:	IS 813 and IS 816
c) Galvanizing	:	IS 2629, IS 2633 and IS 4759
d) Testing	:	IS 2633, IS 4759 and IS 6745

Following standard sections may be supplied in required quantities to cater the cable laying requirement.

i) 25 x 50 x 25 x 2 mm

ii) 30 x 90 x 30 x 2 mm

iii) 50 x 125 x 50 x 2 mm

iv) 50 x 150 x 50 x 2 mm

Following standard sections may be supplied in required quantities to cater the impulse pipe laying requirement.

i) 25 x 50 x 25 x 2 mm

ii) 25 x 90 x 25 x 2 mm

iii) 25 x 125 x 25 x 2 mm

iv) 25 x 150 x 25 x 2 mm

Prototype light channel and accessories in different section shall be manufactured and got approved by NPCIL before taking up mass production.

All light channels and accessories shall be offered for stage wise inspection by NPCIL in the factory and shall be dispatched only after factory inspection.

Required quantity of light channels with accessories like coupler plate, bends etc shall be made available for the unhindered work progress at site.

2. STRUCTURAL STEEL

Structural Steel (ISA, ISMC, ISMB, Plate, Flats etc.), TISCO/ SAIL make, conforming to IS 2062 and as per working documentation, specification and instruction of Engineer in Charge shall be supplied by the contractor

7.17.0 GUIDELINES FOR COMMISSIONING OF AC MOTORS

- IR test of stator and rotor windings.
- Heating of both windings upto the permissible temp.
- Ensure that checking/testing of associated switchboard, cables, relays/meter interlocking as mentioned in relevant chapters are completed.
- Check tightness of cable connection.
- Winding resistance measurement of stator and rotor.
- Checking continuity of winding .
- Check tightness of earth connections.
- Check space heaters and carryout heating of winding (if required)
- Check direction of rotation in decoupled condition during kick-start
- Measure no load current for all phases.

- Measurement of temperature of body during on load and load conditions.
- Check for tripping of motor from local/remote switches and from.
- Checking of vibration (if required).
- Checking of noise level (if required)
- During load running, measurement of stator and bearing temperatures (if applicable) for every half and hour interval till saturation comes.
- Check rightness of foundation bolts
- Check operation of speed switch (if here)
- Check continuity of temperature detectors.
- Check alignment, paralleling of shafts, level of lubrication oil etc. as per manufacture's manual
- Check contact of slip ring brush and measure brush pressure (150-200 gm/sq.cm).
- For CACW drive check cooling water and system/piping availability of pressure, cleaning and pressure testing of pipelines etc.
- Check for polarization index of stator Winding. R10/R1 by motorized megger (The value should bot be less than 2.0) R60/10 absorption coefficient shall not be less than 1.5.
- Dielectric test (only for HT motors.)
- Measurement of open circuit rotor Winding voltage for slip ring motor.
- For actuator drives following shall be checked/tested:
- visual and dimensional
- Hydraulic pressure for values
- IR and operation of limit switches
- Winding resistance

7.18.0 GUIDELINES FOR COMMISSIONING OF DC MOTORS

- IR measurement and heating the winding as per heating curve.
- Check for earth connection.
- Winding resistance for field and armature.
- Check running of drive at minimum and maximum specified.
- Check auto start of drive on failure of AC supply (if applicable)
- Check operation of overload relay.

- Measure vibration.
- Check temperature rise on body of drive after required period of continuous running.
- Measure load currents and on load currents (if possible).
- Check direction of rotation.
- Check continuity of winding.
- Measurement of RPM.

NOTE:

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

SECTION VIII

APPENDIX – II

DECLARATION SHEET

I, hereby certify that, all the information and data furnished by me with regard to this Tender Specification No.BHEL:PSSR:SCT:1243 are true and complete to the best of my knowledge. I have gone through the specifications, conditions, stipulations in detail and agree to comply which the requirements and intent specifications.

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

TENDERER'S NAME & ADDRESS

AUTHORISED REPRESENTATIVE'S
SIGNATURE WITH NAME & ADDRESS

SECTION VIII

APPENDIX – III

TENDER SPECIFICATION NO BHEL:PSSR:SCT:1243

CERTIFICATE OF DECLARATION FOR CONFIRMING KNOWLEDGE ON SITE CONDITIONS

We,

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

TENDERER'S NAME AND ADDRESS

Place:

Date :

SIGNATURE OF AUTHORISED REPRESENTATIVE WITH NAME & ADDRESS:

OFFICE SEAL

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

SECTION VIII

APPENDIX - IV

CHECK LIST

TENDER SPECTFICATION NO, BHEL: PSSR : SCT : 1243

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)	In case 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

KUDANKULAM 2 X 1000 MWe NUCLEAR POWER PROJECT – UNIT 1

CONTROLS & INSTRUMENTATION PACKAGE

BILL OF MATERIALS

Scope of work specific for each item is indicated in the third column of BOM. In addition to these clauses, other common clauses like painting, calibration, Civil Work etc. (under 6.2.0) related to the work are also to be referred.

SL. NO.	DESCRIPTION	REF. CLAUSE	QTY
1.0	**ERECTION & COMMISSIONING / REMOVAL, CALIBRATION & REFIXING OF INSTRUMENTS**		
1.1	Pressure Transmitters	6.2.3	140 Nos.
1.2	DP Transmitters	6.2.3	75 Nos.
1.3	Level Transmitters	6.2.3	15 Nos.
1.4	Flow transmitters	6.2.3	5 Nos.
1.5	Pressure Gauges	6.2.3	320 Nos.
1.6	DP Gauges	6.2.3	50 Nos.
1.7	Temperature Gauges	6.2.3	110 Nos.
1.8	Pressure Switches	6.2.3	30 Nos.
1.9	DP Switches	6.2.3	20 Nos.
1.10	Level Switches	6.2.3	20 Nos.
1.11	Temperature Switches	6.2.3	10 Nos.
1.12	Flow Indicator/ Switch	6.2.3	10 Nos.
1.13	Thermocouples	6.2.3	200 Nos.
1.14	RTDs	6.2.3	130 Nos.
1.15	RTDs installed on Generator/ Exciter (checking only)	6.2.8.5	160 Nos.
1.16	RTDs fixed on BFP motors (for bearing & winding) (checking only)	6.2.8.5	160 Nos.
1.17	Thrust bearing Temperature Indicators/ RTDs	6.2.3	20 Nos.
1.18	Limit Switch/ Microswitch/ Position switch	6.2.3	20 Nos.
1.19	Air humidity/ Temperature Transmitters	6.2.3	4 Nos.
1.20	Level Detectors	6.2.3	20 Nos.
1.21	Servomotor Travel Sensors	6.2.3	20 Nos.

SL. NO.	DESCRIPTION	REF. CLAUSE	QTY
1.22	Gas Analyser Cabinet (CWX01C) including sensor, analysers (H2 purity/ H2 content/Dew point) etc. Approximate weight: 800 kg	6.2.2, 6.2.3	1 set *
1.23	Conductivity Analyser / pH Analyser Online / Sampling type analysers along with sensors, electronic instruments, sampling coolers, interconnection pipes etc.	6.2.3	2 sets*

* Lumpsum rate to be quoted

2.0	**ERECTION/COMMISSIONING OF TUBE CLEANING SYSTEM DN2400**		
2.1	Control panel for Tube Cleaning system, along with monitor, keyboard etc. Approximate size: 850 x 650 x 2250 mm; Weight: 300 kg	6.2.2	6 Nos.
2.2	Control panel for Debris Filter, along with monitor, keyboard etc. Approximate size: 850 x 650 x 2250 mm; Weight: 300 kg	6.2.2	6 Nos.
3.0	**ERECTION/COMMISSIONING OF TUBE CLEANING SYSTEM (for installation in DN600 CW Line)**		
3.1	Control panel for Tube Cleaning system, along with monitor, keyboard etc. Approximate size: 1450 x 750 x 2330 mm; Weight: 450 kg	6.2.2	2 Nos.
3.2	Control panel for Debris Filter, along with monitor, keyboard etc. Approximate size: 1450 x 750 x 2330 mm; Weight: 450 kg	6.2.2	2 Nos.

4.0	**ERECTION/COMMISSIONING OF GENERATOR MONITORING PANEL**		
4.1	PLC Panel for Generator Monitoring, along with attached ceiling cooling unit and computer, printer, UPS etc. Size of Panel: 800 x 800 x 2000 mm; 250 kg Size of cooling unit: 415 x 595 x 475 mm	6.2.2, 6.2.7	1 set*

SL. NO.	DESCRIPTION	REF. CLAUSE	QTY
5.0	**ERECTION/COMMISSIONING OF VIBRATION MONITORING SYSTEM PANEL FOR BFPs**		
5.1	Vibration Monitoring System Panel for BFPs *Note: The erection of pickups, probes and accessories will be carried out by Mechanical Contractor*	6.2.2, 6.2.3	1 set*

* Lumpsum rate to be quoted

6.0	**ERECTION/COMMISSIONING OF TURBOVISORY SYSTEM**		
6.1	Turbovisory System consisting of following – i) Turbovisory Racks: 24 Nos. ii) Housing for racks: 4 Nos iii) interconnecting pair cables (Size varying from 2P x 0.5 sq mm to 24 P x 0.5 sq. mm) between the field instruments/signal conditioning instruments/panels *Note: The erection of pickups, probes and accessories will be carried out by Mechanical Contractor*	6.2.2, 6.2.3	1 set*
7.0	**LAYING, TERMINATION AND TESTING OF CONTROL & INSTRUMENTATION CABLES** PVC/ FRLS, Unarmoured/ Armoured Cables		
7.1	2 Pair to 5 Pair/ X 0.5 / 1.5 sq mm/ 2 C to 7 C x 1.5 sq. mm	6.2.9	8500 Mtrs
7.2	6 Pair to 10 Pair/ 4 Triad X 0.5 / 1.5 sq mm	6.2.9	3000 Mtrs
7.3	12 Pair to 24 Pair X 0.5 / 1.5 sq mm	6.2.9	2000 Mtrs
7.4	4C x 4 Sq.mm	6.2.9	500 Mtrs
7.5	4C x 2.5 Sq.mm	6.2.9	1850 Mtrs
7.6	2C x 2.5 Sq.mm	6.2.9	1200 Mtrs

* Lumpsum rate to be quoted

8.0	**ERECTION/ TESTING OF IMPULSE PIPES (Excluding welding)**		
8.1.0	SS pipe of 08X18H10T upto 20 mm OD size with wall thickness upto 2.5 mm		
8.1.1	14 mm OD	6.2.4	20000 Mtrs

SL. NO.	DESCRIPTION	REF. CLAUSE	QTY
8.1.2	20 mm OD	6.2.4	2500 Mtrs
8.2	CS Pipe of St. 20 upto 16 mm OD with wall thickness upto 2 mm	6.2.4	15000 Mtrs
9.0	**WELDING OF JOINTS IN THE ABOVE IMPULSE TUBES using Orbital welding machine, including supply of High purity Argon gas (99.999%)**		
9.1	SS pipe, 14 mm OD with wall thickness upto 2.5 mm	6.2.4	2500 Nos.
9.2	SS pipe, 20 mm OD with wall thickness upto 2.5 mm	6.2.4	300 Nos.
9.3	CS Pipe, upto 16 mm OD with wall thickness upto 2 mm	6.2.4	1600 Nos.
10.0	**ERECTION OF JUNCTION BOXES**		
10.1	Upto 24 way JB	6.2.6	100 Nos.
10.2	26 way to 50 way JB	6.2.6	30 Nos.
10.3	51 way to 100 way JB	6.2.6	10 Nos.
11.0	**ERECTION OF INSTRUMENT RACKS**		
11.1	Prefabricated Racks of different Sizes	6.2.12	10 MT
12.0	**FABRICATION/ERECTION OF STRUCTURAL STEEL**		
12.1	Angles of size ranging from 25 x 25 x 3 to 50 x 50 x 6 mm	6.2.11	3 MT
12.2	Channels of size 100 x 50 x 6 mm	6.2.11	2 MT
13.0	**ERECTION OF GI LIGHT CHANNELS FOR ROUTING OF IMPULSE PIPES/ CABLES**		
13.1	MS Hot dip galvanized, light channels of various sizes ranging from 50 mm to 200 mm, including accessories like bends, tees, covers etc, and supports as shown in drawing	6.2.4	10 Ton
14.0	**ERECTION OF COPPER TUBES**		
14.1	Cu Tube, 8 mm OD	6.2.5	500 Mtrs

SL. NO.	DESCRIPTION	REF. CLAUSE	QTY
15.0	**ERECTION OF EARTHING MATERIAL**		
15.1	25 x 3 mm GI Flat	6.2.16	500 Mtrs
15.2	8 SWG GI Wire	6.2.16	1000 Mtrs
16.0	**CHECKING & COMMISSIONING OF FOLLOWING ERECTED BY OTHER AGENCY**		
16.1	LT Motors (for Tube Cleaning System)	6.2.8.1	20 Nos. $
16.2	Control Valves	6.2.8.6	24 Nos.$
17.0	**SUPPLY OF MANPOWER** Providing skilled manpower to carry out certain works, as per the technical requirements, which are not covered in above scope of work, but necessary to carry out the works for completion of erection and commissioning of Elec/C&I Equipment		
17.1	Elec/C&I Engineers/ Supervisors	6.25	(per manday)
17.2	Elec/C&I Technicians	6.25	(per manday)

$ Rate to be quoted for commissioning only

TENDER SPECIFICATION

BHEL:PSSR:SCT: 1243

FOR

Handling at Site Stores / Storage Yard
Transportation to site of work, Erection, Testing and
Providing Commissioning assistance for
Control & Instrumentation System for
Unit -1 of 2x 1000 MWe Nuclear Power Plant
at KudanKulam, Tamilnadu

For

Nuclear Power Corporation of India Limited
KudanKulam , Tirunelveli Dist
Tamilnadu .

PART – II PRICE BID

BOOK NO :

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

Bharat Heavy Electricals Limited
(A Govt. of India Undertaking)
Power Sector – Southern Region
EVR Periyar Building
690 , Anna Salai, Nandanam, Chennai – 600 035.

TENDER SPECIFICATION NO:BHEL:PSSR:SCT:1243

NAME OF WORK

Handling at Site Stores / Storage Yard
Transportation to site of work, Erection, Testing and
Providing Commissioning assistance for
Control & Instrumentation System
for Unit -1 of 2x 1000 MWe Nuclear Power Plant
at KudanKulam, Tamilnadu

(PRICE BID)

PART II

Issued to

M/s.

For and on behalf of
BHARAT HEAVY ELECTRICALS LIMITED

Addl. General Manager/Contracts

(This tender document is not transferable)

Place: Chennai-600 035.
Date:

KUDANKULAM 2 X 1000 MWe NUCLEAR POWER PROJECT – UNIT 1

CONTROLS & INSTRUMENTATION PACKAGE

BILL OF MATERIALS

Scope of work specific for each item is indicated in the third column of BOM. In addition to these clauses, other common clauses like painting, calibration, Civil Work etc. (under 6.2.0) related to the work are also to be referred.

SL. NO.	DESCRIPTION	REF. CLAUSE	QTY	UNIT RATE	TOTAL RATE
1.0	**ERECTION & COMMISSIONING / REMOVAL, CALIBRATION & REFIXING OF INSTRUMENTS**				
1.1	Pressure Transmitters	6.2.3	140 Nos.		
1.2	DP Transmitters	6.2.3	75 Nos.		
1.3	Level Transmitters	6.2.3	15 Nos.		
1.4	Flow transmitters	6.2.3	5 Nos.		
1.5	Pressure Gauges	6.2.3	320 Nos.		
1.6	DP Gauges	6.2.3	50 Nos.		
1.7	Temperature Gauges	6.2.3	110 Nos.		
1.8	Pressure Switches	6.2.3	30 Nos.		
1.9	DP Switches	6.2.3	20 Nos.		

SL. NO.	DESCRIPTION	REF. CLAUSE	QTY	UNIT RATE	TOTAL RATE
1.10	Level Switches	6.2.3	20 Nos.		
1.11	Temperature Switches	6.2.3	10 Nos.		
1.12	Flow Indicator/ Switch	6.2.3	10 Nos.		
1.13	Thermocouples	6.2.3	200 Nos.		
1.14	RTDs	6.2.3	130 Nos.		
1.15	RTDs installed on Generator/ Exciter (checking only)	6.2.8.5	160 Nos.		
1.16	RTDs fixed on BFP motors (for bearing & winding) (checking only)	6.2.8.5	160 Nos.		
1.17	Thrust bearing Temperature Indicators/ RTDs	6.2.3	20 Nos.		
1.18	Limit Switch/ Microswitch/ Position switch	6.2.3	20 Nos.		
1.19	Air humidity/ Temperature Transmitters	6.2.3	4 Nos.		
1.20	Level Detectors	6.2.3	20 Nos.		
1.21	Servomotor Travel Sensors	6.2.3	20 Nos.		
1.22	Gas Analyser Cabinet (CWX01C) including sensor, analysers (H2 purity/ H2 content/Dew point) etc. Approximate weight: 800 kg	6.2.2, 6.2.3	1 set *		

SL. NO.	DESCRIPTION	REF. CLAUSE	QTY	UNIT RATE	TOTAL RATE
1.23	Conductivity Analyser / pH Analyser Online / Sampling type analysers along with sensors, electronic instruments, sampling coolers, interconnection pipes etc.	6.2.3	2 sets*		

* Lumpsum rate to be quoted

2.0	**ERECTION/COMMISSIONING OF TUBE CLEANING SYSTEM DN2400**				
2.1	Control panel for Tube Cleaning system, along with monitor, keyboard etc. Approximate size: 850 x 650 x 2250 mm; Weight: 300 kg	6.2.2	6 Nos.		
2.2	Control panel for Debris Filter, along with monitor, keyboard etc. Approximate size: 850 x 650 x 2250 mm; Weight: 300 kg	6.2.2	6 Nos.		
3.0	**ERECTION/COMMISSIONING OF TUBE CLEANING SYSTEM (for installation in DN600 CW Line)**				
3.1	Control panel for Tube Cleaning system, along with monitor, keyboard etc. Approximate size: 1450 x 750 x 2330 mm; Weight: 450 kg	6.2.2	2 Nos.		
3.2	Control panel for Debris Filter, along with monitor, keyboard etc. Approximate size: 1450 x 750 x 2330 mm; Weight: 450 kg	6.2.2	2 Nos.		

SL. NO.	DESCRIPTION	REF. CLAUSE	QTY	UNIT RATE	TOTAL RATE
4.0	**ERECTION/COMMISSIONING OF GENERATOR MONITORING PANEL**				
4.1	PLC Panel for Generator Monitoring, along with attached ceiling cooling unit and computer, printer, UPS etc. Size of Panel: 800 x 800 x 2000 mm; 250 kg Size of cooling unit: 415 x 595 x 475 mm	6.2.2, 6.2.7	1 set*		
5.0	**ERECTION/COMMISSIONING OF VIBRATION MONITORING SYSTEM PANEL FOR BFPs**				
5.1	Vibration Monitoring System Panel for BFPs *Note: The erection of pickups, probes and accessories will be carried out by Mechanical Contractor*	6.2.2, 6.2.3	1 set*		

* Lumpsum rate to be quoted

SL. NO.	DESCRIPTION	REF. CLAUSE	QTY	UNIT RATE	TOTAL RATE
6.0	**ERECTION/COMMISSIONING OF TURBOVISORY SYSTEM**				
6.1	Turbovisory System consisting of following – iv) Turbovisory Racks: 24 Nos. v) Housing for racks: 4 Nos vi) interconnecting pair cables (Size varying from 2P x 0.5 sq mm to 24 P x 0.5 sq. mm) between the field instruments/signal conditioning instruments/panels *Note: The erection of pickups, probes and accessories will be carried out by Mechanical Contractor*	6.2.2, 6.2.3	1 set*		
7.0	**LAYING, TERMINATION AND TESTING OF CONTROL & INSTRUMENTATION CABLES** PVC/ FRLS, Unarmoured/ Armoured Cables				
7.1	2 Pair to 5 Pair/ X 0.5 / 1.5 sq mm/ 2 C to 7 C x 1.5 sq. mm	6.2.9	8500 Mtrs		
7.2	6 Pair to 10 Pair/ 4 Triad X 0.5 / 1.5 sq mm	6.2.9	3000 Mtrs		
7.3	12 Pair to 24 Pair X 0.5 / 1.5 sq mm	6.2.9	2000 Mtrs		
7.4	4C x 4 Sq.mm	6.2.9	500 Mtrs		
7.5	4C x 2.5 Sq.mm	6.2.9	1850 Mtrs		
7.6	2C x 2.5 Sq.mm	6.2.9	1200 Mtrs		

SL. NO.	DESCRIPTION	REF. CLAUSE	QTY	UNIT RATE	TOTAL RATE

* Lumpsum rate to be quoted

8.0	**ERECTION/ TESTING OF IMPULSE PIPES (Excluding welding)**				
8.1.0	SS pipe of 08X18H10T upto 20 mm OD size with wall thickness upto 2.5 mm				
8.1.1	14 mm OD	6.2.4	20000 Mtrs		
8.1.2	20 mm OD	6.2.4	2500 Mtrs		
8.2	CS Pipe of St. 20 upto 16 mm OD with wall thickness upto 2 mm	6.2.4	15000 Mtrs		
9.0	**WELDING OF JOINTS IN THE ABOVE IMPULSE TUBES** **using Orbital welding machine, including supply of High purity Argon gas (99.999%)**				
9.1	SS pipe, 14 mm OD with wall thickness upto 2.5 mm	6.2.4	2500 Nos.		
9.2	SS pipe, 20 mm OD with wall thickness upto 2.5 mm	6.2.4	300 Nos.		
9.3	CS Pipe, upto 16 mm OD with wall thickness upto 2 mm	6.2.4	1600 Nos.		

SL. NO.	DESCRIPTION	REF. CLAUSE	QTY	UNIT RATE	TOTAL RATE
10.0	**ERECTION OF JUNCTION BOXES**				
10.1	Upto 24 way JB	6.2.6	100 Nos.		
10.2	26 way to 50 way JB	6.2.6	30 Nos.		
10.3	51 way to 100 way JB	6.2.6	10 Nos.		
11.0	**ERECTION OF INSTRUMENT RACKS**				
11.1	Prefabricated Racks of different Sizes	6.2.12	10 MT		
12.0	**FABRICATION/ERECTION OF STRUCTURAL STEEL**				
12.1	Angles of size ranging from 25 x 25 x 3 to 50 x 50 x 6 mm	6.2.11	3 MT		
12.2	Channels of size 100 x 50 x 6 mm	6.2.11	2 MT		

SL. NO.	DESCRIPTION	REF. CLAUSE	QTY	UNIT RATE	TOTAL RATE
13.0	**ERECTION OF GI LIGHT CHANNELS FOR ROUTING OF IMPULSE PIPES/ CABLES**				
13.1	MS Hot dip galvanized, light channels of various sizes ranging from 50 mm to 200 mm, including accessories like bends, tees, covers etc, and supports as shown in drawing	6.2.4	10 Ton		
14.0	**ERECTION OF COPPER TUBES**				
14.1	Cu Tube, 8 mm OD	6.2.5	500 Mtrs		
15.0	**ERECTION OF EARTHING MATERIAL**				
15.1	25 x 3 mm GI Flat	6.2.16	500 Mtrs		
15.2	8 SWG GI Wire	6.2.16	1000 Mtrs		
16.0	**CHECKING & COMMISSIONING OF FOLLOWING ERECTED BY OTHER AGENCY**				
16.1	LT Motors (for Tube Cleaning System)	6.2.8.1	20 Nos. $		
16.2	Control Valves	6.2.8.6	24 Nos.$		

	TOTAL VALUE ----------	

SIGNATURE OF CONTRACTOR

17.0	**SUPPLY OF MANPOWER (Optional Rate)** Providing skilled manpower to carry out certain works, as per the technical requirements, which are not covered in above scope of work, but necessary to carry out the works for completion of erection and commissioning of Elec/C&I Equipment				
17.1	Elec/C&I Engineers/ Supervisors	6.23.4	(per man Month)		
17.2	Elec/C&I Technicians	6.23.4	(per man Month)		

$ Rate to be quoted for commissioning only

SIGNATURE OF CONTRACTOR

NOTE TO RATE SCHEDULE

2 The quantities indicated are approximate and are liable for variation and alteration at the discretion of BHEL. The quoted unit rate shall be applicable for any additional items, if included at a later date. The work executed shall be measured and payable at Unit rate quoted by the contractor and accepted by BHEL.

3 The description of work indicated in the rate schedule shall include all types of handling and transportation of materials from storage yard/pre assembly yard to the place of erection, preservation of components at the erection site with contractor's own handling equipment.

4 The tenderer is expected to fill up the rate column after satisfying all terms and conditions of Tender specification.

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

6 Additional Information to be furnished by the bidder along with the Price Bid .

i. Element of VAT added with the above Quoted Price **Rs……**

ii Rate of VAT % **…… %**

iii Reason for inclusion **……..**