

TENDER SPECIFICATION

BHEL: PSSR: SCT: 1331

Handling at Site Stores/Storage yard, Transportation to Site of Work, Pre Assembly, Erection, Testing and Commissioning of Boiler Structures, Pressure Parts, Non Pressure Parts Rotating Equipments and Boiler auxiliaries, ESP and Cooling water piping including Supply and Application of Final Painting for unit 1&2 of 2x 600 MW Units.

at

**North Chennai Thermal
Power Station
Stage - II: 2 x 600 MW
Athipattu, Thiruvallur Dt.
Chennai, T.N. – 600 120**

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 : 1331

NORTH CHENNAI BOILER, ESP, ROTATING MACHINES
AND COOLING WATER PIPING

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

Tender Specification No. BHEL:PSSR:SCT: 1331

Messrs

Date:

Dear Sir,

Sub: Handling at Site Stores / Storage yard, Transportation to Site of Work, Pre Assembly Erection, Testing and Commissioning of Boiler Structures, Pressure Parts, Non Pressure Parts, Rotating Equipments and Boiler auxiliaries, ESP and Cooling water piping including Supply and Application of Final Painting for Unit 1 & 2 of 2 x 600 MW Units at North Chennai Thermal Power Station, Athipattu Village, Chennai, TamilNadu.

Please find enclosed one set of non-transferable tender documents along with General Conditions of Contract Booklet for the above work.

You are requested to go through the tender documents, GCC Booklet and offer your most competitive rate and submit the tender documents duly filled in as per procedure indicated in the tender specification along with requisite EMD of **Rs.2 lakhs (Rupees two Lakhs only)** in the form of Demand Draft drawn in favour of M/s.Bharat Heavy Electrical Limited Chennai - 35

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

Bids with Deviations from the tender conditions will be rejected.

The completed quotations shall reach the office of the under signed on or before **17.03.2009 at 15.00 Hrs.** The Technical bids will be opened on the same day at **15.30** hrs. We shall separately intimate the date for opening the price bids only to those parties who are technically qualified. You are requested to depute your authorized representative at the time of opening.

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

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

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

Thanking you,

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

ADDITIONAL GENERAL MANAGER / CONTRACTS

Place: Chennai -35

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

- This Tender document is not transferable

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

SPECIAL INSTRUCTIONS TO BIDDERS

The Bidder must submit their bids as requested in a sealed cover prominently superscribing 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 seven years indicating contract value, duration, completion period and present engagement as per G.C.C.
02. Organization structure of the Company as per GCC.
03. Financial status of the firm enclosing balance sheet and profit and loss account for the past 3 years and certificate from the Company's Banker as per G.C.C
04. Turnover of the Company in last 3 financial years.
05. Latest Income Tax clearance certificate.
06. BIO DATA of key personnel presently in the Rolls of the company and proposed site organization for carrying out the work including deployment of Engineers and Supervisors.
07. Declaration sheets as per Appendix of Tender Specification.
08. Checklist and Schedule of General particulars as per Appendix in GCC.
09. T & P owned/deployment details as per G.C.C.
10. Technical manpower deployment details as per G.C.C
11. Other relevant details as per GCC and checklist.
12. These terms and conditions will be read and construed along with General Conditions of contract and in case of any conflict or inconsistency between the General conditions and the Terms and condition the tender specification, the provisions contained in the Terms and conditions (NIT, Rate Schedule, Common conditions, Special Conditions including Appendices) shall prevail.

13. The bidders are requested to furnish the documents like copies of LOI's, work order's etc pertaining to the experience indicated in qualifying requirements, as given below.

14. Qualification Requirements:

- a) **The bidder should have executed minimum one unit of 210 MW capacity Boiler and its Auxiliaries in the last seven years.**

Note: The term "executed" means the unit is synchronized.

- b) The bidders should have a minimum average financial turn over of **Rs.19 Crores** in last three financial years ending on 31st March 2008.

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

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

- c) Approval of the agency by customer

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

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

- d) **There are two units of 600MW each at North Chennai. Tender SCT 1331 is for unit 1- 600MW (at North Chennai) only. The quantity indicated in the price bid is for Unit-1 only. The L1 bidder against this quote will be awarded the contract for Unit 1 of North Chennai TPP - 600MW. However, BHEL reserves the right to award the contract for Unit-2 at North Chennai, on the same terms and conditions of SCT 1331, to the next lowest bidder in the order of competitiveness who matches his rates / price with L1 bidder of unit 1. Thus the work will be awarded to two agencies i.e. Unit 1 work for one agency and Unit 2 work for other agency. Each unit will be treated as separate contract.**

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

16. SAFETY PLAN

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

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

PROCEDURE FOR SUBMISSION OF SEALED BIDS

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

Part I (Technical Bid) Cover I

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

Part II (Price Bid) Cover II

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

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

These two separate cover I & II (Part I and Part II) shall together be enclosed in a **third envelope (Cover III)** along with requisite EMD as indicated and this sealed cover shall be superscribed 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 booklets. Out of which one set of each document shall be retained by them for their reference. Balance one set shall be submitted along with their offer as per procedure indicated above.

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

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

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

Additional General Manager/Contracts.

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

TENDER NOTICE

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

Tender Specification No. BHEL: PSSR: SCT: 1331

Description	EMD
Handling at Site Stores / Storage yard, Transportation to Site of Work, Pre Assembly Erection, Testing and Commissioning of Boiler Structures, Pressure Parts, Non Pressure Parts, Rotating Equipments and Boiler auxiliaries, ESP and Cooling water piping including Supply and Application of Final Painting for Unit1&2 of 2 x 600 MW Units at North Chennai Thermal Power Station, Athipattu Village, Chennai, TamilNadu.	Rs. 2, 00,000 (Rupees Two Lakhs)

Cost of Tender Documents (Including all Taxes)	:	Rs.1040/	
Sale Starts on	:	23.02.2009	
Sale closes on	:	16.03.2009	
Due date and Time for Submission	:	17.03.2009	15.00 Hrs.
Date and time for opening Of Technical Bids	:	17.03.2009	15.30 Hrs.

Qualification Requirements

- a) **The bidder should have executed minimum one unit of 210 MW capacity Boiler and its Auxiliaries in the last seven years.**

Note: The term "executed" means the unit is synchronized

- b) The bidders should have a minimum average financial turn over of **Rs.19 Crores** in last three financial years ending on 31st March 2008.

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

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

- c) Approval of the agency by Customer.

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

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

Note : There are two units of 600MW each at North Chennai. Tender SCT 1331 is for unit 1- 600MW (at North Chennai) only. The quantity indicated in the price bid is for Unit-1 only. The L1 bidder against this quote will be awarded the contract for Unit 1 of North Chennai TPP - 600MW.

However, BHEL reserves the right to award the contract for Unit-2 at North Chennai, on the same terms and conditions of SCT 1331, to the next lowest bidder in the order of competitiveness who matches his rates / price with L1 bidder of unit 1.

Thus the work will be awarded to two agencies i.e. Unit 1 work for one agency and Unit 2 work for other agency. Each unit will be treated as separate contract.

Refer Clause 6.10.0 in the Special conditions of Contract, Part II for the mode of award of work for unit 1&2.

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

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

TENDER NOT ACCOMPANIED BY THE PRESCRIBED EARNEST MONEY DEPOSIT ARE LIABLE TO BE SUMMARILY REJECTED.

ADDITIONAL GENERAL MANAGER/CONTRACTS

TENDER SPECIFICATION: BHEL: PSSR: SCT: 1331

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: 1331** issued by Bharat Heavy Electricals Limited, Power Sector: Southern Region, in accordance with the terms and conditions thereof.

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

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

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

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

DATE:

CONTRACTOR:

PLACE:

ADDRESS:

Witness with their address

Signature

Name

Address

**NORTH CHENNAI TPS STAGE-II 2 X 600 MW
PROJECT INFORMATION**

1. Project Name : North Chennai Thermal Power Station
2. Project Stage : Stage- II
3. No. of Units x Capacity : 2 x 600 MW
4. Project setting up by : Tamil Nadu Electricity Board (TNEB)
5. LOCATION AND APPROACH : (i) Athipattu Village about 6 KMs from Athipattu Railway Station. From Chennai City about 20 KMs.
From Chennai Airport 35 KMs
(ii) District: Thiruvallur
(iii) State : Tamil Nadu
- 6 .Nearest Railway Station : i) Athipattu Pudunagar on Chennai – Howrah route
8 KMs from site
ii) Athipattu 6 Kms
7. Nearest Major Town & Distance : Chennai 20 Kms.
8. Nearest Airport & Distance : Chennai 35 KMs
9. Nearest Highway & Distance : All weather road from Pattamandri on
Chennai – Ponneri District Highway / 12 Kms.
10. Temperature : (Dry bulb) : Absolute Max. 45⁰ C (Highest mean monthly Max. 35⁰ C)
: Absolute Min. 15⁰ C (Lowest mean monthly Min. 24⁰ C)
: Average 35⁰ C (Design)
11. Relative Humidity
Maximum : 100 %
Minimum : 36 %
Average : 75 % (Design)
12. Annual Rainfall : Max. 2540.8 mm / Average 1600 mm / Min 1175.7 mm.
13. Wind Load : Basic Wind Speed 50 mm/sec. (Max.) /
11.8 KMPH (Average)
14. Transport:
a) By Rail : Broad Gauge Railway line of Southern Railway
b) Road : District High way
15. Seismic Data : Zone – III as defined in IS :1893 - 2002

**SECTION III
COMMON CONDITIONS OF CONTRACT
FOR ERECTION WORK**

3.1 SCOPE OF CONTRACT

- 3.1.1 The Intent of this specification is to provide Erection and Commissioning services for execution of projects according to most modern and proven techniques and codes. The omission of specific reference to any method and equipment or material necessary for the proper and efficient services towards installation of the Plant shall not relieve the contractor of the responsibility of providing such services, facilities to complete the project or portion of project awarded to him. The quoted rate shall deem to be inclusive of all such contingencies.
- 3.1.2 The contractor shall carry out the work in accordance with instructions/ drawings/ specification/ standard practices supplied by BHEL from time to time.
- 3.1.3 Provision of all types of labour, Supervisors, Engineers watch and ward as required, tools and tackles as required, consumables as required under various clauses of tender specification for handling transportation, erection, testing and commissioning.
- 3.1.4 Proper out-turn as per BHEL plan and commitment.
- 3.1.5 Completion of work in time.
- 3.1.6 Good quality and accurate workmanship for proper performance of equipment / systems.
- 3.1.7 Preservation of all components at all stages of pre-assembly/erection/ till unit is handed over, as specified in detail in clause 3.7.0

3.2 FACILITIES TO BE PROVIDED BY BHEL:

3.2.1 OPEN SPACE :

Open space for building of temporary office shed, contractor's stores shed(s) will be provided free of hire charges.

3.2.2 ELECTRICITY:

The construction power will be provided to the contractor on chargeable at the applicable rate of TNEB under LT tariff V from the nearest substation. The required energy meter for measuring power consumption will be provided and installed by BHEL. The contractor shall make his own arrangement for further distribution with necessary isolator/LCB etc. The present LT tariff V rate of TNEB is

- a) Consumption charges at Rs.5.80 per unit
- b) Fixed charges at Rs. 30 per month
- c) Electricity Tax at the rate of 5%

The TNEB tariff may vary from time to time. Any dispute regarding consumption, the BHEL engineer decision is final

Contractor shall make his own arrangement for alternative source of power supply through deployment of adequate number of DG sets at their cost during the power breakdown / failure and during the initial stages. No separate payment shall be made for this contingency

3.2.3 CONSTRUCTION WATER :

Water (Raw water) required for construction purposes will be provided on chargeable at applicable tariff of TNEB/Metrowater from the nearest storage tank located inside the plant area. The required watermeter for measuring the consumption will be provided by BHEL and the same shall be installed by the contractor. The required pumps & accessories, pipes for drawing water from the storage tank and further distribution will be arranged by the contractor at their cost.

The prevailing water charge is Rs 66.00 per 1000litres which may vary from time to time as per TNEB/Metrowater conditions. Any dispute regarding consumption, the BHEL engineer decision will be final. In case non availability of water, the contractor shall make his own arrangements for uninterrupted work. No separate payment shall be made for any contingency arrangement made by contractor, due to delay / failure for providing water supply

3.2.4 TOOLS & TACKLES:

All the tools and tackles required for the complete erection of components shall be arranged by the contractor, except the items specified and agreed upon by BHEL and the quoted rate shall be inclusive of such requirements.

3.2.4.1 T&P provided by BHEL to sub-contractor free of hire charges shall be shared with other sub-contractors working for BHEL at site and the allotment done by the BHEL Engineer shall be final and binding.

3.2.4.2 **HEAVY LIFT CRANE WILL BE PROVIDED FOR CEILING GIRDER LIFTING AS WELL AS COLUMNS FROM 6TH TIER ONWARDS BY BHEL. THIS CRANE WILL BE RETAINED TILL TWO MONTHS AFTER DRUM LIFTING.**

3.2.4.3 Higher capacity cranes above 75T will be provided to the contractor by BHEL for lifting and positioning of such materials that requires crane as decided / at the discretion of BHEL Engineer. And other equipments/members are to be erected by the contractor with their own T&Ps. During the period of deployment of crane by BHEL, it will be on sharable basis at the discretion of BHEL Engineer.

3.2.4.4 The contractor has to mobilize the following major T & Ps.

- | | |
|----------------------------|-------------|
| 1. 75T crawler crane | - 2 No |
| 2. 18T crawler crane | - 2 No |
| 3. 8T Hydraulic | - 2 No |
| 4. Tractor Trailer 20T/30T | - 1 No each |

Any other cranes as per requirement for execution of works as per schedules agreed with BHEL and taking into consideration safety in handling and erection has to be arranged by the contractor at his cost.

3.2.5.1 The contractor has to mobilize his own cranes and tractor trailers over and above the cranes as per the contract for loading of materials at BHEL storage yard, transport to site and unloading.

3.2.5.2 The contractor has to submit along with his bid documents, the details of the cranes that will be mobilized by him, giving details of capacity and type of crane whether crawler/ tyre mounted and whether telescopic / lattice boom. Crawler type crane is recommended over tyre mounted for higher capacities other than 10/8 T cranes.

3.2.5.3 Besides the T&P and IMTEs being made available to contractor free of hire charges by BHEL, all other T&Ps and IMTEs (duly certified by the Statutory / Competent authority) which are required for successful and timely execution of the work covered within the scope of this tender, shall be arranged and provided by the contractor. He should ensure that these are in good working condition. In the event of the failure of contractor to bring necessary and sufficient T&Ps and IMTEs, BHEL will be at liberty to arrange the same and hire charges as applicable shall be deducted from contractor's bill. Decision of BHEL in this regard shall be final and binding on contractor.

- 3.2.5.4 All Electrical distribution boards, connecting cables, wire ropes, hoses, pipes etc, including temporary air / water / electrical connections etc shall have to be arranged by the contractor at his own cost.
- 3.2.5.5 In case of non-availability of the T&Ps to be provided by BHEL due to breakdown, major overhauls, distribution pattern or any other reason, the contractor shall plan /amend/ alter his activities to meet erection /commissioning targets in consultation with BHEL.
- 3.2.5.6 **The contractor shall arrange trained operators and fuel for 75T capacity BHEL cranes at his cost. For higher capacity cranes, BHEL will provide operator and contractor has to provide fuel for the operation of BHEL cranes.**
- 3.2.5.7 The day to day maintenance of BHEL's T&Ps (other than crane) should be carried out by contractor as per manufacturers / BHEL's maintenance schedule at his cost. These shall be maintained in good working condition during the entire period of use. T&Ps in defective / damaged condition shall be rectified promptly to the full satisfaction of BHEL engineer. Contractor shall maintain records for maintenance of major T&Ps that shall be made available for Inspection whenever required. In case of any lapses on the part of the contractor BHEL at its own discretion will get the servicing / repair of equipment done at the risk and cost of the contractor with BHEL overheads.
- 3.2.5.8 For major overhaul/servicing of cranes BHEL shall deploy a separate group. The contractor should make available the equipment to maintenance agency as per schedule. It is essential that the activities be so planned so that the planned output does not suffer on account of maintenance on critical construction equipment. The contractor will provide all assistance required by way of semi-skilled labour and welders.
- 3.2.5.9 All spares needed for upkeep of all T&Ps shall be supplied by BHEL. However, if there are breakdowns / damages due to negligence of the contractor, the complete service / repair charges and cost of all the spares damaged with BHEL overheads shall be recovered from contractor's RA bills.

- 3.2.5.10 Increasing / shortening of the crane boom to suit work requirements shall have to be arranged by the indenting contractor at his cost. All necessary manpower, tools, support, consumables, illumination etc. will have to be arranged by contractor at his cost. If required, contractor has to return the crane with original boom.
- 3.2.5.11 The area and infrastructure development of the work area are to be carried out by the customer. However in construction projects of this magnitude it is possible that all the areas / approaches may not be ready. In such cases consolidation of ground with boulders & earth and arrangement of sleepers / sand bag filling etc for safe operation / movement of equipment including cranes/trailers etc shall be the responsibility of the contractor at his cost. No compensation on this account shall be payable.
- 3.2.5.12 In the event of contractor not using and maintaining BHEL T&Ps according to BHEL's instructions, BHEL will have the right to withdraw such item without any notice and no claim in this regard shall be entertained and contractor shall be responsible for delay in execution on this account.
- 3.2.5.13 Any loss / damage to any part of BHEL T&Ps and IMTEs shall be to the contractor's account and any expenditure on these accounts by BHEL will be recovered from the contractor's bill in case the contractor fails to make good the loss.
- 3.2.5.14 It shall be responsibility of the contractor to take delivery of T&Ps from stores or place of use by other contractor at project site, transport the same to site and return the same to BHEL store / place as intimated by Engineer in project site **in good working conditions** after use.
- 3.2.5.15 The contractor shall return to BHEL the T&Ps and IMTEs issued to him in good working condition as and when desired by BHEL (on completion or reduction of workload). If contractor delays return of T&P and IMTE, hire charges as applicable shall be levied by BHEL from the time it was requisitioned back till the time of actual return. The T&Ps and IMTEs returned in damaged / unserviceable condition shall be got repaired by BHEL at its own discretion and entire cost of repair with BHEL overheads shall be recovered from the contractor.

- 3.2.5.16 Contractor shall ensure deployment of serviced and healthy T&Ps including cranes, lifting tackles, wire ropes, manila ropes, winches and slings etc. History card and maintenance records for major T&Ps will be maintained by the contractor and will be made available to BHEL Engineer for inspection as and when required. Identification for such T&Ps will be done as per BHEL Engineer's advice.
- 3.2.5.17 Contractor shall ensure deployment of reliable and calibrated IMTEs (Inspection measuring and testing equipment). The IMTEs shall have test /calibration certificates from authorized / Government approved / accredited agencies traceable to National / International standards. Each IMTE shall have a label indicating calibration status i.e. date of calibration, calibration agency and due date for calibration. A list of such instruments deployed by contractor at site with its calibration status is to be submitted to BHEL Engineer for control.
- 3.2.5.18 Re-testing / re-calibration shall also be arranged at regular intervals during the period of use as advised by BHEL Engineer within the contract price. The contractor will also have alternate arrangements for such IMTE so that work does not suffer when the particular instrument is sent for calibration. If any IMTEs not found fit for use, BHEL shall have the right to stop the use of such item. It will be necessary for the contractor to deploy proper item. Any readings taken by the defective instrument will be recalled and repeat the readings taken by that instrument with a proper one. In case he fails to do so, BHEL may deploy IMTEs and retake the readings at contractor's cost.
- 3.2.5.19 BHEL shall have lien on all T&P, IMTEs and other equipment of the contractor brought to the site for the purpose of erection, testing and commissioning. BHEL shall continue to hold the lien on all such items throughout the period of contract / extended period. The contractor and or his sub-contractors, without the prior written approval of the Engineer, shall not remove any material brought to the site.
- 3.2.5.20 The month wise T&P deployment plan to be submitted is only to assess the capability as well as understanding of the contractor to execute the work. It shall be the contractor's responsibility to deploy the required T&P, for timely and successful completion of the job, to any extent over and above those indicated in the above deployment plan (including those which are not covered in the plan submitted) without any compensation on this account.

- 3.2.5.21 The Contractor shall be responsible for the safe and proper use of all the equipments issued to him for Day-to-day maintenance and operation of equipments shall be the contractor's responsibility and shall be as per instructions/standard practice of BHEL Engineer.
- 3.2.5.22 Any loss/damage to any equipment or any part of crane/ T&P due to mal-operation/ negligence of the Bidder to the above equipments shall be on contractor's account and the expenditures on these accounts will be recovered from contractor's bills in case contractor fails to make good the loss.
- 3.2.5.23 Non -availability of any of the above equipment either due to breakdown/routine maintenance or due to distribution pattern of BHEL shall not be quoted as reason for delay of work.
- 3.2.5.24 Monthly availability report of the T&Ps shall be furnished by contractor.
- 3.2.5.25 The contractor shall return the T&P issued to him by BHEL in good working condition as and when so desired by BHEL (Completion or reduction in workload) for diversion for other work. If such return is delayed by contractor due to his fault without written consent of BHEL, hire charges as applicable according to BHEL policy will be levied from such time it was requisitioned by BHEL to the time of actual return and the amount so decided and arrived at, will be recovered from the contractor's bill.
- 3.2.5.26 All other T&P required for the satisfactory execution of work shall be arranged by contractor.
- 3.2.5.27 All the T&P arranged by contractor including electrical connections wherein required shall be reliable / proven / tested with necessary test certificate.
- 3.2.5.28 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.
- 3.2.5.29 The contractor has to return the T & P in good working condition and cost of any replacement required has to be borne by the contractor. Normal wear and tear will be taken into account.

- 3.2.5.30 If at any time it is noticed that contractor is not using any of the T & P or equipment properly according to the instructions of BHEL, BHEL will have the right to withdraw any and all such equipment and any cost due to this shall be contractor's account.
- 3.2.5.31 All the T & P would be issued only at BHEL stores and it shall be the responsibility of the contractor to take delivery from BHEL stores, transport the same to site and return the same to BHEL stores in good condition after use.
- 3.2.5.32 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. Fitness Test certificates obtained from the statutory authority/licensed agency should be submitted before their usage. Periodic fitness tests should be carried out as per norms/ BHEL procedures.
- 3.2.5.33 For 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 responsibility of the contractor to lay necessary sleepers. The sleepers shall be arranged by the contractor at his cost.
- 3.2.5.34 Contractor shall make good any loss or damage to the equipments supplied to him and day to day maintenance and operations of equipments shall be borne by the contractor including consumables like petrol, oil ,etc.

3.2.6 CONSUMABLES:

- 3.2.6.1 Such of those consumables as indicated as consumables provided by BHEL alone will be provided to the contractor by BHEL free of charge for erection activities. Other required consumables like electrodes, all gases, and other materials for this scope of work are to be arranged by the contractor at their cost.

- 3.2.6.2 TIG welding wires for CS, AS & SS welding will be supplied by BHEL free of cost for Boiler applicable Pressure Part PG's. All electrodes including stainless steel electrodes required for shall be arranged by the contractor at his cost.** The bidder shall use the BHEL / Customer approved quality electrodes only. The utilization of the TIG welding wires issued by BHEL shall be duly accounted for exercising maximum care and ensuring economical usage for minimum wastage. If during erection, it is found that the consumption of filler wire is more than the actual requirement by improper usage, the cost for the additional quantity so consumed shall be recovered from the contractor
- 3.2.6.3 The contractor shall provide within finally accepted price / rates, all consumables like welding electrodes (including alloy steel and stainless steel), all gases (inert, welding and cutting), soldering material, dye penetrants, radiography films. Other erection consumables such as tapes, jointing compound, grease, mobile oil, M-seal, Araldite, petrol, CTC / other cleaning agents, grinding and cutting wheels are to be provided by the contractor. Steel, H&S, packers, shims, wooden planks, scaffolding materials hardware items etc required for temporary works such as supports, scaffoldings are to be arranged by him. Sealing compounds, gaskets, gland packing, wooden sleepers, for temporary work, required for completion of work except those which are specifically supplied by manufacturing unit are also to be arranged by him.
- 3.2.6.4 All the shims, gaskets and packing, which go finally as part of equipment, shall be supplied by BHEL free of cost.
- 3.2.6.5 It shall be the responsibility of the contractor to plan the activities and store sufficient quantity of consumables. Non-availability of any consumable materials or equivalent suggested by BHEL cannot be considered as reason for not attaining the required progress or for additional claim.
- 3.2.6.6 All low hydrogen electrodes shall be baked /dried in the electrode baking / drying oven to the temperature and period specified by the BHEL Engineer before they are used in erection work and each welder should be provided with one portable electrode drying oven at the work spot. Electrode drying oven and portable drying ovens shall be provided by contractor at his cost. Separate ovens for baking and holding along with calibrated temperature gauge are to be arranged by the contractor at his own cost as per requirement.

- 3.2.6.7 In case of improper arrangement of procurement of above electrodes BHEL reserves the right to procure the same from any source and recover the cost from the contractor's first subsequent bills at market value plus departmental charges of BHEL communicated from time to time. Postponement of such recovery is not permitted.
- 3.2.6.8 It shall be the responsibility of the contractor to obtain prior approval of BHEL, regarding suppliers, type of electrodes etc before procurement of welding electrodes. On receipt of electrodes at site these shall be subjected to inspection and approval by BHEL. The contractor shall inform BHEL details regarding type of electrodes, batch number, date of expiry etc and produce test certificate for each lot / batch with correlation of batch / lot number with respective test certificate. No electrode without a valid test certificate will to be used.
- 3.2.6.9 BHEL reserves the right to reject the use of any consumable including electrodes, gases, lubricants / special consumables if it is not found to be of the required standard / make / purity or when shelf life has expired Contractor shall ensure display of shelf life on consumable wherever required and records maintained.
- 3.2.6.10 Storage of all consumables including welding electrodes shall be done in an air conditioned / humidity controlled room by the contractor at his own cost as per BHEL manuals and requirement / instruction of the Engineer.
- 3.2.6.11 In case of improper arrangement for procurement of any consumable, BHEL reserves the right to procure the same from any source and recover the cost from the Contractor's first subsequent bill at market value plus the departmental charges of BHEL from time to time. Postponement of such recovery is normally not permitted. The decision of Engineer in this regard shall be final and binding on the Contractor.
- 3.2.6.12 All lubricants and chemicals required for cleaning, pre-commissioning, commissioning, testing, preservation and lubricants for trial runs of the equipment shall be supplied by BHEL / BHEL's client. All services including labour and T&P will be provided by the contractor for handling, filling, emptying, refilling etc. the consumption of lubricants / chemicals shall be properly accounted for. Surplus material if any shall be properly stacked / packed and returned to stores.
- 3.2.6.13 Transportation of oil drums from stores, filling of oil for flushing, first filling of oil and subsequent changeover or

topping / making up till the unit is fully commissioned and handed over to customer is included in scope of this contract. The contractor shall have to return all the empty drums to BHEL / BHEL's client store at no extra cost. Any loss / damage to above drums shall be to contractor's account.

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

3.3.1 CIVIL CONSTRUCTION :

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

3.3.2 WATER DISTRIBUTION:

Distribution of water for construction purpose and as well as drinking purpose to various work-fronts shall be contractor's responsibility and at his cost.

3.3.3 ELECTRICITY DISTRIBUTION:

Provision of distribution of electrical power from the given single central common point to the required places with proper distribution boards, approved cable and cable laying including supply of all materials like cables, switch boards, pipes etc. observing the safety rules laid down by electrical authority of the State / BHEL / their customer with appropriate statutory requirements shall be the responsibility of the tenderer / contractor. **Necessary "Capacitor Banks to improve the Power factor as stipulated by customer shall be provided by the contractor at his cost as per customer requirement. Penalty if any levied by customer on this account will be recovered from contractor's bills.**

3.3.4 POSSESSION OF GENERATORS :

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

3.3.5 ILLUMINATION FACILITY :

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

3.3.6 POWER DISTRIBUTION:

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

3.3.7 CONTRACTOR'S OBLIGATION ON COMPLETION :

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

3.4 GASES

3.4.1 All required gases like Oxygen/ Acetylene / argon / CO₂ required for work shall be arranged by the Contractor at his cost. It shall be the responsibility of the contractor to plan the activities and store sufficient quantity of these gases. Non-availability of gases cannot be considered as reasons for not attaining the required progress.

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 ensure safe keeping of the inflammable cylinder at a separate place away from normal habitat with proper security etc.

3.5 SUPERVISORY STAFF AND WORKMEN

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

- 3.5.2 The contractor shall engage separate stores in-charge (minimum Degree/Diploma Holder) and other experienced supervisory staff who are computer literate and specially skilled labour e.g. crane operators, heavy duty vehicle driver, sarongs, riggers, khalasis etc. under this contract specially for material handling work and record maintaining. Contractor shall have to deploy other staff as per site requirement for the successful execution of material handling work. The contractor shall not divert the labour and staff deployed for material handling work to erection work area.
- 3.5.3 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.
- 3.5.4 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.
- 3.5.5 The Contractor shall also 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 subsequent month as per the plan of activities as required by BHEL, to meet the overall contract requirement.
- 3.5.6 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 other contractor coordinating his work with others and proceed in a manner that shall not delay or hinder the progress of work as a whole.

- 3.5.7 The contractor has to furnish the details of maximum manpower likely to be deployed for the following categories (Ref Annexure I of GCC – Page No 50)
- a) Engineers
 - b) Supervisors
 - c) Fitter
 - d) Welder
 - e) Rigger
 - f) Electrician
 - g) Helpers
 - h) Others
- 3.5.8 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 instructions are taken as final.
- 3.5.9 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.
- 3.5.10 It is the responsibility of the bidder to engage his workmen in shifts or on overtime basis for achieving the target set by BHEL and also during erection, commissioning and testing period. The contractor's quoted rate shall include all these contingencies.
- 3.5.11 During the course of erection,
- If the progress is found unsatisfactory,
 - If the target dates fixed from time to time for every mile stones are to be advanced / not being met,
 - If it is found that the engineers, supervisors and skilled workmen like fitters, operators, technicians etc deployed are not sufficient.

BHEL after giving reasonable opportunity to the contractor will induct on the work the required engineers /supervisors and workmen in addition to contractor's workmen to improve the progress. The expenses so incurred will be recovered from the contractor's bills with overheads.

- 3.5.12 It shall be the responsibility of the contractor to ensure safe lifting of the equipment taking due precautions to avoid any accident and damage to other equipment and personnel. Contractor shall be liable for all accidents, damages etc. to personnel and equipment etc. during the execution of the work.
- 3.5.13 The work shall be executed under the usual conditions like rain, insufficient space, and improper approach roads etc. affecting major power plant construction and in conjunction with numerous other operations at site. The contractor and his personnel shall cooperate with other personnel. The contractor will coordinate his work with others and proceed in a manner that shall not delay or hinder the progress of work as a whole.
- 3.5.14 The month wise manpower deployment plan to be submitted as per the GCC is only to assess the capability as well as understanding of the contractor to execute the work. It shall be the contractor's responsibility to deploy the required manpower, for timely and successful completion of the job, to any extent over and above those indicated in the above deployment plan (including those which are not covered in the plan submitted) without any compensation on this account. The contractor shall identify separate persons at site for quality control and safety and for welding electrodes baking and issue control.
- 3.5.15 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.

3.6 SCOPE OF MATERIAL HANDLING AND SITE STORAGE AND OTHER RESPONSIBILITIES.

- 3.6.1 All the equipment furnished under this contract shall be received from the project stores, sheds / storage yards and transported to pre assembly area / erection site and stored in the storage spaces in a manner so that they are easily retrievable till the contractor erects them. While drawing / lifting material from BHEL / customer stores, contractor shall ensure that the balance / other materials are stacked back immediately.

- 3.6.2 While BHEL will endeavor 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.
- 3.6.3 All lifting and handling equipments like cranes, wire rope slings, D-shackles, chain- pulley blocks, pull-lifts, single sieve and multi sieve pulleys etc are to be subjected to fitness test through licensed /certified agency before they are put into use. Subsequent periodic tests are to be conducted as per statutory stipulations / BHEL manuals / Certifying agency's recommendations / BHEL engineer's instructions. It will be the responsibility of the contractor to ensure safe lifting of the equipment taking due precautions to avoid any accidents and damage to other equipments and personnel. All piping shall be adequately supported and protected to prevent damage during handling and erection. The history cards for major equipments to be maintained by the contractor.
- 3.6.4 The contractor shall take delivery of components, equipment / consumables from storage area after getting the approval of BHEL Engineer on standard indent forms.
- 3.6.5 The contractor shall identify and deploy necessary supervisor/labour for the above work in sufficient quantity as may be needed by BHEL for areas covering their scope.
- 3.6.6 All the equipment shall be handled very carefully to prevent any damage or loss. No untested wire ropes / slings etc. shall be used for unloading /handling. The equipment shall be properly protected to prevent damage either to the equipment or to the floor where they are stored. The equipment from the stores shall be moved to the actual location at the appropriate time so as to avoid damage of such equipment at site.
- 3.6.7 Contractor shall ensure that while lifting slings shall be put over the points indicated on the equipment or as indicated in the manufacturer's drawings. Slings / shackles of proper size shall be used for all lifting and rigging purposes. All care shall be taken to safe guard the equipment against any damage. Dragging of piping / valves should be avoided. In case of any damage the cost shall be covered from the contractor.

- 3.6.8 Approach road conditions from the stores / yards to the erection site may not be equipped and ideal for smooth transportation of the equipment. Contractor may have to be adequately prepared to transport the materials under the above circumstances without any extra cost.
- 3.6.9 Contractor shall be responsible for examining all the plant and materials issued to him and notify the Engineer immediately of any damage, shortage, discrepancy etc before they are moved out of the stores / storage area. The contractor shall be solely responsible for any shortages or damages in transit, handling, storage and erection of the equipment once received by him. As the erection work will be spread in different areas / locations of the project, contractor has to arrange sufficient number of watch / ward personal to avoid any pilferage of material. As per General Conditions of contract BHEL will reserve the right to recover the cost of repair / replacement, if any, to bring back the equipment in original order, in case the equipment / material is lost / damaged while in the custody of the contractor. BHEL's decision in this regard shall be final and binding on the contractor.
- 3.6.10 The contractor shall maintain an accurate and exhaustive record-detailing out the list of all equipment received by him for the purpose of erection and keep such record open for the inspection of the engineer at any time.
- 3.6.11 All the material in the custody of contractor and stored in the open or dusty locations must be covered with suitable weather proof / fire retardant covering material wherever applicable and shall be blocked up on raised level above ground. All covering materials including blocks and sleeper shall be arranged by the contractor at his cost.
- 3.6.12 If the material belonging to the contractor are stored in area other than those earmarked for his operation the engineer will have the right to get it moved to the area earmarked for the contractor at the contractors risk and cost.
- 3.6.13 The contractor shall be responsible for making suitable indoor storage facilities to store all equipment (drawn by the contractor from BHEL / customer stores), which require indoor storage till the time of their installation. The Engineer will direct the contractor in this regard, which item in his opinion will require indoor storage, and the contractor shall comply with Engineer's decision.

- 3.6.14 It shall be contractor's responsibility to arrange necessary tractors, tailor 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.
- 3.6.15 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.
- 3.6.16 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.
- 3.6.17 All welding filler wires are issued to contractor shall be preserved by him carefully to prevent deterioration of their properties. Special care shall be taken to preserve alloy steel and other special electrodes / filler wires. Contractors shall exercise maximum care in using these electrodes, filler wires to minimize wastage by maintaining a record of all usages.
- 3.6.18 All pipe and tube ends shall be covered with plastic caps or will be closed with plastic / wooden plugs as the case may be.
- 3.6.19 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.
- 3.6.20 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.
- 3.6.21 The contractor shall follow 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.
- 3.6.22 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.

- 3.6.23 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.
- 3.6.24 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.
- 3.6.25 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.
- 3.6.26 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.
- 3.6.27 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.
- 3.6.28 The contractor shall take all reasonable care to protect the materials and work till such time the erected equipment has been taken over by BHEL/their client. Wherever necessary suitable temporary fencing and lighting shall have to be provided by the contractor as a safety measure against accident and damage of property of BHEL. Suitable caution notices shall be displayed where access to any part may be deemed to be unsafe and hazardous.
- 3.6.29 The contractor shall be responsible for taking all safety precautions during the construction and keeping the site safe at all times and the end of each working day. 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.

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

3.6.31 Sometimes it may become necessary for the contractor to handle certain un-required 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.

3.7.0 PRESERVATION OF COMPONENTS

3.7.1 After taking delivery from BHEL / customer's stores, plant materials storage shall be subjected to the following protection besides other provision indicated in these specifications elsewhere.

- Items stored outdoors shall be blocked up at least six inches (6") off the ground.
- Motors (LT), valves, electrical equipment, control equipment and instruments etc shall be stored indoors arranged by contractor. HT Motor windings shall be kept dry by use of external heat or space heaters and covered with canopy/ tarpaulin or as suggested by BHEL Engineer.
- Bearings and other wearing surfaces of plant materials shall be protected against corrosion and kept clean.

3.7.2 It shall be the responsibility of the contractor to apply preservatives / touch up paints (primer) on equipment handled and erected by him till such time of final painting. It shall be contractor's responsibility to arrange for required paints (primer), thinners, labour, scaffolding materials, cleaning materials like wire brush, emery sheets, etc, cleaning of surface and provide one coat of preservatives / paints (primer) from time to time as decided by BHEL engineer. The accepted rate shall include this work also. It is to be noted that such painting may have to be done as and when required till such time the final painting is carried out.

- 3.7.3 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.
- 3.7.4 Any failure on the part of contractor to carry out works according to above clauses will entail BHEL to carry out the job from any other party and recover the cost from contractor

3.8.0 DRAWINGS AND DOCUMENTS

- 3.8.1 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.
- 3.8.2 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. Contractor shall maintain complete records of drawings and documents given to them time to time and maintain the latest drawings / documents in their custody. Contractor shall refrain from defacing the drawing / documents available with them.
- 3.8.3 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.
- 3.8.4 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.
- 3.8.5 Deviation from design dimensions should not exceed permissible limit. The contractor shall not correct or alter any dimensions/details without specific approval of BHEL.

3.9.0 SITE CLEANLINESS AND SAFETY REQUIREMENTS

- 3.9.1 Contractor shall strictly follow all safety regulations/conditions as per general conditions of contract booklet enclosed with this tender.
- 3.9.2 Non-conformity of safety rules and safety appliances will be viewed seriously and the BHEL has right to impose fines on the contractor as under.

Sl.No	Safety	Fine (Rs.)
01	Not wearing safety helmet	50/-
02	Not wearing safety belt	100/-
03	Grinding without goggles	50/-
04	Not using 24V supply for internal work	500/-
05	Electrical plugs not used for hand machines	100/-
06	Not slinging properly	200/-
07	Using damaged sling	200/-
08	Lifting cylinders without cage	500/-
09	Not using proper welding cable with lot of joints and not insulated properly	200/-
10	Not removing small scrap from platforms	200/-
11	Gas cutting without taking proper precaution or not using sheet below gas cutting	200/-
12	Not maintaining elec. Winches which are being operated dangerously	500/-
13	Improper earthing of electrical T & Ps	500/-

Contractor should exclusively deploy one Qualified safety Engineer (Degree/Diploma in Safety) along with a safety supervisor for effective implementation and co-ordination of safe working conditions.

SPECIFIC REQUIREMENTS FOR ISO 9001 - 2000

3.10.0 IMPORTANT NOTE

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

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

Contractor shall ensure that all Inspection, Measuring and Testing equipment that are used, whether owned by the 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.

3.11.0 INSPECTION / QUALITY ASSURANCE / QUALITY CONTROL STATORY INSPECTION

3.11.1 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.

3.11.2 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.

3.11.3 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.

- 3.11.4 A Daily log Book should be maintained by every supervisor/Engineer of contractor on the job in Duplicate (One for BHEL and one for Contractor) for detailing and incorporating Alignment/clearance/centering/Leveling Readings and Inspection details.
- 3.11.5 All the Important Measurements shall be recorded in the Daily Log Book with sketches based on BHEL Drawings indicating Readings / Measurements actually Taken and Signed by BHEL/Customer / Contractor Representatives.
- 3.11.6 Approval Given by Customer/BHEL for welding, results tests etc. shall also be recorded in the log book.
- 3.11.7 Welding Details like number of joints, welder's name, date of welding, details of Repair, Heat Treatment, Etc. will be documented in welding Logs as per BHEL Engineer's Instructions. Welder's Performance Record shall be furnished every month. The performance Report of Welders shall indicate the percentage of Repair for each welder.
- 3.11.8 Single line diagrams of all piping schemes shall be drawn manually or through computer software to maintain fit-up, welding, Stress relieving and radiography details. On completion of all piping schemes, as- built drawings shall be prepared by the contractor and submitted to BHEL.
- 3.11.9 Heat Treatment details of Welds indicating minimum temperature recorded, heating rate, cooling rate, soaking time, Etc., shall also be recorded and documented by Contractor as per BHEL Engineer's Instructions. Welder's performance Record shall be furnished every month. The performance Report of Welders shall indicate the percentage of Repair for each welder.
- 3.11.10 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, Leveling, Alignment, centering etc of Erected Equipments at various stages. The Instruments/gauges/Tools etc. provided should be of Brand, Quality and Accuracy, Specified by BHEL Engineer and should have necessary calibration and other certificates as per the Requirements of BHEL Engineer.

- 3.11.11 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.
- 3.11.12 The Welders performance will be reviewed from time to time as per the BHEL / IBR Standards and any welders not performing to the Standards set by BHEL/IBR Standards will be removed from working, Contractor shall arrange for the Alternate welders immediately.
- 3.11.13 All the welders shall carry identity cards as per the Performa prescribed by BHEL. Only welders duly authorized by BHEL / Boiler Inspector / Consultant shall be engaged on the work.
- 3.11.14 Contractor shall ensure speedy alignment and welding of all Equipment erected by him after placement. Also all alignments, Welding, NDT Test required for stage Inspection shall be completed as per Quality Assurance Procedures. All the Quality assurance procedures have to be complied with before effecting column erection, Ceiling Beams erection, drum lifting, further structural work, Hydraulic Test, Trial Run of Equipment, Pre-commissioning and any other tests required to be conducted for completing erection and commissioning.

3.12.0 STAGE INSPECTION BY FES / QA ENGINEERS

- 3.12.1 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 shall be carried out by teams of Engineers, from Field Engineering Services of BHEL's Manufacturing units / Quality Assurance teams/ commissioning Engineers. The Contractor has to arrange all labour, Tools and Tackles, etc. for such stage inspections free of cost.
- 3.12.2 Any modifications suggested by FES and QA Engineers Team shall be carried out. Claims of Contractor, if any shall be dealt as applicable.
- 3.12.3 Any minor rectifications of minor repairs of defective work found out during stage Inspection shall be rectified free of cost, by the contractor.

3.12.4 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 possible.

3.13.0 STATUTORY INSPECTION

3.13.1 The scope includes getting the Approvals from the statutory authorities (Like Boiler Inspector and labour officers). This includes arranging for inspection visits of Boiler Inspector periodically as per BHEL Engineer's instructions, submitting documents, radiograph, etc. and following up the matter with them.

3.13.2 All fees connected with the contractors for testing his welders / men / workers and testing, inspection calibrating of his instruments and equipments, shall be paid by the contractor. It shall be the 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 the contractor's account. However, BHEL/client shall pay Boiler Inspectorate fees law fully payable under the provisions of the Indian boiler regulations and any other statutory laws and its amendments from time to time during erection in respect of the plant equipment ultimately to be owned by our client (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.

3.13.3 Payment of statutory fees as per stipulations of Boiler inspectorate shall be paid by BHEL / client

3.14.0 BOILER INSPECTORATE :

3.14.1 The scope includes getting the approval from the statutory authorities (like boiler inspector and labour authorities) . This includes arranging for inspection visits of boiler inspectorate periodically as per BHEL engineers instructions, submitting documents, radiography etc., and follow up the matter with them.

3.15.0 EXTRA CHARGES FOR MODIFICATION AND RECTIFICATION WORK

- a) BHEL may consider payment for extra works on man day basis for such of those works which require major revamping / rework/rectification/modification which is totally unusual to normal erection or commissioning work which are not due to contractor's faulty erection.
- b) The 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 these work done through other agencies if they so desire.

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

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

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

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

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

3.16.0 EXTRA WORK :

3.16.1 EXTRA WORK DOES NOT INCLUDE Normal dressing of foundations upto 50mm, holes, bases, nuts and bolts. In case of abnormal conditions, this can be mutually discussed before starting of such work.

3.16.2 Extra works are broadly defined as below:

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

3.16.3 The exact period of over run will have to be ascertained before the commencement of contract period.

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

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

3.17.0 PRICE VARIATION

PVC applicable with the base index from the scheduled date of bid opening.

$$P1 = 0.75 \times PO + \frac{(F1-FO)}{FO}$$

Applicable even when F1 is lesser than FO. (Price reduction as applicable).

FO = New all India average consumer price index published by Labour Bureau, Simla, Government of India for Industrial workers (Base 2001 = 100) applicable for the scheduled date of bid opening.

F1 = All India average consumer price Index published by labour Bureau, Simla, Government of India, for Industrial workers (Base 2001 = 100) applicable for the months under consideration.

P1 = Increase in the billing amount as per the escalation formulae for the particular month of billing.

PO = Billing amount calculated on the accepted contract rate.

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

With the provision of price escalation as per the above 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 item / reasons) will be payable during the entire period of execution including extended period, if any.

3.18.0 TIME SCHEDULE

- 3.18.1 The contractor has to mobilize in all respects with in two weeks from the date of issue of fax letter of intent unless BHEL decided to fix any other later date. However, BHEL Engineer will certify the actual date of start of work after adequate mobilization of manpower and T&P by the contractor.
- 3.18.2 The entire work of **Boiler** erection, testing, commissioning as detailed in the Tender specification shall be completed within **26 (Twenty six)** months from the date of start of work. The commencement of work will be decided by BHEL Engineer. Any advancement required completing the project in the course of execution; contractor shall carry out the work without any extra cost.
- 3.18.3 During the total period of contract the contractor has to carryout the activities in a phased manner as required by BHEL Engineer and as per the programme of events / Targets fixed by BHEL / Customer.

- 3.18.4 The work under this scope of contract is deemed to be completed in all respects only when all the components / equipments are erected and trial runs, testing and commissioning of all the equipments are completed. The decision of BHEL in this respect shall be final and binding with contractor.
- 3.18.5 During the tenure of contract, if BHEL is not satisfied with the progress of work, BHEL have the right to withdraw any portion for work / balance work and get the same done either directly employing their own men or through other agency at your risk and cost. You shall not be entitled for any compensation whatsoever in this regard.
- 3.18.6 The work under the scope of this contract is deemed to be completed in all respects, only when the contractor has discharged all the responsibilities laid down in the contract. The decision of BHEL on completion date shall be final and binding on the contractor.

3.19.0 ASCERTAINING AND ESTABLISHING THE REASONS FOR SHORT FALL

- 3.19.1 The onus providing that the reasons / causes leading to extension of the contract period is not due to any reasons attributable to the contractor is basically lying on the contractor. Review of the performance will be made considering the availability of components to be erected and other inputs / constraints over which the contractor has no control. The programme will be reviewed area wise and the following facts will be recorded incase of short fall at the end of every month.
- a) Erection / commissioning not achieved owing to non-availability of fronts.
 - b) Erection/commissioning program not achieved owing to non-availability of materials.
 - c) Erection / commissioning program not achieved owing to non-availability of tools and plants, man power and consumables by the contractor or any other reason attributable to the contractor.
 - d) Erection /commissioning program not achieved due to any other reasons not attributable to the contractor

3.20.0 CONTRACT EXTENSION

If the completion of work as detailed in the specification gets delayed beyond the end of the contract period, then depending on the balance work left out, BHEL at its discretion may/may not extend the contract

3.20.1 A joint program shall be drawn down for the work to be completed during the extended contract period. Review of the program and record of shortfall as described earlier shall be done during the extended period.

3.20.2 The part of extension attributable to the contractor, if any in total contract extension shall be exhausted first, i.e. immediately after end of contract period. This shall be followed by the extension on account of Force Majeure conditions if any and lastly on account of BHEL

3.20.3 OVER RUN CHARGES

In case due to reasons not attributable to the contractor, the work gets delayed and completion time gets extended beyond Twenty six **(26) months** from the date of commencement of the work, the contractor shall be considered for ORC. In case of ORC arises, the same will apply at **Rs.150000/- (Rupees One lakh fifty thousand only)** per month for extension to the completion period beyond **26 months** for the total scope of work as stated above duly taking into account the balance work at the end of that period.

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

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

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

3.21.0 TAXES

3.21.1 Value Added Tax (VAT) for the works

Price quoted shall be inclusive of ALL TAXES except service tax.

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

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

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

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

3.21.2 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.

3.21.3 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.

3.21.4 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.

3.21.5 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 shall be paid/ 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.

3.21.6 DIRECT TAXES

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/Rules.

3.22.0 IMPORTANT CONDITIONS FOR PAYMENT

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

- i. PF Regn. No.
- ii. Labour License No.
- iii. Workmen Insurance Policy No.
- iv. Un Qualified Acceptance for Detailed L.O.I.
- v. Initial 50% Security Deposit.
- vi. Rs 100 /- Stamp Paper for Preparation of Contract agreement.
- vii. All payments due to the contractor shall be made through e-payment including return of EMD amount to unsuccessful tenderers. The tenderer has to furnish details of his bank account as certified by the concerned banker in the format furnished to enable e-payment.

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

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

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

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

3.23.0 PROVIDENT FUND & MINIMUM WAGES

3.23.1 The 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, you are hereby required to get yourself registered with the Provident Fund authorities for the purpose of reconciliation of PF dues and furnish to us the code number allotted to you by the Provident Fund authorities within one month from the date of issue of this letter of intent. Incase you are exempted from such remittance an attested copy of authority for such exemption is to be furnished. Please note that in the event of your failure to comply with the provisions of said Act, if recoveries therefore are enforced from payments due to us by the customer or paid to statutory authorities by us, such amount will be recovered from payments due to you.

3.23.2 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.

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

3.24.0 OTHER STATUTORY REQUIREMENTS

1. The Contractor shall submit a copy of Labour License obtained from the Licensing Officer (Form VI) u/r25 read with u/s 12 of Contract Labour (R&A) Act 1970 & rules and Valid WC Insurance copy or ESI Code (if applicable) and PF code no along with the first running bill.
2. The Contractor should ensure compliance of Sec 21 of Contract Labour (R&A) Act 1970 regarding responsibility for payment of Wages. In case of "Non-compliance of Sec 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.
3. The contractor shall submit monthly running bills along with the copies of monthly wages (of the preceding month) u/r 78 (1) (a)(1) of Contract Labour Rules, copies of monthly return of PF contribution with remittance Challans under Employees Provident Fund Act 1952 and copy of renewed WC Insurance policy or copies of monthly return of ESI contribution with challans under ESI Act 1948 (if applicable) in respect of the workmen engaged by them.
4. The Contractor shall submit copies of Final Settlement statement of disbursement of retrenchment benefits on retrenchment of each workmen under I D Act 1948, copies of Form 6-A(Annual Return of PF Contribution) along with Copies of PF Contribution Card of each member under PF Act and copies of monthly return on ESI Contribution – Form 6 under ESI Act 1948 (If applicable) to BHEL along with the Final Bill.
5. In case of any dispute pending before the Appropriate authority under I D act 1948, WC Act 1923 or ESI Act 1948 and PF Act 1952, BHEL reserve the right to hold such amounts from the final bills of the Contractor which will be released on submission of proof of settlement of issues from the appropriate authority under the act.
6. In case of any dispute prolonged/pending before the authority for the reasons not attributable to the contractor, BHEL reserves the right to release the final bill of the contractor on submission of Indemnity bond by the contractor indemnifying BHEL against

any claims that may arise at a later date without prejudice to the rights of BHEL.

3.25.0 COMPUTER FACILITIES TO BE PROVIDED BY THE CONTRACTOR

The system works with following environment: xp Contractor shall provide 2 Nos of exclusive computer system with the following minimum configurations with qualified computer operators one for each computer for data entry and record keeping who assist BHEL engineers & supervisors in all planning & data entry activities. The contractor has to make his own separate arrangement for his requirements.

Sno	Features	Minimum Requirements
1	Processor	Intel Pentium 4, 3.0 GHz or above
2	Chipset	Intel 895 or higher Intel Chipset
3	RAM	512 MB DDR SDRAM
4	HDD	80 GB
5	FDD	1.44 MB
6	Optical Drive	48x or above Combo Drive
7	Monitor	17" VGA Color
8	Keyboard	Minimum 104 keys Windows keyboard
9	Mouse	2 Button Scroll Optical mouse
10	Ethernet	Integrated 10/100 Mbps NIC for LAN
11	Ports	Minimum 1 Parallel, 1 Serial, 2 USB
12	Software	Windows Office 2003 XP Professional
13	Accessories	Mouse pad & Dustcovers
14	UPS	1 kVA UPS with 1 hr. backup
15	Printer	A4 size Laser Printer - 20 ppm or above (with all cartridges & stationery)

3.26.0 HSE REQUIREMENT

3.26.1 Responsibility of the Contractor in Respect of Safety of Men, Equipment, Material and Environment.

3.26.2 The Contractor shall abide by the Safety Regulations applicable for the Site/Project and in particular as mentioned in the booklet "Safe Work Practices" issued by BHEL. Contractors are also to ensure that their employees and workmen use safety equipments as stipulated in the Factories Act (Latest Revision) during the execution of the work. Failure to use safety equipment as required by BHEL Engineer will be a sufficient reason for issuance of memo, which shall become part of Safety evaluation of the contractor at the end of the Project. Also all site work may be suspended if it is found that the workmen are employing unsafe working practice and all the costs/losses incurred due to suspension of work shall be borne by contractor. A comprehensive list of National Standards from which the contractor can draw references for complying with various requirements under this section is given under.

3.26.3 Hold BHEL harmless and indemnified from and against all claims, cost and charges under Workmen's Compensation Act 1923 and 1933 and any amendment thereof and the contractor shall be solely responsible for the same.

3.26.4 Abide by the Procedure governing entry/exit of the contractor's personnel within the Customer/Client premises. All the contractors' employees shall be permitted to enter only on displaying of authorized Photo passes or any other documents as authorized by the Customer/Client.

3.26.5 Be fully responsible for the identity, conduct and integrity of the personnel/workers engaged by them for carrying out the contract work and ensure that none of them are ever engaged in any anti national activity.

3.26.6 Prepare a sign board giving the following information and display it near the work site:

Name of Contractor

Name of Contractor Site-in-charge & Telephone number

Job Description in short

Date of start of job

Date of expected completion

Name of BHEL Site In-charge

- 3.26.7 Abide by the rules and regulations existing during the contract period as applicable for the contractors at the Project premises Name of BHEL Site-in-charge.
- 3.26.8 Observe the timings of work as advised by BHEL Engineer-in-charge for carrying out the contract work.

3.26.9 Safety

- 3.26.9.1 **Safety Plan:** Safety Plan: Before commencing the work, contractor shall submit a "safety plan" to the authorized BHEL official. The safety plan shall indicate in detail the measures that would be taken by the contractor to ensure safety to men, equipment, material and environment during execution of the work. The plan shall take care to satisfy all requirements specified hereunder.

The contractor shall submit "safety plan" before start of work. During negotiations, before placing of work order and during execution of the contract, BHEL shall have right to review and suggest modifications in the safety plan. Contractor shall abide by BHEL's decision in this respect.

- 3.26.9.2 The contractor shall take all necessary safety precautions and arrange for appropriate appliances and/or as per direction of BHEL or it's authorized person to prevent loss of human lives, injuries to men engaged and damage to property and environment.
- 3.26.9.3 The contractor shall provide to his work force and also ensure the use of Personnel Protection Equipment (PPE) as found necessary and/or as directed and advised by BHEL officials without which permission is liable to be denied.
- ❖ Safety helmets conforming to IS 2925/1984 (1990)
 - ❖ Safety belts conforming to IS 3521/1989
 - ❖ Safety shoes conforming to IS 1989 part-II /1986(1992)
 - ❖ Eye and face protection devices conforming to IS 2573/1986(1991), IS 6994 (1973), part-I (1991), IS 8807/1978 (1991), IS 8519/1977(1991).
 - ❖ Other job specific PPEs of standard ISI make as may be prescribed

- 3.26.9.4 All tools , tackles, lifting appliances, material handling equipment, scaffolds, cradles, cages, safety nets, ladders, equipment, etc., used by the contractor shall be of safe design and construction. These shall be tested and certificate of fitness shall be obtained from manufacturer in case of new equipments and from licensed / certified agencies for equipments which have already been under use, before putting them to use and from time to time as instructed by authorised BHEL official who shall have the right to ban the use of any item found to be unsafe.
- 3.26.9.5 All electrical equipment, connections and wiring for construction power, its distribution and use shall conform to the requirements of Indian Electricity Act and Rules. Only electricians licensed by the appropriate statutory authority shall be employed by the contractor to carryout all types of electrical works. All electrical appliances including portable electric tools used by the contractor shall have safe plugging system to source of power and be appropriately earthed.
- 3.26.9.6 The contractor shall not use any hand lamp energized by electric power with supply voltage of more than 24 volts. For work in confined spaces, lighting shall be arranged with power source of not more than 24 volts.
- 3.26.9.7 The contractor shall adopt all fire safety measures as per relevant Indian Standards.
- 3.26.9.8 Where it becomes necessary to provide and/or store petroleum products, explosives, chemicals and liquid or gaseous fuel or any other substance that may cause fire or explosion, the contractor shall be responsible for carrying out such provisions and/or storage in accordance with the rules and regulations laid down by the relevant government acts, such as petroleum act, explosives act, petroleum and carbides of calcium manual of the chief controller of explosives, Government of India etc. The contractor in all such matters shall also take prior approval of the authorized BHEL official at the site.
- 3.26.9.9 Proper properly designed and approved before being put to use.

- 3.26.9.10 All excavations and openings must be securely and adequately fenced/ barricaded and warning signs erected when considered necessary as per relevant code of practice.
- 3.26.9.11 No persons shall remove guardrails, covers or protective devices unless authorized by a responsible supervisor and alternative precautions have been taken.
- 3.26.9.12 Access ways, means of escape and fire exits shall be clearly marked, kept clear and un-obstructed at all times.
- 3.26.9.13 Only authorized persons holding relevant license will drive and operate site plant and equipments eg. cranes, dumpers, excavators, transport vehicles etc. Only authorized personnel are allowed to repair, commission electrical equipments.
- 3.26.9.14 Gas cylinders shall be handled and stored as per Gas Cylinder Rules and relevant safe working practices.
- 3.26.9.15 All wastes generated at Site shall be segregated and collected in a designated place so as to prevent spillage/contamination/scattering at Site, until the waste is lifted for disposal to designated disposal area as advised by BHEL official.
- 3.26.9.16 The contractor shall arrange at his cost (wherever not specified) appropriate illumination at all work spots for safe working when natural day light is not adequate for clear visibility.
- 3.26.9.17 The contractor shall train adequate number of workers/supervisors for administering "**FIRST AID**". List of competent first aid administrators should be prominently displayed.
- 3.26.9.18 The contractor shall display at strategic places and in adequate numbers the following in fluorescent markings.
- Emergency telephone numbers
 - Exit, Walkways
 - Safe working load charts for wire ropes, slings, D shackles
 - Warning signs

- 3.26.9.19 The contractor shall be held responsible for any violation of statutory regulations (local, state or central) and BHEL instructions that may endanger safety of men, equipment, material and environment in his scope of work or other contractors or agencies. Cost of damage, if any, to life and property arising out of such violation of statutory regulations and BHEL instructions shall be borne by the contractor.
- 3.26.9.20 In case of a fatal or disabling injury/accident to any person at construction sites due to lapses by the contractor, the victim and/or his/her dependents shall be compensated by the contractor as per statutory requirements. However, if considered necessary, BHEL shall have the right to impose appropriate financial penalty on the contractor and recover the same from payments due to the contractor for suitably compensating the victim and/or his/her dependents. Before imposing any such penalty, appropriate enquiry shall be held by BHEL giving opportunity to the contractor to present his case.
- 3.26.9.21 In case of any damage to property due to lapses by the contractor, BHEL shall have the right to recover cost of such damages from payments due to the contractor after holding an appropriate enquiry.
- 3.26.9.22 In case of any delay in the completion of a job due to mishaps attributable to lapses by the contractor, BHEL shall have the right to recover cost of such delay from payments due to the contractor after notifying the contractor suitably and giving him opportunity to present his case.
- 3.26.9.23 If the contractor fails to improve the standards of safety in its operation to the satisfaction of BHEL after being given a reasonable opportunity to do so, and/or if the contractor fails to take appropriate safety precautions or to provide necessary safety devices and equipment or to carry out instructions regarding safety issued by the authorized BHEL official, BHEL shall have the right to take corrective steps at the risk and cost of the contractor after giving a notice of not less than seven days indicating the steps that would be taken by BHEL.

3.26.10 EMERGENCY RESPONSE

- 3.26.10.1 BHEL will have an Emergency response Plan for each Project Site in consultation with the owner as the case may be, detailing the procedure for mobilization of personnel indicated, in order to prepare for any emergency that may arise in order to ensure the priorities of
- Safe guard of life
 - Protect assets under construction or neighboring
 - Protect environment
 - Resumption of normal operations as soon as the emergency condition is called off.

All Contractors shall also be part of the emergency response plan and the personnel so nominated shall be aware of their duties and responsibilities in an emergency response situation.

- 3.26.10.2 At least 5% Contractors supervisors and workmen shall undergo training in Administering 'First Aid'. The trained persons should represent for all categories of work and for all areas of work. Adequate number of trained persons should be available for each shift. These first aid personnel shall be included in the emergency response team. Contractor employees and workmen are encouraged to participate in first aid training programmes whenever organized by BHEL.

- 3.26.10.3 The contractor has to establish the methodology to calculate safety indices (like Frequency rate, Severity Rate and incident rate) as per IS 3786- 1983 under the guidance of BHEL safety engineer. The safety indices thus worked out are to be regularly submitted once in 3 months.

3.26.10.4 OCCUPATIONAL HEALTH

- 3.26.10.5 Specific occupational health hazards will be identified through the hazard evaluation processes in consultation with BHEL engineers and the necessary prevention/reduction/elimination methods implemented.

- 3.26.10.6 All personnel working in an activity with a potential risk to health shall be made aware of all those risks and the actions they must take to reduce/ control/ eliminate the risk .

3.26.10.7 Safety coordinator shall conduct periodic checks to ensure that every group of Workers engaged in similar activities are aware of potential risks to health and the actions required to be taken to mitigate the risk.

- ❖ In order to protect personnel from associated health hazards, the following main areas will be focused
- ❖ Issue of approved Personnel Protective Equipment
- ❖ Verification that the PPE are adequate/maintained and worn by all staff involved in operations that are potentially hazardous to their health
- ❖ Ensure that the personnel deployed are physically fit for the operation/work concerned
- ❖ Provide hygienic and sanitary working conditions

3.26.10.8 Contractor workers employees engaged in noise risk areas shall be issued with hearing protection aids and the use of the same will be enforced. Further, these workers will be educated on the hazards of noise.

3.26.10.9 Contractor workers engaged in dust environment shall be issued with necessary dust protection aids and the use of the same shall be enforced.

3.26.10.10 Workers engaged in exposure to bright light/rays as in welding or radiation shall be issued with eye protection devices and the use of the same shall be enforced.

3.26.10.11 Adequate arrangements shall be made to provide safe drinking water.

3.26.10.12 Health monitoring records on at least sample basis for contractor employees & Workmen shall be maintained for persons engaged in specified categories of work. These shall include

- Noise induced hearing loss
- Lung Function test
- Ergonomic Test
- Eye Test for Welders, Grinders, Drivers etc

3.24.12.0 HYGIENE AND HOUSE KEEPING

- 3.24.12.1 Good house keeping and proper hygiene is one of the key requirements of occupational Health safety and environment management. Towards this the contractor shall encourage his workers and supervisors to maintain cleanliness in their area of work.
- 3.24.12.2 The contractor shall arrange to place waste bins / chutes at convenient locations for the collection of scrap and other wastes. The bins shall be clearly marked and segregated for metal, non-metal, hazardous and non hazardous wastes.
- 3.24.12.3 BHEL may take up appropriate remedial measures at the cost of the contractors if the contractors fail in good housekeeping and if there is an imminent risk of pollution

3.26.11 ENVIRONMENT MANAGEMENT

- 3.26.11.1 BHEL has a sound environmental management system, which is to be maintained and implemented by all the contractors. The system allows for project specific objectives to be set and developed sensitive to client requirements, applicable environmental legislation and BHEL's own objectives and policy. BHEL engineers will assess and monitor the environmental impact of their work and lay out objectives for their minimization. The contractors shall implement the objectives for continual improvement of environmental performance. BHEL shall regularly audit environmental impacts and their improvements.
- 3.26.11.2 **WASTE MANAGEMENT:** The objective of waste management is to ensure the safe and responsible disposal of waste, ensuring that it is correctly disposed of and being able to audit the process to ensure compliance.
- 3.26.11.3 Chemical wastes if any shall be collected separately and disposed of to BHEL designated refuse yard as per BHEL advice.
- 3.26.11.4 No dangerous chemicals, noxious waste products or materials will be disposed off on or off site without approval obtained through BHEL.
- 3.26.11.5 All disposal of wastes generated during construction shall be in accordance with all relevant legislation.
- 3.26.11.6 Acid and alkali cleaning wastes shall be neutralized to acceptable norms before disposal to the designated area.

- 3.26.11.7 All necessary measures shall be taken to ensure safe collection and disposal of waste oils in particular to ensure the prevention of their discharge into surface waters, ground waters, coastal waters or drainages.

3.26.12 SUPERVISION

- 3.26.12.1 Contractor must provide at least one full time on site safety coordinator having with relevant diploma / degree in safety engineering, when the manpower engaged is in excess of 50 for the contract activities in the premises. If the manpower is less than 50, the on site safety coordination responsibilities shall be assumed by any one of the contractor's other supervisory staff; however in both the cases, the contractor must specify in writing the name of such persons to the BHEL Engineer in Charge.
- 3.26.12.2 Contractor's safety coordinator or his supervisor responsible for safety as the case may be shall conduct at his work site, and document formal safety inspection and audits at least once in a week. Such documents are to be submitted to BHEL Engineer in Charge for his review and record.
- 3.26.12.3 Contractor, supervisor must attend all schedule safety meetings as would be intimated to him by the BHEL Engineer in Charge.
- 3.26.12.4 Before starting work under any contract, the contractor must ensure that a job Specific safety procedures/field practices as required over and above the safety permit conditions are prepared and followed .He should also ensure that all supervisors and workers involved understand and follow this procedures /field practices.
- 3.26.12.5 Contractor must ensure that in his work site appropriate display boards are put displaying signs for site safety, potential hazards and precautions required.

3.26.13 TRAINING & AWARENESS

- 3.26.13.1 Contractor shall deploy experienced supervisors and other manpower that are well conversant with the safety and environment regulations of the Project. The electricians to be deployed on the job should have wireman license.
- 3.26.13.2 All Supervisors & Workmen of the Contractor shall undergo Fire safety training/demonstration whenever arranged by BHEL with the help of either Customer's Fire and Safety department or outside faculty so as to acquire knowledge of

fire prevention and also to be able to make use of appropriate fire extinguishers.

- 3.26.13.3 Contractor must familiarize himself from BHEL Engineer in Charge about all known potential fire, explosion or toxic release hazards related to the contract. He in turn will ensure that same information has been passed to the supervisors and workmen.
- 3.26.13.4 Contractor must ensure that all his supervisors are properly trained and each employee has received and understood from his supervisor necessary training and briefing about the safety requirement. Necessary document as a means to verify that employees have understood the training is to be maintained.
- 3.26.13.5 The contractor supervisors shall also give a small safety briefing to all the workmen under his charge before undertaking any new work and specially understand the safety requirements that are mandatory.

3.26.14 REPORTING

- 3.26.14.1 The contractor shall submit report of all accidents, fires and property damage, dangerous occurrences to the authorized BHEL official immediately after such occurrence but in any case not later than twelve hours of the occurrence. Such report shall be furnished in the manner prescribed by BHEL and also to meet statutory requirement.
- 3.26.14.2 Any injury sustained by any of the contractor's employees within the Project premises must be reported to BHEL supervisor and FIRST AID should be immediately administered. The Contractor shall be responsible for keeping and maintaining proper records of Accidents to his personnel.
- 3.26.14.3 Contractor must arrange to immediately investigate, properly document and report any injury, accident or near miss involving any of his employees and take appropriate follow up action. He must furnish within 12 hours of the incident a written report to BHEL Engineer in charge and the Safety Section.
- 3.26.14.4 According to the factory act and the Employees state Insurance Act & regulation, any person sustaining any injury within the project premises and absenting himself from work for more than 46 hours, his accident report has to be sent to the respective Government Authorities. Therefore contractor

shall inform the owner's representative such matter immediately for their needful action.

- 3.26.14.5 In addition, contractor shall submit periodic reports on safety to the authorized BHEL official from time to time as prescribed.
- 3.26.14.6 Before commencing the work, the contractor shall appoint/nominate a responsible officer to supervise implementation of all safety measures and liaison with his counterpart of BHEL.

3.26.15 AUDIT REVIEW AND INSPECTION

- 3.26.15.1 BHEL shall conduct audit on the contractor performance and compliance with the project specific requirements of the Environment and Occupational Health & Safety Management systems. The programme of audit shall cover all activities under the contract but will focus particularly on high -risk activities. The Construction Manager shall decide the schedule of audit. The audit findings shall be communicated to the contractors and necessary remedial action as advised by BHEL Engineers shall be under taken within the stipulated time.
- 3.26.15.2 Inspections shall be carried out regularly by the contractors and by BHEL engineers on activities, facilities, equipment and documentation to cover the following aspects

- Compliance with procedures and systems
- Availability, condition and use of PPE
- Condition of maintenance tools, equipments, facilities
- Availability of fire fighting equipments and its condition
- Use of fire fighting equipments and first aid kit
- Awareness of occupational health hazard
- Awareness of safe working practices
- Presence of quality supervision
- Housekeeping

The Safety Coordinator shall visit and inspect work sites daily. All unsafe acts, unsafe conditions that have imminent potential for causing harm /injury/ damage will be immediately corrected. He shall maintain a daily logbook giving details of unsafe acts or conditions observed and the corrective action taken and recommendations for preventing recurrence. Adequacy of corrective actions will be verified .The contractor shall take remedial measures as per the findings of each inspection.

Besides the above, the contractor shall be required to carry out the following inspections.

SI No	Equipment	Scope of Inspection	Inspection by	Schedule
1	Hand tools	To identify unsafe/defective tool	User	Daily
2	Power tools	To identify unsafe/defective tool	User	Daily
3	Fire Extinguishers	To check pressure and any defect	User Safety coordinator	Daily Monthly
4	Lifting equipment/ tackles	To check for defects and efficacy of brakes	User Third party	Daily Every year
5	PPE	To check for defects	User	Daily

3.26.16 NON COMPLIANCE

3.26.16.1 **NONCONFORMITY OF SAFETY RULES AND SAFETY APPLIANCES WILL BE VIEWED SERIOUSLY AND THE BHEL HAS RIGHT TO IMPOSE FINES ON THE CONTRACTOR AS UNDER** for every instance of violation noticed: Ref Clause No 3.10.2.

3.26.16.2 Any other non-conformity noticed not listed in clause No 3.10.2 will also be fined as deemed fit by BHEL. The decision of BHEL engineer is final on the above. The amount will be deducted from running bills of the contractor. The amount collected above will be utilised for giving award to the employees who could avoid accident by following safety rules. Also the amount will be spent for purchasing the safety appliances and supporting the safety activity at site.

3.26.16.3 **CITATION:-**If safety record of the contractor in execution of the awarded job is to the satisfaction of safety department of BHEL, issue of an appropriate certificate to recognise the safety performance of the contractor may be considered by BHEL after completion of the job.

3.26.16.4 Memorandum of understanding

After Award Of Work, Contractors Are Required To Enter Into A Memorandum Of Understanding As Given Below:

Memorandum of Understanding

BHEL, PSSR is committed to Health, Safety and Environment Policy (EHS Policy) as given in the booklet titled "Safe Working Practices" issued to all contractors.

M/s _____ do hereby also commit to the same EHS Policy while executing the Contract Number _____

M/s _____ shall ensure that safe work practices not limited to the above booklet are followed by all construction workers and supervisors. Spirit and content therein shall be reached to all workers and supervisors for compliance.

BHEL will be carrying out EHS audits twice a year and M/s _____ shall ensure to close any non -conformity observed/reported within fifteen days.

Signed by authorised representative of M/s-----

Name:

Place & Date:

HSE SPECIFIC REQUIREMENT

OCCUPATIONAL HEALTH & SAFETY MANAGEMENT SYSTEM

SUB CONTRACTOR TO ENSURE COMPLAINECE 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 COMPLAINE OF THE FOLLOWING SAFETY RELATED POINTS

01. Personnel protective equipments (PPEs): Required number of following PPES (Confirming to Relevant is Standards) to be made available to workmen at site and ensured that they are used .
- Helmet
 - Safety goggles
 - Welding face shields
 - Safety belts for working at heights
 - Safety shoes
 - Ear plugs
 - Rubber gloves and mats for low tension (I.T) electrical works
 - Gum boots & aprons
 - Other items as required by BHEL site
02. Sub contractor to liase with nearest fire station and inform contact telephone number and contact person to meet any emergency.
03. To provide appropriate fire fighting equipment at designated work place and to provide fire fighting training to selected persons in his group of workmen to meet emergencies.
04. To provide adequate number of 24 V power supply points to work in a constrained and enclosed space.
- 05 . All power tapping points / switch boards /power & control cabling should fulfill required electrical safety aspects as per relevant is standard.
- 06 ELCB'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 IMTE's should have valid calibration certificate from recommended institution / testing lab and these should be in place.
17. All lifting tackle and plant equipment should have safe working load certificate.
18. The right worker should be deployed for right job and the resume of site in-charge, supervisors, and key workers to be submitted before commencement of work..
19. Sub-contractor should submit inspection / testing matrix of all T&Ps and to be approved by BHEL.
20. Sub-contractor to display safety slogan, safety board, caution boards wherever required in consultation with BHEL.

21. Sub-contractor to provide gas detectors of reputed make at desired locations.
22. Sub-contractor to conduct emergency mock drills, one drill per 6 months 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 COMPLAINECE OF THE FOLLOWING ENVIRONMENT RELATED POINTS

1. HOUSE KEEPING : Sub contractor to carry out daily house keeping of work areas / stores through a check list prepared in consultation with BHEL.
2. Sub contractor shall adopt pollution prevention / reduce /control approach in all his site activities. this shall include:
 - a. Transporting of oil / chemicals from stores to site safely without causing spillage. in case of any spillage, the area shall be cleaned and the remnant spilled oil disposed off to a safe place, identified for such disposal.

- b. To use required containers / cans / safety gadgets / appliances for transporting and for usage of oil / chemicals at site.
3. Sub contractor shall arrange for segregation / collection of scraps and dispose off to the identified place meant for scrap collection.
4. Sub contractor to adopt good erection practices / procedures with the objective of reduction of waste generation / rework

OTHER HSE REQUIREMENTS TO BE COMPLIED BY SUB CONTRACTOR

1. Sub contractor to clearly understand and accept the HSE policy of PSSR with a commitment to comply the requirements of the policy.
2. Sub contractors to arrange for daily meeting of their supervisors and work force before they disperse for their daily planned activities where in the relevant health , safety and environment aspects of the job and use of PPES are explained
3. Sub contractor to conduct monthly HSE meeting (internal) and submit the report to BHEL.
4. HSE slogans to be displayed in a proper board - hoarding at designated places in consultation with BHEL.
5. Sub contractor to submit a structured programme for training & occupational Health Screening of their work force at site after the Award of LOI.

SECTION – VI- PART -I

SPECIAL CONDITION OF CONTRACT North Chennai Thermal Power Station Stage - II : 2 x 600 MW BOILER & ITS AUXILIARIES PACKAGE

6.1 SCOPE OF WORK

- 6.1.1 The work to be carried out at quoted / accepted rates by the contractor under the scope of these specifications covers the complete work of handling, loading and transporting of materials from project stores sheds / storage yards to site of erection or preassembly yard and unloading at pre-assembly area/erection site, checking, cleaning chipping and leveling of foundations, providing packers and shims/pre-assembling of equipments at the pre-assembly yard, inspection, minor rectification, preservation, erection, leveling, and other adjustments, cutting, edge / surface preparation, welding, grinding, radiography, LPI/ MPI/ UT testing wherever needed, heat treatment, carrying out air tightness test by soap solution / kerosene, hydraulic test, steam /air blowing light up, chemical cleaning, passivation, steam blowing and safety valve floating including inter connection all the termination points, erection and dismantling of all temporary piping, valves, pumps, tanks etc., required for the above operations, all pre-commissioning tests and trial runs of the boiler & auxiliaries and supply and application of final painting covered under the tender specifications and providing adequate assistance during entire commissioning and unit trial operations and final painting of Unit- 1&2 of Stage-II 2 x 600 MW sets at North Chennai Thermal Power Project , Attipattu, Chennai, Tamil Nadu.
- 6.1.2 The quantities indicated in the tender specification are approximate and are liable for variation and alteration at the discretion of BHEL. The quoted unit rate shall be applicable for any additional product group also, if included at a later date. The work executed shall be measured and priced as per the unit rate arrived at for each work area as mentioned in the relevant clauses.

- 6.1.3 The work shall conform to dimensions and tolerances given in various drawings and quality manuals provided by BHEL. If any portion of work is found to be defective in workmanship not conforming to drawings or other stipulations, the contractor shall dismantle and redo the work duly replacing the defective materials at his cost, failing which the job will be carried out by BHEL by engaging other agencies / departmentally and recoveries will be effected from contractor's bill towards expenditure incurred including BHEL's overhead charges.
- 6.1.4 Contractor shall submit a copy of license to undertake construction /repair of Boilers & Piping issued by Boiler inspectorate before commencement of Pressure Parts / Piping Erection.
- 6.1.5 **The PG wise break up of Boiler and Auxiliaries are indicated under Section- VII Appendix II, but the contractor is required to erect actual tonnage which may be necessary to complete the work in all respects as detailed in the tender specifications, for which payments shall be released on finally accepted tonnage rates.**

The weights and dimensions of material shown are approximate and are liable to vary. No increase in quoted / accepted rates / prices shall be allowed due to change in weights and dimensions of the equipment / materials.

The terminal points as decided by BHEL shall be final and binding on the contractor for deciding the scope of work and effecting the payment for the work done up to the terminals.

- 6.1.6 The estimated weights, given in the part-II (Price Bid) are approximate and are meant for general idea to the contractor about the magnitude of the work involved. These are subject to change as per site conditions. No additional claims will be admissible on account of variations.
- 6.1.7 The work covered under this specification is of highly sophisticated nature requiring the best quality of workmanship, engineering and construction management. The contractor should ensure timely completion of the work. The contractor must have the adequate quantity of tools, construction aids, equipments, etc in his possession. He must also on his rolls adequate trained, qualified and experienced supervisory staff and skilled personnel.

- 6.1.8 Contractor shall execute the work as per sequence and procedure prescribed by BHEL at site. BHEL engineer, depending upon the availability of materials, fronts etc, will decide the sequence of erection and methodology. No claims for extra payment from the contractor will be entertained on the grounds of deviation from the method of erection adopted in erection of similar jobs or for any reason whatsoever.
- 6.1.9 Contractor has to work in close co-ordination with other erection agency at site. BHEL engineer will co-ordinate area clearance. In a project of such magnitude, it is possible that the area clearance may be less/more at a particular given time. Activities and erection program have to be planned in such a way that the milestone events like boiler light up, steam blowing, rolling etc are achieved as per schedule/ plans. Contractor shall arrange & augment the resources accordingly.
- 6.1.10 During the course of execution of work, certain rework/modification/ rectification/ repairs/fabrication etc will be necessary on account of feed back from various relevant source, and also on account of design discrepancies/ alterations, manufacturing defects, site operations/ maintenance requirements. Contractor shall carry out such rework/ modification/ rectification/ fabrication/ repairs etc promptly and expeditiously. Daily log sheets indicating the details of work carried out, man -hours etc shall be maintained by the contractor and got signed by BHEL engineer every day. Claims of contractor, if any, for such works will be dealt as per Special Conditions of Contract.

Supervisors/Engineers, consumable etc required for the above work contractor shall provide, which is included in the scope of work. All the expenditure including taxes and incidentals in this connection will have to be born by the bidder unless otherwise specified in the relevant clause. The contractors quoted rates should be inclusive of all such contingencies.

- 6.1.11 It shall be specially noted that the contractor's labour and staff may have to work round the clock to meet the completion schedules/ plans, which may involve payment of considerable overtime. Supervisors/Engineers, consumable etc required for this is included in the scope of work. The contractors quoted rates should be inclusive of all such contingencies.

- 6.1.12 The contractor is strictly prohibited from using BHEL's regular components like angles, channels, beams, plates, pipe/tubes, and handrails etc for any temporary supporting or scaffolding works. Contractor shall arrange himself all such materials. In case of such misuse of BHEL materials, a sum as determined by BHEL engineer will be recovered from the contractor's bill. The decision of BHEL engineer is final and binding on the contractor.
- 6.1.13 No member of the already erected structure/ platform, pipes, grills; platform, other component and auxiliaries should be cut without specific approval of BHEL engineer.

6.2.0 TRANSPORTATION FROM STORES / YARD

- 6.2.1 Loading at storage yard, transport to site, unloading at Pre-assembly area / site/working area is in the scope of work. Required cranes for loading of materials at storage yard will be in the scope of contractor. The contractor shall provide any fixtures, concrete blocks & wooden sleepers, which are required for temporary supporting of the components at site.
- 6.2.2 Contractor shall take delivery of the components and equipments from the storage area after getting the approval of BHEL Engineer on standard indent forms to be specified by BHEL. Complete and detailed account of the equipments erected as well as the progress shall be submitted to the Engineer as directed.
- 6.2.3 All the components shall be handled very carefully to prevent any damage or loss. The equipment 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 / loss of such equipment at site.
- 6.2.4 Contractor shall plan and transport equipments, components from storage yard to erection site and erect them in such a manner and sequence that material accumulation at site does not lead to congestion at site of work. Materials shall be stacked neatly, preserved and stored in the contractor's shed/work area in an orderly manner. In case it is necessary to shift and re-stack the materials kept at work area/site to enable other agencies to carry out their work, same shall be done by the contractor at no extra cost.

6.3.0 **FOUNDATION DRESSING FOR GROUTING :**

- 6.3.1 It shall be contractor's responsibility to check the various equipment foundations for their correctness with respect to level, orientation, dimensions etc., and ascertained dimensions shall be measured and submitted to BHEL for approval before erection. Also minor chipping, dressing of foundations up to **50 mm** for obtaining proper face for packer plates/shims, and may be required for the erection of the equipment/plants will have to be carried out by the contractor without extra cost.
- 6.3.2 The surface of foundations shall be dressed to bring the surface of the foundations to the required level and smoothness prior to placement of equipment/equipments based on the foundations.
- 6.3.3 All equipment bases and structural steel bases and foundations pockets shall be grouted and finished as per these specifications after surface preparation unless otherwise recommended by the equipment manufacturers. The surface preparation includes soda washing of the foundations to remove oil, grease etc. to ensure proper grouting. The required materials like sand, gravel, cement etc and cleaning consumables shall be arranged by the contractor at his cost. Special non-shrinkage cement like conbextra, shrink-comp or its equivalent etc. as approved by BHEL for grouting will be arranged by the contractor at his cost.
- 6.3.4 The concrete foundation, surfaces shall be properly prepared by chipping, as required to bring the top of such foundation to the required level to provide the necessary roughness for bondage and to ensure enough bearing strength. All laitance and surface film shall be removed and cleaned and the packers placed with suitable mortar prior to erection of the equipment. The contractor shall ensure perfect blue matching of the packer plates with foundations by dressing the foundation and between the packer plates and base plates of structural columns to the satisfaction of BHEL Engineer.
- 6.3.5 Total grouting of the columns/equipments including pocket grouting, grouting at the gap between foundation and base plates top surface of column/equipments is in the scope of the contractor. All the grouting should be carried out by non-shrink cement like conbextra GPI/Conbextra GP II / Shrinkkomp or its equivalent etc. This special non-shrink cement shall be arranged by the contractor at his cost. The quoted rate shall inclusive of the same.

6.3.6 **PROCEDURE FOR GROUTING** : Contractor has to carryout the grouting as per the work instructions for grouting available at site.

6.4.0 **ERECTION**

6.4.1 Brief list of System/ sub-system to be erected by the contractor & approximate weight of individual PGMAs and number of welding joints, HT and NDT requirements are given in the appendices and are meant for giving general idea to the tender only about magnitude of the work involved. This should not be taken for billing or any other claims. All weights and no. of welds for such purposes will have to be taken from design documents only (Shipping list/ FWS/ Drgs.).

6.4.2 All normal erection and assembly techniques necessary for completion of works under this specification and magnitude have to be carried out. It is not possible to specifically list out all of them. Absence of any specific reference will not absolve the contractor of his responsibility for the particular operation. These would include

- Scaffolding and rigging operations
- Machine / flame / electric cutting, grinding, welding, radiography and stress relieving.
- Fitting, refitting, filing, straightening, chamfering chipping, scrapping, reaming, cleaning, checking, leveling, blue matching, aligning and assembly.
- Machining, surface grinding, drilling, doweling, shaping
- Temporary erections for alignment, dismantling of certain equipment for checking, cleaning, servicing and site fabrication

6.4.3 Normally the high pressure valves will have prepared edges for welding. But if it becomes necessary the contractor shall prepare new edges or recondition the edges by grinding or chamfering to match the corresponding tubes and pipes. All fittings like "T" pieces , weld neck flanges, reducers etc., shall be suitably matched with pipes for welding. The valves will have to be checked, cleaned or overhauled in full or in part before erection, after chemical cleaning and during commissioning. Edge preparation becomes the part of erection work. However, payment for new edge preparation reconditioning beyond reasonable limits will be considered as per man days rates.

- 6.4.4 Adjustments like removal of ovalities in pipes and opening or closing the fabricated bends of high pressure piping to suit the layout shall be considered part of work and the contractor is required to carry out such work free of cost, as per instructions of BHEL, which shall include specific heat treatment procedures etc., Quality correction beyond reasonable limits will be paid as per man days rates.
- 6.4.5 Certain adjustments in length of steel members may be necessary while erecting high pressure pipelines of boiler and piping (pre fabricated lines) and the contractor should remove the extra lengths/ and add extra lengths to suit the final layout after preparing edges afresh and adopting specified heat treatment and NDT procedures at no extra cost, wherever indicated.
- 6.4.6 Suspension for piping, pressure parts, ducting etc., will be supplied in running lengths which shall be cut to suitable sizes and adjusted as required.
- 6.4.7 Ducts / expansion pieces are dispatched to site in loose walls / plates and these are to be assembled at site before erection. All field connection duct / expansion pieces and dampers shall be seal welded on inside as well as outside. Also it may sometime become necessary to remove any of the erected members to facilitate erection of bigger/pre-assembled equipment. In such as the removal and re-erection of such members, which are essential will have to be carried out by the contractor without any extra payment.
- 6.4.8 Fabricated pipes are sent in standard length and have to be cut and edge prepared to suit the site conditions and the layouts. Tubes or pipes wherever deemed to be convenient will be sent in running lengths with sufficient bends. Bends up to NB 65 mm will have to be fabricated at site adopting specified heat treatment procedures. Wherever required at no extra cost.
- 6.4.9 All welded joints should be painted with anti corrosive paint, once radiography and stress relieving works are over. Daily welding reports in the proforma suggested by BHEL should be submitted by next morning without fail.

- 6.4.10 All the dampers, valves, lifting equipments, power cylinders, etc., shall be serviced and lubricated to the satisfaction of BHEL engineer before erecting the same and also during pre commissioning. The bearings of dampers shall be properly cleaned, serviced and lubricated before commissioning at no extra cost. Even after commissioning the equipments, if there are problems in the operation they have to be attended to by the contractor during the tenure of the contract.
- 6.4.11 In case of any class of work for which there is no such specifications as laid down in the contract such as blue matching, welding of stainless steel parts etc., the work shall be carried out in accordance with instructions and requirements of the BHEL engineer at the quoted rates only.
- 6.4.12 In the case of structural members / ducts in certain cases, the raw material will be supplied in random lengths and the contractor will have to make up the length / prepare the edges to suit the matching profiles, weld / bolt connect the joints at no extra cost. Normally, the **matching** profile will be cut out for the structural members but the contractor will have to carry out suitable alteration / adjustments at site, without any extra payment in case it becomes necessary.
- 6.4.13 Attachment welding of necessary instrumentation tapping points, thermocouple pads, root valves, condensing vessels, flow nozzles and control valves etc., both for regular measurements and performance testing to be provided on boiler / its auxiliaries, **ESP** and pipelines covered within the scope of this tender, will also be the responsibility of the contractor and the same will be done as per the instructions of BHEL Engineer. The erection and welding of all above items will be contractor's responsibility. Even if a) Product groups under which these items are released are not covered in the scope of this tender, b) Items are supplied by an agency other than BHEL.
- 6.4.14 Spring suspensions / constant load hangers have to be preassembled and adjusted for the required loading and erected as per instructions, of BHEL Engineer. Any adjustments, removal of temporary arrestors / lockers, etc., have to be carried out as and when required.

- 6.4.15 The contractor shall carry out necessary preservative painting, periodic application of preservations on pressure parts and other equipments during erection / after erection until completion of work. Necessary preservatives / paints, thinner and consumables are to be arranged by the contractor at his cost. The quoted price to be inclusive of above.
- 6.4.16 The contractor shall take all reasonable care to protect the materials and equipment during erection. Touch up painting required to be done on any equipment or part during the course of erection will have to be done by the contractor.
Contractor shall provide necessary crew with all items like wire brushes, paint brushes, emery paper, cotton waste, scaffolding materials etc., at his cost.
The contractor has to arrange required fire proof tarpaulins to protect the machined components / assembled parts drawn from BHEL before and after erection at their cost.
- 6.4.17 The contractor shall fabricate piping, install lub oil systems and carry out the acid cleaning of fabricated piping. The contractor shall also service the lub oil system, carry out the hydraulic test of oil coolers. etc.,
- 6.4.18 All rotating machineries and equipments shall be cleaned, lubricated, checked for their smooth rotation, if necessary dismantling and refitting before erection. If in the opinion of BHEL engineer, the equipment is to be checked for clearance, tolerance at any stage for work or during commissioning period, all such works are to be carried out by contractor at his cost.
- 6.4.19 The HT motor bearings shall be blue matched at site and checked for bearing clearance. Scrapping of bearing housing, if required to any extent shall be carried out by the contractor. No extra claim for blue matching of any two surfaces will be entertained. The HT motors will also be checked for air gap and adjustment stator/rotor to magnetic center shall be carried out as part of erection.
- 6.4.20 The fans shall be checked for blade clearance and other vital tolerances. The IGV units shall be serviced. Necessary assistance for balancing of equipment during trial run shall be provided by the contractor.
- 6.4.21 Vital clearance of mill should be checked at site and adjusted if required.

- 6.4.22 All the bearings, gear boxes, etc. of the equipments and electrical motors to be erected are provided with protective greases only. Contractor shall arrange as and when required by the Engineer for cleaning the bearings, gears etc. with kerosene or some other agent, if necessary by dismantling some of the parts of the equipment during erection and shall arrange for re-greasing/lubricating them with the recommended lubricants and for assembling back the dismantled parts. Required cleaning agent (kerosene etc) shall be arranged by the contractor at his cost. The quoted rate shall inclusive of the same.
- 6.4.23 The instructions of the motor manufacturer regarding storage of the motors and re-conservation must be strictly followed without any deviation.
- 6.4.24 All the motors if necessary shall be stripped open thoroughly serviced with proper care and reassembled properly before erection by the contractor. During servicing, if any deficiency is observed, the same should be taken up with BHEL engineer at site without any delay.
- 6.4.25 All the shafts of the rotating equipments shall have to be properly aligned to those of matching equipment to perfection, accuracy as required and the equipment shall be free from excessive vibrations so as to avoid overheating of bearings or other conditions, which may tend to shorten the life of the component. All bearing shafts and other rotating parts shall be thoroughly cleaned and lubricated as per the recommendations of BHEL Engineers before starting.
- 6.4.26 The contractor shall carry out the trial run of motors including checking the direction of rotation in the uncoupled conditions, checking, aligning and coupling the motor to the respective driven equipment. Before starting the motor, values of insulation (IR value) shall be recorded and if found necessary, dry out operation to be carried out by the contractor at no extra cost.
- 6.4.27 D.S.L./equivalent system for hoisting equipments are also to be erected and commissioned including load testing by the contractor within the quoted rates. Required manpower including electricians to be arranged by the contractor for carrying out commissioning of electrical hoist and load testing of the above electrical hoist. Required loads will be provided by the BHEL free of cost. But, transportation, handling and returning the same back to BHEL is in the scope of contractor.
- 6.4.28 All the tubes and pipes shall be cleaned and blown with compressed air and shown to the Engineer before lifting.

Sponge ball test shall be carried out for all tubes before erecting the same. Bigger size pipes should be cleaned with flexible wire brush, wherever necessary. After cleaning is over, the end caps shall be put back in tube openings till such time they are welded to other tubes. Required compressors shall be arranged by the contractor at his cost.

- 6.4.29 All attachment welding including those for insulation and refractory work coming on the pressure parts shall have to be done by the contractor. The hooks are suitable for stud welding machines. Contractor's quoted rate shall include all these contingencies. Attachment welding on pressure parts shall be done by qualified and certified welders only.
- 6.4.30 It is the responsibility of the contractor to do the alignment, checking, etc., if necessary, repeatedly to satisfy BHEL Engineer / customer Engineers with all the necessary tools and tackles manpower, etc., without any extra cost. The alignment will be complete only when jointly certified so, by the BHEL Engineer & customer. Also the contractor should ensure that the alignment is not disturbed afterwards.
- 6.4.31 Burner tilt mechanism will be checked for freeness, serviced and adjusted, if necessary to obtain optimum tilt before and after installation.
- 6.4.32 Fine fittings, boiler trim piping, oil system and other small bore piping have to be routed according to site conditions and hence shall be done only in position. As such, layout of small bore piping in boiler and oil system shall be done as per the site requirement. Necessary sketch for routing these lines should be got approved from BHEL by the contractor. There is a possibility of slight change in routing the above pipelines when after completion, to suit the site conditions. The contractor should absorb this cost in his quoted rate.
- 6.4.33 Additional platforms for approaching different equipments as per the site requirement, which may not be indicated in drawings, shall be assembled and erected by contractor. However, the contractor shall be paid for this work on accepted tonnage rate for erection. The steel materials required for these works shall be supplied by BHEL free of cost and the contractor will have to install them to suit the requirement. Works of major nature not covered under this clause.
- 6.4.34 Complete penetration of water wall (Panel to panel) tube to tube and fins welding shall be achieved either by single side or double side welding. The decision of BHEL Engineer is final.

- 6.4.35 Work such as minor rectification of foundation bolts, reaming of holes, drilling of dowels, matching of bolts and nuts, making new dowel pin, etc. are covered in the scope of work.
- 6.4.36 The column erection has to be done tier by tier with all bracings, beams to be erected, welded / bolted. Second tier of erection can be carried out only after grouting of column base.
- 6.4.37 Certain extra lengths of various tubes/pipes and fabricated ducts are provided as erection allowance and the same have to be cut/adjusted to suit the site conditions and layouts or certain small lengths may have to be added for adjustments to suit the site conditions. For any mismatch while matching the joints in tubes, the cutting, adjusting, re-welding, addition spool pieces should be done by the contractor to match site conditions without any extra payment.
- 6.4.38 No temporary supports shall be welded on the pressure parts or piping. Welding of temporary supports, cleats, etc. on the boiler columns shall be avoided. In case of absolute necessity contractor shall take prior approval from BHEL Engineer. Further, any cutting or alteration of member of the structure of platform or other equipment shall not be done without specific prior approval of BHEL Engineer.
- 6.4.39 Contractor shall engage separate gangs throughout the contract period, exclusively for proper house keeping of the site. The contractor has to make necessary arrangements for collection and for bringing down the scrap from, all locations and taking them away from the erection areas to various locations as indicated by BHEL Engineer. The house keeping must be a routine and continuous activity. Periodical payments to the contractor for the work done will be considered only if the housekeeping is certified as satisfactory by the customer.
- 6.4.40 All hangers, supports and anchors (including concreting or welding) shall be installed as per drawing to obtain are reliable and complete pipe installation as per instructions of BHEL Engineer. Normally supports are issued in running meters. Any additional supports as called for by BHEL Engineer shall be fabricated by the contractor and provided at no extra cost. However, the raw material required for fabrication of such supports shall be supplied by BHEL free of cost. (Any machining or threading is involved will only be done by BHEL.
- 6.4.41 Some platform materials in PG 36 and 38 approach ladders, suspension materials etc. will be supplied in running meters. The contractor has to fabricate these materials wherever they

are supplied in running meters and erect them within the quoted rates.

- 6.4.42 The materials for boiler roofing and side cladding etc. will be supplied by BHEL and contractor has to erect the same at the quoted / accepted tonnage rate.
- 6.4.43 It shall be the responsibility of the contractor to provide ladders on column for initial works till such time stairways are completed. For this the ladder should not be welded on the column and should be fabricated clamping type ladders. No temporary welding on any structural members is permitted except under special circumstances with the approval of BHEL. The necessary materials for the ladders are to be arranged by bidder within quoted rate.
- 6.4.44 Assistance for calibrating / testing the power cylinders / valves, gauges, instruments, etc. and setting to actuators coming under various groups shall be provided by contractor within the quoted rates.
- 6.4.45 Hanger rods are shown in the pressure parts arrangement drawing for boiler. Any cutting / welding and required heat treatment and necessary NDT of such hanger rods will be done by the contractor. The hangers for pressure parts will be tested for even distribution of load with the help of torque wrench.
- 6.4.46 Skin casing sheet for covering the boiler roof panels, and other areas will be supplied as fabricated items. Any cutting and re-fabrication to suit the site conditions shall be carried out within the quoted rates.
- 6.4.47 It is the responsibility of the contractor to engage his workmen in shifts or on overtime basis for achieving the desired progress and target set by BHEL. The contractor's quoted rate shall include all these contingencies.
- 6.4.48 The contractor is strictly prohibited in using any of the Boiler / ESP components like angles, channels, hand-rails for any temporary supporting or scaffolding work. In case of such misuse, a sum as determined by BHEL shall be recovered from contractor's bills. Also the contractor will be responsible for the safe custody and proper accounting of all materials in connection with the work. If the contractor has drawn materials in excess of design requirements, recoveries will be effected for such excess draws at the rate prescribed by manufacturing units.

- 6.4.49 For all the site routed piping under PG-21, 24 & 42 as built drawings are to be submitted by the contractor immediately after erection.
- 6.4.50 The contractor has to remove the scrap/debris periodically as and when required and returned to BHEL stores. In case the contractor fails to remove the scrap / debris, the same shall be done by BHEL at the cost of contractor. The temporary structures / item welded either to structures or pressure parts are to be cut and removed without any damage, the same shall have to be made good by the contractor.
- 6.4.51 Regarding steam coil-Air preheater the contractor is expected to erect as per the drawings. Hydraulic test of SCAPH has to be carried out on the ground before lifting it to the position.
- 6.4.52 The contractor has to erect the passenger cum goods lift including the civil portion, as per instruction of BHEL Engineer, including transport of materials from BHEL Stores. The dismantling of the erected lift, Transport / Handling over to BHEL Stores is also covered in this scope of work. The contractor has to arrange operators, Technicians for round the clock operation and maintenance is to be carried out by the contractor at his cost. The operation and maintenance shall be carried out till the end of contract period, or the date on which the lift is dismantled as per the directives of BHEL, whichever is earlier.
- 6.4.53 EP collecting electrodes may require straightening and repair due to minor transport damages before erection and sport heating in position to get correct alignment which shall be done by contractor with in quoted rate.

6.4.54 ROOF INSULATION

One or two layer of insulation mattress on roof top of E.S.P roof (inner) shall be applied as per drawing before outer roof is placed. The scope shall also include the above work even though the materials are supplied under some other product group and the erected materials shall be paid at the accepted tonnage rate for ESP.

- 6.4.55 **EACH CEILING GIRDER WILL BE SUPPLIED IN MAXIMUM 3 PIECES AND CEILING GIRDERS ARE TO BE PRE-ASSEMBLED AT SITE AND WELDING, NDT & STRESS RELIEVING ARE TO BE CARRIED OUT, INCLUDING 100% RADIOGRAPHY and UT FOR THE FULLY COMPLETED FLANGE WELDS HAVING HIGHER THICKNESS OF CEILING GIRDERS. THE REQUIRED HT & NDT EQUIPMENTS, CONSUMABLES & INSTRUMENTS ARE INCLUDED IN THE SCOPE OF BIDDEER. THE HEAVIEST ASSEMBLED**

CEILING GIRDER WEIGHT WILL BE AROUND 197 MT WITH 200MM THICK FLANGE AND MAXIMUM ELEVATION OF CEILING GIRDER TOS ~95M AND HEIGHT OF CEILING GIRDER IS ~3.8M".

6.5.0 **DRUM LIFTING**

BHEL shall arrange to unload Boiler Drum in a convenient location approx. 300 to 400 mtrs away from the Boiler foundation. Transportation of the same to erection site shall be within the scope of the Bidder. **The required sleepers, jacks, rails, etc. arrangement is in Contractor's scope.**

6.5.1 Drum will be lifted with Electrical operated Heavy Duty Winch with necessary T&Ps like multi sheave pulley blocks. BHEL will provide free of cost the winches (15 T) with wire ropes and Multi sheave pulley blocks. All other T&Ps required for Drum lifting like smaller capacity winches, D shackles, etc are to be arranged by the contractor at his cost.

6.5.2 The temporary structures required for suspension of fixed pulley, anchoring of Winches & Guide pulleys and related works along with consumables are in the scope of contractor. Servicing of winches, wire ropes, pulley blocks and inspection & testing of the same are to be arranged by the contractor. Structural Steel Materials required for fabrication of Temporary structure for drum lifting alone will be supplied by BHEL.

6.5.3 Any additional arrangement / civil foundations required to carry out drum lifting shall be arranged by the contractor with in the quoted rate including arrangement of materials.

6.5.4 HSFG Bolts for Boiler supporting structure are to be tightened by turn of nut method/Torque Wrench, as per the instruction of BHEL Engineer. The bolted joints shall be jointly checked by BHEL/Customer and contractors personnel for the required tightness and re-tightness wherever necessary. The tightened bolts shall be identified by colour paints. Facility for random checking with calibrated Torque Wrench shall also be provided by contractor.

6.6.0 **AIR LEAK TEST**

Air leak test is to be conducted for the cold & hot Primary & Secondary air ducts. Also gas tightness test is to be done for the flue gas ducts. In addition to this, leak tests are to be done for the furnace, skin casing works carried out in the boiler roof, furnace bottom etc to the satisfaction of BHEL / Customer.

6.7.0 PRESERVATION / TOUCH UP PAINTING

6.7.1 Contractor shall carryout cleaning and preservation/ touch up painting as a part of erection work for the materials / equipments under this tender specification right from pre-assy stage, during erection and after erection till the equipment is cleared for final painting, wherever deficiency in painting / rusting is noticed. The primer paint shall be matching shop primer. The required manpower, other required consumables, T&P etc shall be provided by the contractor with in the quoted rate. The arrangement of primer paint will be in contractor's scope.

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

6.8.0 PROGRESS OF WORK

6.8.1 Contractor is required to draw mutually agreed monthly erection programs in consultation with BHEL well in advance. Contractor shall ensure achievement of agreed program and shall also timely arrange additional resources considered necessary at no extra cost to BHEL.

6.8.2 Progress review meetings will be held at site during which actual progress during the week vis-a-vis scheduled program shall be discussed for actions to be taken for achieving targets. Contractor shall also present the program for subsequent week. The contractor shall constantly update / revise his work program to meet the overall requirement. All quality problems shall also be discussed during above review meetings. Necessary preventive and corrective action shall be discussed and decided upon in such review meetings and shall be implemented by the contractor in time bound manner so as to eliminate the cause of nonconformities.

6.8.3 The contractor shall submit daily, weekly and monthly progress reports, manpower reports, materials reports, consumables (gases / electrodes) report, cranes availability report and other reports as per Performa considered necessary by the Engineer as per the format enclosed with this tender document.

6.8.4 The progress reports shall indicate the progress achieved against planned with reasons indicating delays if any, shall also furnish in detail the reason for the same and shall give remedial action which the contractor intends to take to make good the slippage on lost time, so that further works can proceed as per

the original programme and the slippage do not accumulate and affect the overall programme. The contractor shall submit detailed monthly plan after discussion with BHEL engineer and the same has to be forwarded by the first week of the month (working month or calendar month)

6.8.5 The monthly report ending on 24th of every month shall be submitted in a spiral bounded book and shall contain the following details :-

- a) Colour Progress photographs to accompany the report should be submitted.
- b) Erection progress in terms of tonnage and welding joints, radiography and stress relieving completed as relevant to the respective work areas against planned.
- c) Site Organization chart of engineers & supervisors as on 24th of the month with further mobilization plan
- d) Category- wise man hours engaged during the previous month under the categories of fitters, welders, riggers, khalasis, grinder-men, gas-cutters, electricians, crane operations and helpers. Data will be spilt up under the work area of Boiler
- e) Consumables report giving consumption of all types of gases and electrodes during the previous month.
- f) Availability report and utilization report of cranes
- g) Safety implementation report in the format
- h) Pending material and any other inputs required from BHEL for activities planned during the subsequent month.

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

6.8.7 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 employed are not sufficient BHEL will induct required additional workmen to improve the progress and recover all

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

- 6.8.8 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.
- 6.8.9 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 the BHEL Engineer as required.

6.9.0 WELDING, HEAT TREATMENT AND NON-DESTRUCTIVE TESTING

- 6.9.1 The pressure parts, equipments and piping shall be erected in conformity with the provisions of Indian Boiler Regulations and as may be directed, as per other standard / specification in practice in BHEL. The method of welding (viz) ARC, TIG or other methods as indicated in the detailed drawing or as instructed by BHEL Engineer shall be followed. BHEL Engineer will have the option to change the method to suit site conditions.
- 6.9.2 Welding of pressure parts, Piping shall be done by certified high pressure welders who possess valid certificate and who are approved by BHEL Engineer. The number of welds indicated for Pressure Parts is only a tentative figure. The actual no. of welds and NDT & HT requirement will be released by the Mfg. unit in FWS/ EWS as approved document. Contractor shall make note of it while quoting and no claim will be entertained in this regard.
- 6.9.3 All welders including tack welders, structural and high pressure welder shall be tested and approved by BHEL Engineer before they are actually engaged on work even though they may possess a valid certificate. BHEL reserves the right to reject any welder if the welder's performance is not found to be satisfactory. The contractor shall maintain the records of qualification AND performance of welders. BHEL Engineer will issue all the welders qualified for the work, an identity card. The welder will keep the same with him at work place at all times. He may be stopped from work if he is not found in possession of the same.

- 6.9.4 Engineer may stop any welder from the work if his performance is Unsatisfactory for any technical reason or if there is a high percentage of rejection in the joints welded by him. The welders having passed qualification tests does not absolve the contractor of contractual obligation to continuously check the welder's performance. The contractor will be responsible for the periodic renewal, re-testing of the welders as demanded by BHEL.
- 6.9.5 Faulty welds caused by the poor workmanship shall be cut and re-welded at the contractor's expense. The Engineer prior to any repair being made shall approve the procedure for the repair of defective welds. After the repair has been carried out, the compliance shall be submitted to the quality engineer.
- 6.9.6 The contractor shall carry out the root run welding of all HP / LP piping, valves by TIG welding method only. The contractor shall have to carry out full TIG welding of butt weld joints of tubes / pipes of lesser thickness if required. During the root runs of stainless steel joints, the contractor shall before and during welding have to purge the pipes with inert gas. Contractor shall follow the Process Procedure issued by BHEL for T91 / P91 Weld , wherever applicable, and the quoted rate inclusive of all the consumables required for the process.
- 6.9.7 All expenses for testing of contractor's welders including destructive and Non- destructive tests conducted by BHEL at site or at laboratory shall have to be borne by the contractor only. Limited quantity of tube and pipe material required for making test pieces will be supplied by BHEL free of cost.
- 6.9.8 Only BHEL approved electrodes and filler wire will be used. All electrodes shall be baked and dried in the electric electrode-drying oven to the required temperature for the period specified by the Engineer before these are used in erection work. All welders shall have electrodes drying portable oven at the work spot. The electrodes brought to the site will have valid manufacturing test certificate. The test certificate should have a co-relation with the lot number / batch number given on electrode packets. No electrodes will be used in the absence of above requirement. The thermostat and thermometer of electrode drying oven will be also calibrated and test certificate from Govt. approved / accredited test house traceable to National / International standards will be submitted to BHEL before putting the oven in use. The contractor shall also arrange periodical calibration for the same. Separate ovens shall be used for baking and holding.
- 6.9.9 All butt / fillet welds shall be subject to Non -Destructive testing as per the Drawing/Procedures/Welding Schedules/Documents at no additional cost.

- 6.9.10 The contractor shall maintain a record in the form as prescribed by BHEL of all operations carried out on each weld. He has to maintain a record indicating the number of welds, the names of welders who welded the same, date and time of start and completion, preheat temperature, radiographic results, rejection if any, percentage of rejection etc. and submit copies of the same to the BHEL Engineer as required. Interpretation of the BHEL Engineer regarding acceptability or other wise of the welds shall be final.
- 6.9.11 The contractor shall carry out the edge preparation of weld joints at site in accordance with the details acceptable to BHEL Engineer. Wherever possible machining or automatic flame cutting should be done. Gas cutting will be allowed only wherever edge preparation otherwise is impractical. All slag / burrs shall be removed from the edge and all the hand cuts shall be ground smooth to the satisfaction of engineer.
- 6.9.12 All welds shall be painted with anticorrosive red oxide paint once radiography and stress relieving works are over. Necessary consumables and scaffolding etc including paints shall be provided by contractor at his own cost.
- 6.9.13 Pre-heating, radiography and other NDT tests, post heating and stress relieving after welding of tubes, pipes, Non Pressure Parts like Crown Plate support assy., Ceiling girder & etc. including attachment welding wherever necessary, are parts of erection work and shall be carried out by the contractor in accordance with the instructions of the Engineer. Contractor at his cost shall arrange all equipment and consumables essential for carrying out the above process.
- 6.9.14 Contractor shall arrange all necessary stress relieving equipment with automatic recording devices (for heat treatment & stress relieving). The contractor shall arrange for labour, heating elements, thermocouples, thermo-chalks, temperature recorders, thermocouple attachment units, graphs, sheets insulating materials like asbestos cloth, ceramic beads, asbestos ropes etc. required for heat treatment/ stress-relieving operations. The contractor should take a note of the following,
- Temperature shall be measured by thermocouple and recorded on a continuous printing type recorder. All the recorded graphs used for heat treatment process shall be the property of BHEL.
 - All stress relieving equipment will be used after due calibration and submission of test certificate to BHEL.

Periodic calibration from Govt. Approved / accredited Test Houses traceable to National / International standards will also be arranged by the contractor for such equipment at his cost.

- The contractor shall obtain the signature of Customer/ Client Engineer or his representative on the strip chart of the recorder prior to the starting of SR operations.

- 6.9.15 The contractor shall also be equipped for carrying out other NDT like RT, UT, LPI /MPI / Hardness test etc. as required as per welding schedules / drawings within the finally accepted price / rates. The UT has to be conducted by qualified Engineer/ Supervisor (Level – II/ III) in the presence of BHEL/ Customer Engineer or Representative. The recorded graph sheet duly signed by BHEL/ Customer to be submitted to BHEL.
- 6.9.16 The technical particulars, specification and other general details for radiography work shall be in accordance with ASME, IBR or ISO as specified by BHEL.
- 6.9.17 The contractor for radiography work shall use iridium-192 the geometric un-sharpness shall not exceed 1.5 mm. The contractor should take adequate safety precautions while carrying out radiography. Contractor at his cost shall arrange necessary safe guards required for radiography (including personnel from BARC).
- 6.9.18 Low speed high contrasts, fine grain films (D-7 or equivalent) in 10 cm width only are used for weld joint radiography. Film density shall be between 1.5 to 2.0.
- 6.9.19 All radiographs shall be free from mechanical, chemical or process marks, to the extent they should not confuse the radiographic image and defect finding. Penetrameter as per ASME or ISO must be used for each exposure.
- 6.9.20 Lead numbers and letters are to be used (generally 6mm size) for identification of radiographs. Contract number, joint identification, source used, welder's identification and SFD are to be noted down on paper cover of radiograph.
- 6.9.21 Lead intensifying screens for front and back of the film should be used as per the above-referred ASME specification. The joint is to be marked with permanent mark A, B, C to identify the segments. For this a low stress stamp shall be used to stamp the pipe on the down streamside of the weld. For multiple exposures on pipes, an overlap of about 25-mm of film should be provided.

- 6.9.22 Radiography personnel with sufficient experience and certified by M/s BARC for conducting radiographic tests in accordance with safety rules laid down by Division of Radiological protection only have to be deployed. These personnel should also be registered with DRP / BARC for film badge service.
- 6.9.23 All arrangements for carrying out radiography work including dark room and air conditioner and other accessories shall be provided by contractor within the space allotted for office at his cost. As an alternative the contractor may deploy an agency having all above facilities and who are duly approved / accredited by BARC and / or other Regulatory authorities. Detailed particulars of such agencies will be submitted and got approved by BHEL Engineer before the actual deployment of agency for radiography work.
- 6.9.24 The contractor shall have a dark room fully equipped with radiography equipment, film (un-exposed), chemicals and any other dark room accessories. All radiography films shall be developed in the dark room at site.
- 6.9.25 Contractor shall note that 100% radiography will be done at the initial stages on all the piping welding joints. Subsequently radiographic inspection will be done on the basis of quality of welding. However minimum percentage of joints to be radiographed shall not be less than the requirement of BHEL welding schedule / IBR / Customer's requirements. The percentage may be increased depending upon the quality of joints and at the discretion of BHEL. Radiography on LP piping joints is not envisaged. However other NDT test as called for in the FQP including LPI, MPI and HT will have to be carried out.
- 6.9.26 All the Radiographs shall be properly preserved and shall become the property of BHEL. They are to be reconciled with the work done, joints radiographed and submitted to BHEL / customer.
- 6.9.27 Since radioisotopes are being used, all precautions and safety rules as prescribed by BHEL/BARC/ Customer shall be strictly followed. BARC /DRP certificate to be provided before taking up the work.
- 6.9.28 Radiography of joints shall be so planned after welding, that the same is done either on the same day or next day of the welding to assess the performance of HP welders. If the performance of welder is unsatisfactory, he is to be replaced immediately.
- 6.9.29 wherever radiographs are not accepted, on account of bad shot, joints shall be re-radiographed and re- submitted for evaluation.

- 6.9.30 However, if the defect persists after first repair, further repair work followed with radiography shall be repeated till the joint is made acceptable. In case the joint is not repairable, the same shall be cut, re-welded and re-radiographed at contractor's cost.
- 6.9.31 Heat treatment and radiography may be required to be carried out at any time (day and night) to ensure the continuity of the progress. The contractor shall make all necessary arrangements including labour, supervisors/ Engineer required for the work as per directions of BHEL.
- 6.9.32 The contractor shall assist BHEL Engineer in preparing complete field welding schedule for all the field welding activities to be carried out in respect of piping and equipment erected by him involving high pressure welding at least 30 days prior to the scheduled start of erection work at site. The contractor shall strictly adhere to such schedules.
- 6.9.33 The contractor shall deploy required number of H.P. welders to carry out the H.P. weld joints. The welding works should not be held up due to shortage / want of I.B.R./H.P. welders.
- 6.9.34 All welded joints shall be subjected to acceptance by BHEL Engineer.
- 6.9.35 The technical particulars, specifications and other general details of work shall be in accordance with BHEL welding, Heat treatment and NDE manuals or equivalent as decided by BHEL Engineer.
- 6.9.36 Contractor shall carryout Radiography applicable as per IBR/ FWS/ DRG.. However percentage radiography shown in the respective drawings/ FWS shall be final and binding on the contractors.

The field joints are to be radiographed and preheating and post weld heat treatment to be done as per BHEL procedure and manuals.

The percentage of Radiography are tentative, which may be increased depending upon the quality of joints at the discretion of BHEL.

- 6.9.37 All radiographs shall be free from mechanical, chemical or process marks to the extent they shall not confuse the radiographic image and noticed.
- 6.9.38 Penetrometer as per ASME/ISO shall be used for all exposures.
- 6.9.39 Lead numbers and letters (generally of 6mm size) are to be used for identification of radiographic contract No., joints identification, sources used welders identification, SFD used are to be noted

down in the paper cover of radiography. Lead intensifying screens for front and back of the film shall be used as per the instructions of BHEL Engineer.

- 6.9.40 The weld joint is to be marked with permanent mark A, B, C, etc. to identify the segments. For this a low stress stamp shall be used to stamp the pipe on the down stream side of the weld. For multiple exposures on pipes, an overlap of about 25 mm of film shall be provided.
- 6.9.41 The contractor shall be fully equipped with radiography equipments,, films, chemicals and other dark room facilities. There must be a number of radiographic personnel with sufficient experience and certified by BARC for field radiographic inspection. Further, the contractor must follow strictly the safety rules laid down by BARC, from time to time, contractor's radiographers shall also be registered with BARC for film badge service.
- 6.9.42 Contractor shall provide all skilled, unskilled work men required for the job, which will include Engineers, supervisors, operators, as required for timely and satisfactory execution of radiography work.
- 6.9.43 All the radiographs shall be properly preserved in air-conditioned rooms and shall become the property of BHEL.
- 6.9.44 Radiography of joints shall be so planned after welding that the same is done either on the same day or next day of the welding to assess the performance of high pressure welders. If the performance of the welder is unsatisfactory, he shall be replaced immediately.
- 6.9.45 The defects as pointed out by the Engineer shall be rectified immediately to the satisfaction of Engineer and Re-radiographed. The decision of Engineer regarding acceptance or otherwise of the joint shall be final and binding on the contractor.
- 6.9.46 Wherever radiographs are not accepted on account of poor exposure, joints shall be re-radiographed and new film submitted for evaluation. Radiographs shall be taken again on joints after carrying out repairs. However, if the defect persists after first repair as per radiograph, carrying out radiography shall be repeated till the joint is made acceptable. In case the joint is not repairable, the same shall be cut, re-welded and re-radiographed at contractor's cost.
- 6.9.47 The contractor shall also be equipped for carrying out other NDT like liquid penetrant inspection, magnetic particle inspection, etc

as and when required in the interest of work within the quoted rates.

6.9.48 For carrying out ultrasonic testing of welded joints of large size tubes and pipes, it will be necessary to prepare the surface by grinding to a smooth finish and contour as desired by BHEL Engineer. The contractor's scope of work include such preparation and no extra charges are payable for this.

6.9.49 It may also become necessary to adopt inter layer radiography / MPT / UT depending upon the site/technical requirement necessitating interruptions in continuity of the work and making necessary arrangements for carrying out the above work. The contractor shall take all this into account and quote the price inclusive of all such work and radiography.

6.9.50 The welded surface irrespective of place of welding shall be cleaned of slag and painted at the center with primer paint to prevent corrosion at no extra cost towards this. Paint for this purpose shall be provided by contractor.

6.10.0 TESTING , PRE-COMMISSIONING & COMMISSIONING AND POST COMMISSIONING

6.10.1 The Contractor shall carry out all the required tests and pre-commissioning and commissioning activities required for their successful and reliable operation. These would include Air leak test of Boiler, Ducts, Hydraulic test of boiler, land flow test, clean air flow test, Gas Distribution Test, chemical cleaning of piping and boiler, water washing, oil flushing of oil system etc. as instructed by BHEL using contractors own consumables, labour and scaffoldings etc. Air leak test on pressure parts preliminary to hydraulic test by compressed air shall also be carried out to check and rectify the various leakage and defects etc. All the chemicals required for carrying out these activities will be supplied by BHEL free of cost.

All required tests (Mechanical and electrical) indicated by BHEL and their clients for successful commissioning are included in the scope of these specifications. These tests / activities may not have been listed in these specifications. Specialized test equipment, if any, shall be provided by BHEL/ its client free of hire charges. However contractor has to take proper care of the equipment issued to him.

After completion of erection of furnace, ducts and air heaters, a test shall be performed on the steam generator by the contractor

to establish the Gas tightness of the erected equipment from the outlet of FD fan through the steam generator up to stack.

- 6.10.2 All the tests may have to be repeated till all the equipment satisfy the requirement / obligation of BHEL at various stages. The contractor shall do all the repairs for site-welded joints arising out of the failure during testing.
- 6.10.3 The scope of pre-commissioning activities cover installation of all necessary equipment including temporary piping, supports, valves, blanking, pumps, tanks, with access platforms valves, along with accessories required for hydro test, chemical cleaning, steam blowing or for any other tests. The scope also covers the off site disposal of effluents.
- 6.10.4 All items / material required for conducting hydraulic test, alkali boil out, acid cleaning/EDTA cleaning steam blowing etc., will be supplied by BHEL. However, servicing, dismantling and returning of the same to stores is the responsibility of the contractor who is erecting the equipment / piping. The contractor may note that no separate payment shall be released for any temporary works that are to be carried out for conducting pre-commissioning and commissioning tests. Bidders are advised to include expenses on temporary works along with the rates being quoted by them. Broadly the work on temporary systems will be as under:
- Erection etc. of all temporary piping including valves, tanks, effluent pumps, electrical control panel and cabling along with insulation and supports for steam blowing; chemical cleaning and effluent disposal are to be carried out as part of work. Contractor will be responsible for their operation and any servicing required during the pre-commissioning activities. He will also service the equipment and handover the equipment to the other agency for further erection / commissioning activities. All the pumps, motors and electrical control panels/ switch gear, valves and actuators will be furnished to the contractor after due servicing.
 - Erection etc. of blowers and blanks and putty, temporary fixtures & ducts required for conducting air tightness test are to be installed (Putty to be procured by the contractor).

The above is only a broad breakup of the temporary works. The engineer at site will make final break up. His decision will be final and binding by all the parties.

Dismantling of the temporary equipment and piping will be done by the agency that has erected the equipment. He will also return the equipment to the stores.

- 6.10.5 Drum will be dispatched without fixing internals and internals will be sent separately. The internals have to be fixed as and when required. Dismantling and re-assembly to be done to suit various commissioning requirements.
- 6.10.6 Commissioning of the boiler will involve trial run of all the equipment erected. The boiler has to be lighted up for refractory drying, alkali boil out, acid cleaning/ EDTA cleaning, passivation, preservation, steam blowing and floating of safety valves. Flushing of all the lines by air, oil or steam as the case may be, trial run of the boiler, servicing of valves and any other works incidental to commissioning are to be carried out. Contractor shall supply manpower round the clock.
- 6.10.7 It shall be the responsibility of the contractor to preserve the boiler as per BHEL's requirement.
- 6.10.8 It shall be the responsibility of the contractor to provide various categories of workers in sufficient numbers along with Supervisors during pre commissioning, commissioning and post commissioning of equipment and attending any problem in the equipment erected by the contractor till handing over. The contractor will provide necessary consumables, T&Ps, IMTEs etc., and any other assistance required during this period. Association of BHEL's / Client's staff during above period will not absolve contractor from above responsibilities.
- 6.10.9 It shall be specifically noted that the above employees of the contractor may have to work round the clock along with BHEL Engineers and hence overtime payment by the contractor to his employees may be involved. The contractor's finally accepted rates should be inclusive of all these factors also.
- 6.10.10 In case, any rework is required because of contractor's faulty erection, which is noticed during pre-commissioning and commissioning, the same has to be rectified by the contractor at his cost. If any equipment / part is required to be inspected during pre-commissioning and commissioning, the contractor will dismantle / open up the equipment / part and reassemble / redo the work without any extra claim.
- 6.10.11 During commissioning, opening / closing of valves, changing of gaskets, Re-alignment of rotating and other equipment, attending

to leakage and adjustments of erected equipment may arise. The finally accepted price /rates shall also include all such work.

- 6.10.12 The contractor shall make all necessary arrangements including making of temporary closures on piping / equipment for carrying out the hydro-static testing on all piping, equipment covered in the specification at no extra cost.
- 6.10.13 The valves will have to be checked, cleaned or overhauled in full or in part before erection, after acid cleaning, steam blowing and during commissioning as may be necessary.
- 6.10.14 In case any defect is noticed during tests, trial runs and commissioning such as loose components, undue noise or vibration, strain on connected equipment etc., the contractor shall immediately attend to these defects and take necessary corrective measures. If any readjustment and re-alignment are necessary, the contractor at his cost shall do the same as per Engineer's instructions including repair, rectification and replacement work. The parts to be replaced shall be provided by BHEL.
- 6.10.15 All temporary supports shall be removed in such ways that pipe supports are not subjected to any sudden load. During hydraulic testing of pipes, all piping having variable spring type supports shall be held securely in place by temporary means while constant spring type support hangers shall be pinned or blocked solid during the test.
- 6.10.16 The contractor shall carry out cleaning and servicing of valves and valve actuators prior to pre-commissioning tests and / or trial operations of the plant. A system for recording of such servicing operations shall be developed and maintained in a manner acceptable to BHEL Engineer to ensure that no valves and valve actuators are left un-serviced. Wherever necessary as required by BHEL Engineer, the contractor shall arrange to lap / grind valve seats.
- 6.10.17 Cleaning and servicing of all the filters / strainers, in the system shall be done by the contractor within the accepted price. All oils and greases to be filled in the main equipments as first fill and subsequent topping offs will be furnished by BHEL.
- 6.10.18 At the time of each inspection, the contractor shall take note of the decisions/ changes proposed by the Engineer and incorporate the same at no additional cost.
- 6.10.19 Hydraulic testing pumps for Boiler shall be provided by BHEL free of hire charges. The testing pumps will be issued to the

contractor in working conditions. Installation, electrical connection, erection, testing and dismantling and returning to BHEL stores, etc, shall be carried out by the contractor as part of this work without any extra charges. In case any servicing of the test pump is to be done during the course of the test, the contractor shall provide the necessary labour for the same and spares will be arranged by BHEL.

6.10.20 All pressure parts and some of the Low Pressure parts shall be subjected to hydraulic test as per the Standard / statutory requirements. The contractor shall make necessary arrangements and other services to carry out the required tests as per the instructions and directions of the BHEL Engineers.

6.10.21 Contractor at his cost shall lay all necessary temporary piping, install the pumps, blanks, valves required for the test, pressure gauges etc. Required pipes, valves, plates etc., will be given by BHEL. Temporary piping, pumps, valves, flanges, blanks etc shall be removed by him and returned to BHEL. All thermo well points are to be seal welded, with plug in position. All Temperature Element points are to be provided with blanks and welded. Necessary blanks will be provided by BHEL.

Welding and stress relieving of temporary blanks or suitably fixing temporary blank flanges with gaskets and fasteners and welding and providing suitable deaeration / venting / draining points with valves as per BHEL Engineer's instructions, for performing hydro-test of piping and other equipments is within the scope of work. Gaskets, valves, fasteners will be provided free of cost by BHEL Contractor shall cut steel blanks from steel provided within quoted rate. After completion of hydraulic test, welded blanks shall be cut and removed and weld burrs ground finished and cavities / scars of cutting weld filled and ground as per BHEL Engineer's instructions. Seal welding of thermo-wells and blanks of Temperature Element are to be removed by grinding only after steam blowing.

6.10.22 The hydraulic testing of the equipment and piping, covered under this scope of work has to be carried out by the contractor as per instructions of BHEL Engineer. The contractor shall provide all facilities required for hydraulic testing. Filling pump of suitable capacity shall be arranged by BHEL. Before hydraulic test, all the hangers are to be locked by locking pin/plate or temporary support. After completion of Hydraulic test, these are to be removed and all hangers are to be readjusted if required, to the desired valve within quoted valve.

6.10.23 All the above tests shall be repeated till all the equipment satisfy the requirement of BHEL to their customer. As far as the hydraulic pressure test is concerned and same shall be conducted to the

satisfaction of Boiler inspector wherever applicable. Any rectifications required shall have to be done / redone by the contractor at his cost.

- 6.10.24 Transportation of oil drums from customer's BHEL's stores, filling of lubricants and filling of oil for flushing and first filling and subsequent topping up during commissioning and post commissioning is included in the scope of this contract. The contractor shall have to return all the empty drums to the customer / BHEL stores. Similarly transport of chemicals for various pre-commissioning activities / processes mentioned in the above clauses and returning of remaining and / or the empty containers of the chemicals to customer / BHEL stores is the responsibility of the contractor.
- 6.10.25 Replacing / cleaning of filters of the erected equipments and piping system etc. during pre-commissioning / commissioning stage is within the scope of work.
- 6.10.26 Contractor shall lay the temporary pipelines with fittings, accessories and erection / commission pumps, tanks, valves, fittings, hangers and supports and other installations as instructed by BHEL, Engineer for the purpose of chemical cleaning / alkali flushing / steam blowing / steam washing / steam flushing / water flushing / water washing / oil flushing etc. of piping and other equipments are in the scope of work. Necessary, materials for this will be provided by BHEL. Overhauling / cleaning / servicing of valves, pumps, fittings in temporary system and acid cleaning tanks etc prior to the above operations / activities will also be carried out by the contractor at his cost. All the chemicals will be supplied by BHEL free of cost.
- 6.10.27 Chemical cleaning (Acid cleaning of piping /EDTA cleaning/alkali flushing) will involve the installation of temporary piping, valves, cutting of some of the existing valves, placing the rubber, wedges in the valves, gagging of valves, and installation of temporary tanks for chemical and for mixing. Necessary temporary access platforms to mixing tank are to be made by the contractor. The dissolving tank, neutralizing tank etc. required for acid pickling will have to be fabricated by the contractor with in the quoted rate. Required materials will be provided by BHEL free of cost. Chemicals for chemical cleaning will be provided by BHEL and handling of chemicals & other consumables and other connected activities has to be carried out by the contractor at their cost. All other consumable would have to be provided by the contractor.

Laying of insulation of this temporary piping, tanks are to be carried out by the contractor within quoted rate, and required insulation materials will be provided by BHEL. The welding joints

in the temporary pipe lines for acid cleaning and steam blowing are to be welded by HP welders only. Required NDT tests are to be carried out for the above joints within quoted as per customer / BHEL requirement.

- 6.10.28 Contractor shall lay all necessary electric cables and switches etc. required for the hydraulic test and other tests, flushing etc., and maintain the system till the tests are completed satisfactorily. The required power cables are to be arranged by the bidder at his cost.
- 6.10.29 Steam blowing lines for Oil piping shall be erected as per the instructions of BHEL Engineer. Necessary pipes and other items will be supplied by BHEL free of cost. All arrangements for erection including welding have to be arranged by the contractor at the rates specifically quoted / accepted for this work. After completion of steam blowing, all the temporary lines to be dismantled and restoration of piping to be carried out, within quoted rate.
- 6.10.30 During steam blowing operations the required manpower shall be arranged by the contractor as per the instructions of BHEL Engineer within the quoted rates. The manpower for the above operation may be required round the clock if necessary. The contractor shall carry out the above operation as per the instructions of BHEL Engineer within the quoted rates.
- 6.10.31 During the initial stages of work, trenches for draining water may not be available for alkali flushing or mass flushing for discharging and draining the system and piping. Necessary low point drains and temporary piping for this will have to be erected by contractor from materials provided by BHEL.
- 6.10.32 After the chemical cleaning has been successfully completed, removing all temporary piping, fittings of tanks etc. checking all the valves for any accumulation of foreign materials, welding the valves, pipes which were cut and cleaning, re-fixing as per BHEL Engineer's instructions is within the scope of work/specification.
- 6.10.33 The contractor as per BHEL requirements will suitably make preservation of cleaned surfaces.
- 6.10.34 Contractor may have to replace old/damaged gaskets / packing etc. for equipments and the same shall be carried out by contractor as per requirement. Materials will be given by BHEL.
- 6.10.35 In case any erection defect is detected during various tests / operations trial runs as detailed above such as loose components undue noises or vibration strain on connected equipment steam or oil or water leakage etc. the contractor shall immediately attend these defects and take necessary corrective measures. The parts to be replaced shall be provided by BHEL free of cost. If the

insulation is to be removed to attend any of the defects the cost of removal and reapplication of insulation should be borne by the contractor.

- 6.10.36 Necessary scaffolding and approaches for conducting the above shall also be within the scope of the contract.
- 6.10.37 The contractor shall carryout any other test as desired by BHEL Engineer on erected equipment covered under the scope of this contract during testing, pre-commissioning, commissioning, and operation, to demonstrate the completion of any part or whole work performed by the contractor.
- 6.10.38 During this period, though BHEL's and customer's staff will also be associated in the work, the contractor's responsibility is to make available resources in his scope till such time the commissioned units are taken by the customer.
- 6.10.39 Contractor shall cut/open the completed works if needed, as per BHEL engineer's instructions during commissioning for inspection, checking and make good the works after inspection is over. This contingency shall be included within the quoted value. During commissioning opening of valves, changing of gaskets, attending to leakages, minor modification / rectification works may arise. The contractor has to carry out these works at his cost by providing required manpower in all the three shifts. In case any rework is required because of contractor's faulty erection and which is noticed during commissioning the same has to be rectified by the contractor at his cost.
- 6.10.40 For conducting gas tightness test, it may be required to erect the blowers and connecting ducts and commission the same for tightness test. It is the responsibility of the contractor to erect the blowers & dismantle once the test is over. Contractor shall carry out the work with in the quoted rate and BHEL will provide blowers and dummies free of cost for conducting the test.
- 6.10.41 Contractor to provide necessary commissioning assistance from pre-commissioning state onwards and up to continuous operation of the unit & handing over to customer. The category of personnel to be as par site requirement and to meet the various pre-commissioning and commissioning programmes made to achieve the schedule agreed with customer.
- 6.10.42 After synchronization, the commissioning activities will continue. It shall be the responsibility of the contractor to provide manpower including necessary consumables, hand tools and supervision as part commissioning assistance for a period of six months or till handing over of sets to customer, which ever is earlier.

- 6.10.43 It shall be specifically noted that the contractor may have to work round the clock during the pre-commissioning, commissioning and post-commissioning period along with BHEL Engineers. Hence contractor's quoted rate shall take into consideration of all expenses that will be incurred for such arrangement of personnel including engineers/supervisors.
- 6.10.44 The valves, dampers, actuators etc. will have to be checked cleaned and overhauled in full or in part before erection, after acid cleaning, steam blowing and during commissioning as maybe necessary.
- 6.10.45 Commissioning of the boiler will involve trial runs of all the equipments erected, lighting up of the boiler for refractory drying, blowing of the steam lines, floating of safety vales, flushing of all the lines by air, oil or steam as the case may be, trial run of the fans, Lub. Oil pumps, Mills, servicing of all equipments like dampers, actuators, valves etc. and any other works incidental to commissioning. Contractor shall provide required workers along with supervisors with all the requisite tools round the clock and material for all these works, which shall form part of the work to be done.
- 6.10.46 During this period though the BHEL's/Clients staff will also be associated in the work, the contractor's responsibility will be to arrange required tools, man and plants till such time the commissioned units are taken over by BHEL's client.
- 6.10.47 After floating of safety valves, the commissioning activities and trail operations will continue upto handing over of the unit. It shall be the responsibility of the contractor to provide various categories of workers in sufficient numbers as per the work requirement along with supervisors including necessary consumable tools etc., during this period. The rate quoted shall indicate all these contingencies also. The various categories of workers required for pre-commissioning, commissioning and post-commissioning activities are as follows:
- a. Pipe fitters
 - b. Millwright Fitters
 - c. HP & Structural welders
 - d. Riggers
 - e. Unskilled workers
 - f. Supervisors

- g. Electricians
- h. Any other category of workers as may be required.

Further in addition to the above contractor has to arrange the following manpower exclusively for assisting BHEL commissioning engineers during stabilization and trial operation period. These manpower will be directly controlled by BHEL commissioning engineers.

1. One Engineer per shift for three shifts.
2. Two supervisor per shift for three shifts
3. Two fitters per shift for three shifts
4. Five riggers/ helpers per shift for three shifts
5. One Electrician per shift for three shifts

It shall be specifically noted that the above employees of the contractor may have to work round the clock along with BHEL commissioning Engineers and hence, overtime, may be involved. The contractor's quoted rate shall be inclusive of all these factors also.

- 6.10.48 During commissioning any improvement or rectification due to design requirement is involved and if the contractor is asked to carry out the job, they shall be paid at man-day rates. For this purpose, daily labour report indicating therein nature of work carried out, consumables used, etc. shall be maintained by contractor, and got signed by BHEL Engineer every day. It is not obligatory on the part of BHEL to get the works done by the contractor. They can employ any other agency if they so desire at that time.
- 6.10.49 Fixing dummy plates at required locations for conducting tightness test and normalizing after the test is over, is also covered in the scope of contract and shall be carried out with in the quoted rate. BHEL will provide raw materials for the dummy plates.
- 6.10.50 The ESP rectifier transformers are to be only erected by the contractor. **Testing, Commissioning and oil filtering is not in the scope of this contract.**
- 6.10.51 It is the responsibility of the contractor to provide electricians round the clock during pre-commissioning and post-commissioning activities. Further removal and reconnection of power for HT and LT motors are to be carried out as part of commissioning

activities. Contractor's quoted rate shall include all these contingencies.

- 6.10.52 Loading of Emitting/electrodes should be done only just before commissioning of boiler. The contractor has to carry out this work after getting clearance from BHEL engineer whose decision shall be final and binding in this regard.
- 6.10.53 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.
- 6.10.54 Hanger adjustment / re adjustment during erection, before and after Hydraulic Test, before and after steam blowing, during and after full load operation, are to be carried out by the contractor within Quoted Rate.
- 6.10.55 The contractor has to provide required man power assistance during pre-commissioning and commissioning checks of motor operated valves, actuators, control valves etc without any extra charges.

6.11.0 FINAL PAINTING

- 6.11.1 The scope of work shall also include supply and application of final painting as required and specified for the components of **ESP**, boiler and its auxiliaries.
- 6.11.2 The scope of work includes supply and application of enamel paints/ Epoxy based polyamide cured/ Aliphatic Polyurethane as per the painting specification and BHEL's instructions for the components of **ESP**, boiler and its auxiliaries
- 6.11.3 All exposed metal parts of boiler, equipment including pipings, structures, hand-railing etc. Wherever applicable after installation unless otherwise surface protected, be first painted after thoroughly cleaning all such parts duct, rust, scales, grease, oil and other foreign materials. The same after inspected and approved by BHEL/Customer Engineers shall be released for painting. The instrument for checking the thickness of coat is to be procured by contractor and should be calibrated after periodical intervals. Before applying the subsequent coats, the thickness of each coat shall be measured and should be informed to BHEL.

- 6.11.4 The quality of the finish paint shall be as per the standards of ISI or equivalent and the colour is as approved by BHEL/ Customer.
- 6.11.5 Suggestive Painting schedule is furnished in Appendix – VII The actual colour to be applied is indicated in the enclosed Suggestive painting specification in Appendix – VII. The scope of painting includes application of colour bands, lettering the names of the systems, equipments tag nos of valves, marking the directions of flow and other dates required by customer / BHEL at the appropriate place as identified by BHEL / Customer, within the quoted rate. Actual painting schedule will be provided by BHEL/ Customer.
- 6.11.6 Number of finish coats shall be as indicated in the painting specification enclosed in this tender. The painting specification which is forming part of this tender as enclosed shall be strictly followed.
- 6.11.7 Paints, thinner and brush, emery sheets, platform materials and other consumables shall be arranged by the contractor at his cost

6.12.0 PAYMENT TERMS

The tenderer shall quote separate rates as per the rate schedule appended. The contractor shall submit his running bills once in a month at the end of each month along with applicable FQA Log sheets/Protocols duly signed by the concerned.

BHEL Engineer shall take measurement and certify regarding the actual work executed in the measurement books and bills for erection work.

Subject to any deduction which BHEL may be authorized to make under the contract, the contractor shall on the certificate of engineer at site be entitled for payment as explained hereunder:

6.12.1 STRUCTURES – PG 35, 36, 38, 39 & 89

- a. 15 % on pro-rata basis wherever pre-assembly is involved.
- b. 20% on pro-rata basis after erection and alignment.
Or
- c. 35% on pro-rata basis on erection and alignment wherever pre-assembly is not involved.
- d. 33 % on pro-rata basis on completion on welding.
- e. 10% on pro-rata basis on completion of Radiography and stress relieving wherever applicable.
- f. 2 % on pro-rata basis for completed tonnage on completion of furnace alignment.
- g. 5% on pro-rata basis for completed tonnage on completion of Second pass alignment.
- h. 3% on pro-rate basis for completion of area cleaning, cutting / removal and return of scraps.

6.12.2 Non Pressure Parts-20,28,30,31,41,42,43,45,47,48,50 & 57

- a. 30 % on pro-rata basis on completion of pre-assembly.
- b. 30 % on pro-rata basis on erection and alignment and completion of welding.
- c. 20 % on pro-rata basis on completion of supports in all respects in the respective zones as per drawings.
- d. 5 % on pro-rata basis for the completed tonnage on completion of all above PGMAS.
- e. 3 % on pro-rata basis for completion of coal firing in all elevations.

6.12.3 PR PARTS UNDER PGs 04,05,06,07,08,09,10,11,12, 15,16,17,18,19,21,24,32 & 97

- a. 22 % on pro-rata basis on completion of pre-assembly
- b. 25 % on pro-rata basis on completion of erection and alignment.
- c. 20 % on pro-rata basis on completion of welding.
- d. 10 % on pro-rata basis on completion of Radiography.

- e. 5 % on pro-rata basis on completion of stress relieving.
- f. 3 % on pro-rata basis on completion of supports, fin welding and other attachment welding in all respects.
- g. 3% on pro-rata basis on completion of welding of PG 18 items/ components.

6.12.4 Non Pressure parts –Air Pre Heater - PG 52

From the amount payable for the total PGMA weight at tonnage rates payment will be released as follows.

- a. 11 % on completion of Support Steel squareness and leveling expansion arrangement, housing panel erection and alignment, welding of pedestals and verticality.
- b. 14 % on completion of erection of support bearing assembly, centre section ,rotor post, hot and centre section, guide bearing, rotor post alignment ,erection and alignment and welding of housing panels hot and cold end connecting plate assemblies.
- c. 17 % on completion of modules erection, alignment of rotor.
- d. 13 % on completion of pin rack setting, drive assembly
- e. 17 % on completion of seals setting
- f. 13 % on completion of erection of lub oil system, cleaning device, fire sensing device, deluge lines, water washing system, CW lines,basket removal doors, observation port and lighting and other accessories.
- g. 3% on completion of PGMA

6.12.5 ROTATING MACHINE - PG 55, 56, 61, 65, 67 and MOTORS

- a. **15%** of the contract rate on pro-rata basis on checking of foundation, chipping and placement of packers.
- b. **30%** of the contract rate on pro-rata basis on placement of equipments on the foundations.
- c. **33%** of the contract rate on pro-rata basis on completion of alignment, welding & grouting.
- d. **5%** of the contract rate on pro-rata basis on PGMA completion as certified by BHEL.
- e. **5%** of the contract rate on pro-rata basis on completion of trial run.

6.12.6 HANDLING EQUIPMENTS - PG 99

- a. **35%** of the contract rate on pro-rata basis on completion of pre-assembly and erection.
- b. **43%** of the contract rate on pro-rata basis on completion of alignment, welding and Load Testing.
- c. **10%** of the contract rate on pro-rata basis on PGMA completion as certified by BHEL.

6.12.7 Further 7% payment for – PG 35, 36, 38, 39 , 89, 20,28,30, 31,41,42,43,45,47,48,50,57,04,05,06,07,08,09,10,11, 12,15,16,17,18,19,21,24,32, 97,52, 55, 56, 61, 65,67,99 AND HT MOTORS

Further 7 % payment on pro-rata basis common to all PG shall be released on achievement of the following milestones events for the tonnage erected.

- a. 1 % will be released after completion of hydraulic test for the erected tonnage.
- b. 1% will be released after completion of alkali boilout, chemical cleaning and completion of gas tightness test & air tightness as applicable.
- c. 1% will be released on completion of safety valve floating.
- d. 3% will be released on completion of final painting
- e. 1 % will be paid on submission and settlement of final bill.

6.12.8. ESP – PG79

- a. 22% of the rate on prorated basis on completion of pre assembly wherever applicable.
- b. 18% of the rate on prorated basis on completion of erection alignment for the items wherever pre-assembly is involved.

OR

- a. 40% of the tonnage rate on prorated basis on completion of erection, alignment for the items wherever pre-assembly is NOT involved.
- b. 34% payment on prorated basis on completion of fastening, welding, grouting along with supports etc.

- c. 6% on prorated basis (for the erected tonnage) will be paid after completion of Hopper Upper part middle and lower parts inspection doors, heating elements, poking doors etc.,
- d. 5% on prorated basis (for the erected tonnage) will be released after completion of inner roof, outer roof, insulator, housing, rectifier transformer, pent house and their connected works in the roof, like mono rails and hoist etc.
- e. 5% prorated basis (for the erected tonnage) will be released after completion of Gas Distribution of Gas Distribution path and completion of rapping mechanism with the drives in all respects.

Further 5% applicable for **PG 79** covered under the scope of Contract shall be released as detailed below:

- i) 1% of the contract value for the erected tonnage will be paid after completion of final painting.
- ii) 1% of the contract value for the erected tonnage will be paid on charging of all ESP fields
- iii) 1% of the contract value for the erected tonnage will be paid on completion of Gas Distribution test.
- iv) 2% of the contract value for the erected tonnage will be paid on submission and acceptance of final bill.

6.12.9 The final amount of 5% of the executed value arrived at by actual quantity erected multiplied by unit rate accepted shall be paid after the guarantee period of 12 months. The guarantee period will commence from the date of handing over of unit to customer or six months after **the unit reaches full load after commissioning of all equipments / system whichever is earlier.** However, this 5% amount can be released against matching Bank Guarantee valid for the entire guarantee period as aforesaid in the prescribed proforma of BHEL.

6.12.10 The 'Engineer' will certify regarding the actual work executed in the measurement books and bills, which shall be accepted by the contractor in measurement book.

6.12.11 Contractor shall submit shortage / damage reports on BHEL's standard materials management forms. No payment shall be released till the contractor submits these reports and are verified by the Engineer.

- 6.12.12 Subject to any deduction that BHEL may be authorised to make under the contract, the contractor on the certificate of the Engineer at site be entitled for payment as explained hereunder.
- 6.12.13 **Field Quality assurance formats:** It is the responsibility of the contractor to collect and fill up the relevant FQA Log Sheets of BHEL and present the same to BHEL after carrying out the necessary checks as per the log sheets and obtaining the signature of BHEL/Customer in token of their acceptance.
- 6.12.14 No levy or payment or charge made or imposed shall be impeached by reasons for any clerical error or demanded or charged.
- 6.12.15 BHEL at discretion, may further split-up the above percentage and effect payment to suit the site conditions, cash flow requirements, according to the progress of work.
- 6.12.16 **CONTRACTOR SHALL NOTE THAT THE FINAL BILL SHALL BE RELEASED ONLY ON PRODUCTION OF A CERTIFICATE ISSUED BY SITE IN CHARGE THAT THE CONTRACTOR HAS FULFILLED THE ENTIRE CONTRACTUAL / STATUTORY REQUIREMENT.**

6.13.0 FINAL SITE INSPECTION & TEST

- 6.13.1 The employer / owner shall maintain at site a joint protocol for recording actual measurement of work carried out at site, inspection and witnessing of various tests conducted by the contractor. The owner/employer or his authorized agents may inspect various stages of work during the course of the contract awarded to him. The contractor shall make necessary arrangements for such inspection and carry out the rectification pointed out by the owner/employer without any extra cost to the owner / employer. The contractor shall take this into consideration while quoting his rates for various items/works. No cost whatsoever such duplication of inspection of work be entertained

SECTION – VI- PART -II
SPECIAL CONDITIONS OF THE CONTRACT
North Chennai Thermal Power Station Stage - II: 2 x 600 MW
COOLING WATER PIPING PACKAGE

- 6.0.0. The scope of work under this specification covers, but not limited to the following:
- 6.1.0 Handling at store / yard, transportation to site, fabrication and welding of support, branch pipes, man holes, instrument tapping, flanges etc, (wherever applicable), laying pipe line for supply line & return line of main cooling water piping along with valves, alignment, welding and doing required, NDT, completion of permanent hangers & supports, wherever required conducting air test & hydro-test, assisting BHEL to carry out the required tests before the line is taken over by the customer of **CW PIPING at Unit 1&2- of 2 x 600 MW NCTPS, STAGE-II at North Chennai, Tamil Nadu** is in the scope of this contract. The entire civil work is excluded from the scope of contractor.
- 6.1.1 The terminal points decided by BHEL are final and binding on the contractor for deciding the scope of work and effecting the payment for the work done up to the terminals.
- 6.1.2 Contractor shall erect pipe line as per the sequence prescribed by BHEL at site. The sequence of erection and methodology will be decided by the BHEL Engineer depending upon the availability of materials, fronts and other inputs etc. No claim for extra payment from contractor will be entertained on the grounds of deviation from the methods of erection adopted in erection of similar piping in other places.
- 6.1.3 The work covered under this specification is of highly sophisticated nature, requiring the best quality workmanship, engineering and construction management. The contractor should ensure successful and timely operation of equipment installed. The contractor must have adequate quantity of tools, construction aids, equipments etc., in his possession. He must also have on his rolls adequate trained, qualified and experienced supervisory staff and skilled personnel.

6.1.4 The piping materials as per specification below will be supplied by BHEL:

- a. Piping up to & including 350 NB shall be SS 316 ERW
- b. Piping 400 NB and above shall be carbon steel (IS:2062), rolled and welded confirming to IS:3589. And carbon steel cooling water pipes shall be line with PU (Polyurethane) coating internally as per AWWA C222.
- c. Underground piping from CW Pump discharge to condenser & after condenser to seal pit shall be GRP (**G**lass **R**einforced **P**lastic) pipe. The design of GRP pipe shall be as per AWAA m 45 / AWWA c950.
- d. For drains & vents of sizes Nb 50 and below the thickness shall be minimum sch. 80. for sizes above Nb 50 thickness as per BHEL standard procedure.

6.2.0 TRANSPORTATION FROM STORES & FABRICATION YARD

6.2.1 Loading at storage yard and transporting to site, unloading at site / pre assembly area or at working area, is in the scope of work. Required cranes for loading & unloading of materials, trailer shall be in the scope of contractor. The contractor shall provide any fixtures, concrete blocks & wooden sleepers, sandbags which are required for temporary supporting of the components at site.

6.2.2 Contractor shall take delivery of the components from the storage area after getting the approval of BHEL Engineer on standard indent forms. Complete and detailed account of the materials erected as well as the progress shall be submitted to the Engineer as directed.

6.2.3 The individual steel pipes of maximum diameter NB 4000 mm x 20 mm thick (approx) will be supplied with approximate length of 10 or 12 metres with bevel cut edge preparation. However any damage occurs during transit/handling to be made good by the contractor within the quoted rate. For bends pre fabricated mitre bends will be supplied.

6.2.4 All the pipes / components 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 pipes. The bare pipes shall be lifted with Teflon coated hooks with cranes then loaded / unloaded on / from trailers to avoid bevel damages. It is always safer for the pipes to be lifted at two points.

6.2.5 Pipes shall not be dropped to avoid impact or bump.

- 6.2.6 The equipment 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 /loss of such equipment at site.
- 6.2.7 Contractor shall plan and transport equipments, components from storage yard to erection site and erect them in such a manner and sequence that material accumulation at site does not lead to congestion at site of work. Materials shall be stacked neatly, preserved and stored in the contractor's shed/work area in an orderly manner. In case it is necessary to shift and re-stack the materials kept at work area / site to enable other agencies to carry out their work, same shall be done by the contractor at no extra cost.

6.3.0 ERECTION

- 6.3.1 Brief list of equipments / sub-assemblies to be erected by the contractor & approximate weight is given in Section - VII, Appendix -II weight schedule and is meant for giving general idea to the contractor only about magnitude of the work involved. The components are sent in parts for convenient transportation. They are to be cleaned, assembled in stage by stage, welded, erected and aligned as per the drawing dimensions / tolerance and instructions of BHEL Engineers.
- 6.3.2 The entire consumables, equipments / T&Ps required for successful completion of the work is in the scope of contractor and the quoted rate shall be inclusive of all these, except specifically indicated as free supply by BHEL.
- 6.3.3 All the equipments / material to be taken inside the plant building, shall be cleaned thoroughly before taking them inside and erected. The contractor shall clean, wherever necessary as per instruction of BHEL Engineer during erection at the quoted rate.
- 6.3.4 The contractor shall take necessary measures to see that all the machined surfaces are preserved and covered.
- 6.3.5 Carrying out piping as per the specification between equipments constituting terminal points, whether the terminal equipments fall within the scope of work/specification, contractor shall carry out the terminal joints at either end. Also where the piping connection to the terminal points involve flanged joints, matching of flanges, fixing gaskets, bolting and tightening as per BHEL Engineers instructions is in the scope of work. In case piping connected to equipment, matching of flanges for

achieving the parallelism and alignment at the equipment end, by suitably resorting to heat correction or other method as instructed by BHEL Engineer, with in the quoted rate.

- 6.3.6 Underground protection for the buried carbon steel pipes: - wherever pipelines are buried, underground protection shall be provided with anti - corrosive tape of 4 mm thick conforming to IS-10221 and AWWA C 203-93. Pipe surfaces shall be cleaned by shot blasting before application. Tests to be carried out after application - (a) Bond/Adhesion test (b) Holiday test. The preservative paint, anti corrosive tape, all the required consumables, T&Ps and the instruments required for the above application and testing are to be arranged by the contractor at his cost.
- 6.3.7 GRP pipes are typically joined using double bell "Reka" couplings/Flanged joints/Mechanical clamps / lamination joints.
- 6.3.8 Contractor has to draw the material either from BHEL store yard or fabrication yard and transport to his working place.
- 6.3.9 Welders shall be qualified as per the welder qualification procedures of BHEL/ASME, applicable for this type of job. Only qualified welder shall be deployed for welding.
- 6.3.10 All dimensions / elevations refers to centerline of pipe unless otherwise specified and the pipe routing shall be carried out as per the drawing. Wherever the dimensions are not specified / shown as approximate the same may be routed as per site requirement / convenience as per site engineer's advice.
- 6.3.11 Normally weld neck valves will have prepared edges for welding. It may be occasionally necessary to prepare new edges, re-prepare the edges to suit site conditions, which shall be done by the contractor at no extra cost.
- 6.3.12 Wherever pre-fabricated pipes/bends are supplied, there may be necessity to make minor changes, including strengthening by additional welds. This shall be treated as part of the contractor's scope.
- 6.3.13 Certain adjustments in length may be necessary while erecting pipelines to suit site condition, for which an extra length of piping is provided on each line. Contractor should remove the extra lengths to suit the final layout and prepare edges afresh is in the scope of work. It may also required to add extra lengths of pipes to suit final layout for contractor to put spools after edge preparation. All these works are to be carried out by the contractor with in the quoted rate.

6.3.14 Box cutting and excavation of earth up to the required depth and width, concreting etc., shall be carried out by others on phased manner as per the site requirement and decided by BHEL site in-charge. As and when the clearance for erection of piping is given, contractor shall carry out erection work promptly with out any delay and release for further civil in a phased manner as instructed by site in-charge.

6.3.15 Once the clearance is given to the erection contractor, he has to lay the pipes immediately with out any delay and complete erection, alignment, welding & NDT as per the drawing / welding schedule. Pipes are to be lifted and placed only by cranes and should strictly follow the lifting procedure / instruction of BHEL Engineers.

6.3.16 **SAFETY PRECAUTION DURING WELDING :**

In the larger diameter pipes, welding is to be done from inside and outside the pipe, as per drawing. While doing inside pipe welding , adequate precaution is to be taken by contractor to exhaust the weld gases form affecting the welders doing the work. Suitable exhaust fans are to be provided . Welders and helpers inside should have face mask and other safety equipments and safety ware. Suitable lighting and fan are to be made. Manhole escape arrangment is to be identified. Welding inside pipe should be taken up only after getting clarence from safety engineer and after ensuring that Safety relief measures are made available nearer to work area.

A supervisor should be continuously made available in the area of welding through out.

6.3.17 Minor adjustments like removal of ovalities in pipes and opening or closing of the fabricated bends by process of heat correction or any other method approved by BHEL Engineer to suit the layout, with specified procedure to be carried out with in the quoted rate.

6.3.18 Contractor shall arrange all the equipments, alignment bolts, tools, consumables like welding rods, etc. for welding of pipes and consumables like jute, cotton waste, hacksaw blades, petrol, Kerosene oil etc. are also in contractor's scope. All these shall be carried out with in the quoted rate.

- 6.3.19 Contractor shall use only bolted clamps for achieving alignment of piping, wherever "L" shaped stoppers and wedges are to be used for aligning piping and equipments, the same shall be subjected to the approval of BHEL Engineer. Contractor shall remove the bridge, stopper etc., and not by hammer. Any burrs left on the equipments / piping, after welding, shall be ground off or any scar or cavity made good by welding and grinding. NDT tests shall be carried out if necessary to detect surface and sub-surface cracks in these ground areas.
- 6.3.20 All the weld joints on equipments and piping shall be ground or filed on completion of welding as per instructions of BHEL Engineer so as to achieve smooth surface devoid of ripples, undulations etc.,
- 6.3.21 Pipelines shall be cleaned off welding slag and burrs by hand files, wire brushes and flexible grinders wherever required.
- 6.3.22 Temporary lugs / structures meant for transportation is to be removed by the contractor as and when instructed by BHEL Engineer.
- 6.3.23 Flame cutting of piping and other equipment shall be strictly done as per BHEL Engineer's instructions and in his presence only.
- 6.3.24 Contractor shall also weld small length of piping with root valve to the pressure, flow and level tapping points on piping or flow nozzles / orifices / metering elements fixed on piping as per the instructions of BHEL Engineer.
- 6.3.25 On completion of bottom layer of pipes, contractor has to conduct hydraulic test. For conducting hydro - test both ends of each lines are to be blanked suitably. Raw materials for blanking such as plate / structural items will be given by BHEL on free of charges. Fabrication, welding of dummies and NDT and removal of dummies after successful completion of hydro - test and making edge preparation on the parent pipe after HT is in the scope of contract. For Hydro test to be conducted in stages or to be repeated, the same plates shall be used for blanking by suitably grinding.
- 6.3.26 Contractor shall arrange all temporary piping, pumps, pressure gauges and valves etc., required for the hydraulic test. Temporary piping, pumps, valves, flanges, blanks etc shall be removed by him once the work is over and could be taken back. The pipes, fittings, valves, etc shall be suitable and withstand

the rated hydro test pressure of 7.5 kg per sqcm. The pump shall be suitable for pressurization to this test pressure and the volume of water to be used for sectionalized hydro test.

- 6.3.27 The contractor has to arrange(low pressure) hydro-testing pump for conducting hydraulic test on his own with in the quoted rate. The servicing, installation, electrical connection, erection, testing and dismantling after completion of hydro-test shall be carried out by the contractor as part of this work without any extra charge. The pump would be taken back after completion of the work as certified by BHEL engineer.
- 6.3.28 Required water filling pump is to be arranged by the contractor.
- 6.3.29 All the above tests shall be repeated till all the equipment satisfy the requirement of BHEL to their customer. Any rectification required shall have to be redone by the contractor at his cost.
- 6.3.30 After completion of hydro test on bottom layer it is to be cleared for concrete to Civil agency, after de-watering and removing all temporary supports / scraps.
- 6.3.31 In lieu of Radiographic Test and Hydraulic Test of Cooling water pipes, 100% Ultrasonic Test with permanent record (Graph sheet) can be acceptable subject to customer acceptance during erection to meet project schedule and erection continuity. However, on completion of CW system, the Hydraulic test has to be done for the whole system if required and insisted upon by the customer.
- 6.3.32 The BHEL supplied valves as part of CW system will have to be checked, lapped or overhauled in full or in parts before / after erection. Contractor shall arrange experienced valve technician at his own cost. Any special tools required for lapping only will be arranged by BHEL.
- 6.3.33 For other agencies, such Civil works, LP Piping, Cabling, instrumentation etc., to commence their work from/ on the equipments coming under this scope, Contractor has to clear the front, expeditiously and promptly as instructed by BHEL Engineer. Some time it may be required to re-schedule the activities to enable other agencies to commence / continue the work so as to keep the over all project schedule.
- 6.3.34 All drains / vents/ relief line etc. from the stubs on the piping to be erected by the contractor, is completely covered in the scope of work.

- 6.3.35 Fixing / fitting / welding of thermowell stubs, tapping points, root valves for instruments etc is within the scope of work.
- 6.3.36 The contractor shall conduct non destructive tests like radiography / ultrasonic test for weld defects etc., dye penetrant tests, magnetic particle test etc. on weld joints, castings, valve bodies and other equipments etc. as per BHEL Engineer's instructions / welding schedule.
- 6.3.37 Contractor shall arrange the clearance from the statutory authorities (Labour commissioners etc.,) as required for installation of the plant and equipment and render all assistance, service required in this regard.
- 6.3.38 All Operating / Approach platforms, cross over, canopies, ladders etc., shall have to be fabricated from raw materials supplied by BHEL and erected with in the quoted rate. No separate rate is payable on weight basis for supports, other than those indicated in PGMA or supplied by Units, which will be covered in the overall weight.
- 6.3.39 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 till the upper encasing is done.
- 6.3.40 Any failure on the part contractor to carry out work according to above clauses will entitle BHEL to carryout the job though any other party and recover the cost from contractor.
- 6.3.41 Contractor shall cut / open works if needed, as per BHEL Engineer's instructions during commissioning for inspection, checking and make good the works after inspection is over. This contingency shall be included within the quoted value. During commissioning opening of valves changing of gaskets attending to leakages minor modification rectification works may arise. The contractor has to carry out these works at his cost by providing required manpower with T & Ps in all the three shifts. In case any rework is required because of contractor's faulty erection and which is noticed during commissioning, the same has to be rectified by the contractor at his cost.

6.4.0 HYDRAULIC TEST AND OTHER TESTS (as applicable)

- 6.4.1 All cooling water piping systems shall be subjected to Hydraulic test of 7.5 Kg/sqcm or **as specified in the drawing or as per instruction of BHEL engineer** for various system. The contractor shall supply necessary labour and other services to

carry out the required tests as per the instructions and directions of the BHEL Engineers.

- 6.4.2 Hydraulic testing, as required shall be carried out by the contractor. The servicing, installation, electrical connection, erection, testing and dismantling of Hydraulic Test pump, temporary pipelines, fittings, etc shall be carried out by the contractor as part of this work.
- 6.4.3 All the above tests shall be repeated till all the pipelines to satisfy the requirements / obligation of BHEL to their customer. As far as the hydraulic pressure test is concerned, the same shall be conducted to the satisfaction of BHEL / Customer Engineers. Any rectifications required shall have to be done / redone by the contractor at his cost.
- 6.4.4 Contractor shall arrange and provide all temporary piping materials of suitable size and capacity necessary for conducting hydraulic test. Those items that are issued along with main equipments / components specified under dispatch unit for temporary piping etc. supplied by BHEL or others or any other agency alone will be paid at the quoted rates for erection. Charges for dismantling and removal of temporary lines, pumps etc. shall be included in the quoted rates.

6.5.0 PRESSURE TEST FOR PIPING

- 6.5.1 Soundness of the welds shall be tested hydraulically under the supervision of the BHEL Engineer and Customer, to the pressure indicated in the drawing for cooling water piping system. Prior to the test, the piping system shall be inspected by the BHEL Engineer to the extent necessary to ensure compliance with clearance for the test, which will be obtained by the contractor from the Engineer.
- 6.5.2 The test shall be repeated till the BHEL and Customer are satisfied as applicable.
- 6.5.3 As a rule, pressure tests shall be performed after all eventual pipe branches have been completed and valves installed. Should it be required to hasten erection work, pressure tests may be performed by sections. For this scope of work, the erected pipe lines shall be Hydraulically tested in as per site requirement segments. For conducting hydraulic test, both ends of pipe lines shall be blanked by welding of plates. Only one or two set of plates and structural materials for blanking required for one segment will be provided by BHEL free of charge. After completion of hydraulic test in one segment, the same plates are to be cut and removed and utilized / welded on the other

segment of the pipe lines, to carry out the hydraulic test for the respective segments. No separate plates for blanking for each segments will be provided. After completion of Hydraulic test, the required edge preparations shall be carried out on the end of pipe lines and to be welded with the respective pipe lines. In such cases joint connection shall be checked during a final and additional test, if required. The contractor shall note this aspect and quote accordingly.

6.5.4 The following specifications shall be completed with during hydrostatic test.

- a. Vent nozzles with valves shall be provided at the highest point of the runs, to eliminate air pockets. At the lowest point drain nozzles, with valves shall be provided to drain water from pipes. The nozzles and valves shall be of the same materials as the pipe.
- b. The lowest part of the pipe shall always be filled first with water.
- c. Pressure shall be slowly increased (without shocks) to the stipulated value and maintained as long as required to visually check all joints.
- d. Following the control specified above the pressure shall be slowly decreased to the design pressure after which the pipe shall be subjected to the peening test, applying knocks every 150 mm approx. especially in the welded joint areas, with a 0.5 – 1.5 kg. Hammer (depending on the pipe wall thickness). The hammer used shall be a round headed one.
- e. Following the peening test, the pressure shall be increased to the stipulated value and all welded joints shall be visually inspected.
- f. Following these test, the pipe shall be drained or pumped out to the other section to be hydro test using the drain out pump to be provided by Contractor and wherever necessary shall be flushed with air for all pipes.
- g. The pressure test is considered satisfactory if no cracks, unjustified pressure reductions, leakages, seepages etc., appear.
- h. Should defects be found, these shall be repaired in the same manner as these during radiographic examination. Hydraulic test shall be repeated after defects have been repaired.

- 6.5.5 During hydraulic test, the pipes being tested shall be isolated from the equipments to which they are connected.
- 6.5.6 Openings on piping for pressure / temperature impulse connections shall be fully closed during the test to prevent dust or foreign matter from being introduced into the instrument piping inadvertently.
- 6.5.7 Test records shall be made of pressure testing for above piping system. These records shall contain the following information:
 - a. Date of test
 - b. Identification of piping tested
 - c. Test fluid
 - d. Test pressure
 - e. Approval of the Engineer

6.6.0 CONCRETE ENCASED PIPING

- 6.6.1 Buried piping running in two tiers shall have concrete encasement for bottom pipe.
- 6.6.2 The pipe in general shall be laid on the bottom cement encasing and welded. After Hydro test clearance will be given for top end casing of CW piping. The civil works for the buried pipings are excluded for this scope of work.
- 6.6.3 The scope, quantity & sizes of buried piping are as per BOM and the relevant drawings.
Erection welding schedule shall be furnished during erection.
10 % Radiographic test shall be done.
- 6.6.4 Access shall be provided for the welding of the circumferential joints by increasing the width and depth of the trench at these points. There should be no obstruction to the welder from any side so that good welded joint is obtained. This type of incidental works are to be carried out by the contractor within quoted rates.
- 6.6.5 Prior to lowering and laying pipe in any trench, the contractor shall inspect and accept for the backfilling and compaction of trench bottom is in accordance with IS 5822 / as per drawing to provide an acceptable bed for placing the pipe.

6.7.0 Painting

- 6.7.1 The pipe edges shall be thoroughly cleaned of all rust, grease, dirt, weld scales and weld burrs etc., moisture or other foreign

matters. Grease or heavy oil shall be removed by washing with a volatile solvent such as gasoline. Kerosene will not be permitted for cleaning. Priming shall immediately follow this cleaning operation with mechanical priming machine. Alternatively, with the concurrence of BHEL / customer the pipe line shall be adequately scrubbed manually with wire brush and scrapped wherever necessary.

- 6.7.2 The underground Carbon steel pipes shall be preserved and coating & wrapping as per IS-10221 latest standards.
- 6.7.3 The above ground carbon steel pipes shall be painted as per painting schedule for shade and thickness.
- 6.7.4 It shall be the responsibility of the contractor to apply preservatives / touch up paints and final painting including providing required labor and consumables for painting.

6.8.0 **PAYMENT TERMS FOR COOLING WATER PIPE LINES :**

- a. 15% of the contract value on completion of pre assy and placement in position wherever applicable.
And
20% of the contract value on completion of erection and Alignment for the items wherever pre assy was involved.
OR
- b. 35% of contract value on completion of erection & alignment for the items where pre assy is not involved.
- c. 40% of the contract value after completion of welding/ Joints .
- d. 10% of the contract value after completion of NDE as applicable (Radiography or MPI or LPI or UT)
- e. 5% of contract value after completion of hydraulic testing and filling up and submission of FQA sheets.
- f. 3% of contract value after reconciliation of materials, T & P etc, including cutting & removal of scraps, temporary supports and return the same to stores etc.
- g. 2% on submission of final bill and acceptance.

The balance 5% of contract value (actual quantity multiplied by accepted unit rate) shall be paid after guarantee period of 12 months. The guarantee period will commence from the date of handing over of unit to customer or six months after the unit

reaches full load after commissioning of all equipments / system whichever is earlier. Refer Cl 6.12.9 (part I)

- 6.8.1 The 'Engineer' will certify regarding the actual work executed in the measurement books and bills, which shall be accepted by the contractor in measurement book.
- 6.8.2 Contractor shall submit shortage / damage reports on BHEL's standard materials management forms. No payment shall be released till the contractor submits these reports and are verified by the Engineer.
- 6.8.3 Subject to any deduction that BHEL may be authorised to make under the contract, the contractor on the certificate of the Engineer at site be entitled for payment as explained hereunder.
- 6.8.4 **Field Quality assurance formats:** It is the responsibility of the contractor to collect and fill up the relevant FQA Log Sheets of BHEL and present the same to BHEL after carrying out the necessary checks as per the log sheets and obtaining the signature of BHEL/Customer in token of their acceptance.
- 6.8.5 No levy or payment or charge made or imposed shall be impeached by reasons for any clerical error or demanded or charged.
- 6.8.6 BHEL at discretion, may further split-up the above percentage and effect payment to suit the site conditions, cash flow requirements, according to the progress of work.
- 6.8.7 **CONTRACTOR SHALL NOTE THAT THE FINAL BILL SHALL BE RELEASED ONLY ON PRODUCTION OF A CERTIFICATE ISSUED BY SITE IN CHARGE THAT THE CONTRACTOR HAS FULFILLED THE ENTIRE CONTRACTUAL / STATUTORY REQUIREMENT.**
- 6.9.0 **FINAL SITE INSPECTION & TEST**
 - i. The employer / owner shall maintain at site a joint protocol for recording actual measurement of work carried out at site, inspection and witnessing of various tests conducted by the contractor. The owner/employer or his authorized agents may inspect various stages of work during the currency of the contract awarded to him. The contractor shall make necessary arrangements for such inspection and carry out the rectification pointed out by the owner/employer without any extra cost to the owner / employer. The contractor shall take this into

consideration while quoting his rates for various items/works. No cost whatsoever such duplication of inspection of work be entertained.

6.10.0 MODE OF AWARD OF WORK FOR UNIT-1& UNIT-2

There are two units of 600MW each at North Chennai. Tender SCT 1331 is for unit 1- 600MW (at North Chennai) only. The quantity indicated in the price bid is for Unit-1 only. The L1 bidder against this quote will be awarded the contract for Unit 1 of North Chennai TPP - 600MW.

However, BHEL reserves the right to award the contract for Unit-2 at North Chennai, on the same terms and conditions of SCT 1331, to the next lowest bidder in the order of competitiveness who matches his rates / price with L1 bidder of unit 1.

Thus the work will be awarded to two agencies i.e. Unit 1 work for one agency and Unit 2 work for other agency. Each unit will be treated as separate contract.

**SCOPE AT A GLANCE
SECTION VII – APPENDIX I**

**SITE FACILITIES
PROJECT: NCTPS 2 x 600 MW , STAGE –II , UNIT – 1&2**

Sl.No	Description	Scope / to be taken care by		Remarks
		BHEL	Bidder	
	PART I			
1.1.0	ESTABLISHMENT			
1.1.1	FOR CONSTRUCTION PURPOSE:			
A	Open space for office	Yes		
B	Open space for storage	Yes		
C	Construction of bidder's office, canteen and storage building including supply of materials and other services		Yes	
D	Bidder's all office equipments, office / store / canteen consumables		Yes	
E	Canteen facilities for the bidder's staff, supervisors and engineers etc		Yes	
F	Fire fighting equipments like buckets, extinguishers etc		Yes	
G	Fencing of storage area, office, canteen etc of the bidder		Yes	
1.1.2	FOR LIVING PURPOSES OF THE BIDDER			
A	Open space		Yes	
B	Living accommodation		Yes	
1.2.0	ELECTRICITY			
1.2.1	<u>Electricity For construction purposes</u> (to be specified whether chargeable or free)	Yes		CHARGEABLE
1.2.1.1	Single point source	Yes		
1.2.1.2	Further distribution for the work to be done which include supply of materials and execution		Yes	
1.2.2	Electricity for the office, stores, canteen etc of the bidder inside plant premises which include:	yes		CHARGEABLE at single point source as referred in sl.no. 1.2.1.1
1.2.2.1	Distribution from single point including supply of materials and service		Yes	

SI.No	Description PART I	Scope / to be taken care by		Remarks
		BHEL	Bidder	
1.2.2.2	Supply, installation and connection to energy meter (except supply of inlet & outlet cable) including operation and maintenance	Yes		
1.2.2.3	Duties and deposits including statutory clearances for the above		Yes	
1.2.2.4	Living facilities for office use including charges		Yes	
1.2.2.5	Demobilization of the facilities after completion of works		Yes	
1.2.3	Electricity for living accommodation of the bidder's staff, engineers, supervisors etc on the above lines.		Yes	
1.3.0	WATER SUPPLY			Chargeable basis if possible to provide by BHEL
1.3.1	For construction purposes:			
1.3.1.1	Making the water available at single point		Yes	
1.3.1.2	Further distribution as per the requirement of work including supply of materials and execution		Yes	
1.3.2	<u>Water supply for bidder's office, stores, canteen etc</u>		Yes	
1.3.2.1	Making the water available at single point		Yes	
1.3.2.2	Further distribution as per the requirement of work including supply of materials and execution		Yes	
1.4.0	TRANSPORTATION			
1.4.1	For construction purposes:		Yes	
1.4.1.1	For the site personnel of the bidder		Yes	
1.4.1.2	For the bidder's equipments and consumables (T&P, consumables etc)		Yes	
1.5.0	LIGHTING			

SI.No	Description PART I	Scope / to be taken care by		Remarks
		BHEL	Bidder	
1.5.1	For construction work (supply of all the necessary materials) 1. At office storage area 2. At the preassembly area 3. At the construction site /area		Yes	
1.5.2	For construction work (execution of the lighting work/ arrangements) 1. At office storage area 2. At the preassembly area 3 At the construction site /area		Yes	
1.5.3	Providing the necessary consumables like bulbs, switches, etc during the course of construction		Yes	
1.5.4	Lighting for the living purposes of the bidder at the colony / quarters		Yes	
1.6.0	COMMUNICATION FACILITIES FOR SITE OPERATIONS OF THE BIDDER			
1.6.1	Telephone, fax, internet, intranet, e-mail etc		Yes	
1.7.0	COMPRESSED AIR SUPPLY			
1.7.1	Supply of Compressor and all other equipments required for compressor and compressed air system including pipes, valves, storage systems etc		Yes	
1.7.2	Installation of the above system and operation and maintenance of the same		Yes	
1.7.3	Supply of the all the consumables for the above system during the contract period		Yes	

SCOPE AT A GLANCE
PROJECT: NCTPS 2 x 600 MW , STAGE -II , UNIT - 1&2

Sl.No	Description PART III ERECTION TESTING & COMMISSIONING	Scope / to be taken care by		Remarks
		BHEL	Bidder	
3.1.0	SCOPE OF WORK			
3.1.0.1	Handling at site stores/ storage yard		Yes	
3.1.0.2	Transportation within the site		Yes	
3.1.0.3	Erection testing & commissioning		Yes	
3.1.0.4	Final painting of erected materials including supply of paints, thinners etc		Yes	
3.1.0.5	Carrying out P.G.test	-	-	
3.1.1.0	HANDLING & TRANSPORTATION			
3.1.1.1	Stores/storage yard to preassy area/ erection site		Yes	
3.1.1.2	Pre assembly area to site of installation		Yes	
3.1.1.3	Erection site to pre assembly area / stores/ storage area if required		Yes	
3.1.1.4	Touch up painting wherever required till final painting.(please refer the relevant clause for supply of paints, thinners etc)		Yes	
3.1.1.5	Preparation storage at site for proper stacking of materials		Yes	
3.1.2	ERECTION TESTING & COMMISSIONING			

SI.No	Description PART III ERECTION TESTING & COMMISSIONING	Scope / to be taken care by		Remarks
		BHEL	Bidder	
3.1.2.1	Erection drawings/documents/working instructions etc	Yes	-	
3.1.2.2	Welding schedules	Yes	-	
3.1.2.3	Engineering drawings for construction methods	Yes	-	
3.1.2.4	Organising the resources required for erection, testing & commissioning of the materials covered under the scope and executing the work as per instruction of BHEL engineer	-	Yes	
3.1.2.5	Final painting of all the materials erected	-	Yes	
3.1.2.6	Demobilization of the erection site		Yes	
3.1.2.7	Cleaning of / upkeep of erection / preassembly / storage areas		Yes	
3.1.2.8	Return of excess materials drawn to BHEL stores/ customer		Yes	
3.1.2.9	Reconciliation of all the consumables, T&P drawn from BHEL / customer ` s store		Yes	
3.1.2.10	Filling up quality log sheets		Yes	
3.1.2.11	Providing all temporary arrangements like platforms, scaffoldings etc for execution		Yes	
3.1.2.12	Assistance for P.G test	-	-	
3.1.3	CIVIL WORKS			
3.1.3.1	Taking over of foundations		Yes	

SI.No	Description PART III ERECTION TESTING & COMMISSIONING	Scope / to be taken care by		Remarks
		BHEL	Bidder	
3.1.3.2	Checking, chipping and correcting final dimensions of the foundations if required		Yes	
3.1.3.3	Placement, erection of embedded parts integral for the scope of work and coordination with customer's civil/other agencies for embedment.		Yes	
3.1.3.4	Bolt grouting with grout as specified		Yes	
3.1.3.5	Final grouting of all the equipments covered under this scope		Yes	
3.1.4	STATUTORY CLEARANCES			
3.1.4.1	Labour license		Yes	
3.1.4.2	Provident fund		Yes	
3.1.4.3	Insurance what ever comes under bidder's scope		Yes	
3.1.4.4	Workmen compensation		Yes	
3.1.4.5	Minimum wages		Yes	
3.1.4.6	Sales tax		Yes	
3.1.4.7	Local laws governing the works like electrical inspectorate, factory inspectorate, etc		Yes	
3.1.4.8	Professional tax		Yes	
3.1.4.9	Safety rules and regulations		Yes	
3.1.4.10	Approval from competent authority for installation like IBR etc		Yes	

SI.No	Description PART III ERECTION TESTING & COMMISSIONING	Scope / to be taken care by		Remarks
		BHEL	Bidder	
3.1.5	SUBMISSION OF REPORTS			
3.1.5.1	Man power deployment category wise and area wise		Yes	
3.1.5.2	Deployment of tools and plant , area wise		Yes	
3.1.5.3	Consumables used		Yes	
3.1.5.4	Erection log		Yes	
3.1.5.5	Erection data PGMADU wise		Yes	
3.1.5.6	Data on joints welded as per log sheet/ welding schedule		Yes	
3.1.5.7	Materials management reports as per instruction of BHEL		Yes	
3.1.5.8	Meeting between BHEL and bidder at BHEL office every day for monitoring the progress	Yes	Yes	

SECTION – VII – Appendix - II
NCTPS STAGE-II 2 X 600 MW UNIT-
WEIGHT SCHEDULE – BOILER, ROTATING EQUIPMENTS
ESP, CW PIPING AND AUXILIARIES
SUMMARY

Sl.No.	DESCRIPTION	WEIGHT IN MT
1	STRUCTURES	13263
2	PRESSURE PARTS	6555
3	NON-PRESSURE PARTS	7151
4	ROTATING EQUIPMENTS	2452
5	ESP	8289
6	CW Piping	
	a) Carbon Steel/SS piping & other fittings	600
	b) GRP piping	500
	TOTAL WT IN MT (Approximately)	38810

Note to weight schedule :

- 1** The weights mentioned above are approximate and liable to vary as per design consideration. There will be change in PG, weight, description etc. However payments will be made for the tonnage actually erected at the quoted rate.
- 2** Besides PG/PGMA indicated in the weight schedule, there is likelihood of addition product groups integral to Boiler, **ESP** and its aux. The quoted rate shall be applicable for such product groups also.
- 3** Fixing components for insulation: The scope of works covers welding of all attachment on the pressure parts for fixing insulation & refractory.
- 4** The erection & dismantling of temporary piping, pumps, tanks, dummy plates & other miscellaneous equipment etc.. For pre-commissioning and commissioning activities like hydraulic test, chemical cleaning, steam blowing, gas tightness test etc. Are covered in this contract and shall be carried out within the quoted rate.
- 5** Imported electrodes/TIG welding wires released under XX992 will be given by BHEL. All electrodes are to be supplied by contractor under his scope.
- 6** The Erection of rectifier transformer, along this package is covered in this scope of contractor. However, dry out, testing and commissioning is not in the scope of this contract.
- 7** Complete ESP inner roof insulation and ESP water washing system & hoists etc are covered in this scope of contract

**NCTPS STAGE -II 2 X 600 MW UNIT-
BOILER, ESP, Aux. & CW PIPING WEIGHT SCHEDULE
PG WISE**

SLNO.	PG	DESCRIPTION	WEIGHT IN MT
1	4	DRUM	295.00
2	5	WATER WALL HEADERS	210.00
3	6	WATER WALL PANELS	676.00
4	7	CIRCULATING SYSTEM	390.00
5	8	FURNACE BUCK STAYS	790.00
6	9	SEAL BOXES	15.00
7	10	S H HEADERS	216.00
8	11	S H COILS	1127.00
9	12	S H COMPONENTS	549.00
10	15	R H HEADERS	100.00
11	16	R H COILS	650.00
12	17	R H COMONENTS	235.00
13	18	ROOF SKIN CASING	25.00
14	19	ECONOMISER	852.00
15	20	SOOT BLOWERS	80.00
16	21	SOOT BLOWER PIPING	28.00
17	24	FINE FITTING	373.30
18	28	MAN HOLES AND MOUNTINGS	13.00
19	30	ENCLOSURES	220.00
20	31	BOILER SKIN CASINGS	17.00
21	32	FIXING COMPONENTS FOR INSULATION	10.00

**NCTPS STAGE -II 2 X 600 MW UNIT-
BOILER, ESP, Aux. & CW PIPING WEIGHT SCHEDULE
PG WISE**

SLNO.	PG	DESCRIPTION	WEIGHT IN MT
22	35	MAIN BOILER STRUCTURES	6187.00
23	36	GALLERIES & STRUCTURES	4550.00
24	38	INTER CONNECTING PLATFORMS	900.00
25	39	EXTERNAL STRUCTURES	1500.00
26	41	OIL BURNERS AND SCANNERS	3.00
27	42	FUEL OIL SYSTEM	131.00
28	43	IGNITOR AND SCANNER AIR SYSTEM	84.00
29	45	WIND BOX	158.00
30	47	COAL PIPES	554.00
31	48	DUCTS (BOILER & BUNKER AREA UP TO BOF, ESP)	3661.00
32	50	STEAM COIL AIR PRE-HEATERS	15.50
33	52	AIR -HEATERS	1475.00
34	55	FD & PA FANS	186.00
35	56	SEAL AIR & ID FANS	212.00
36	57	DAMPERS & ACTUATORS	603.00
37	61	MILLS	1562.00
38	65	GRAVIMETRIC FEEDER	59.00
39	67	RAW COAL GATE & SPOUT ASSEMBLY	197.00
40	79	ESP	8289.00
41	89	ESP GALLERIES & ESP ROOF	126.00
42	97	C AND I (PRESSURE PARTS ATTACHEMENTS)	0.50
43	99	EQUIPMENT HANDLING SYSTEM	150.00

**NCTPS STAGE -II 2 X 600 MW UNIT-
BOILER, ESP, Aux. & CW PIPING WEIGHT SCHEDULE
PG WISE**

SLNO.	PG	DESCRIPTION	WEIGHT IN MT
44		HT Motors	235.00
45		Carbon Steel/SS piping/other fittings	600.00
46		GRP pipe	500.00
		TOTAL WEIGHT IN METRIC TONS (APPROXIMATE)	38810.00

PGMA WISE WEIGHT SCHEDULE

A) STRUCTURES : PG – 35, 36 & 38

PGMA	PGMA DESCRIPTION	Estimated Weight in Kgs	REMARKS
35-010	Foundation Materials-Boiler	18273.98	
35-111	Main Columns Left 1st Pass	514870.23	
35-112	Main Columns Left 2nd Pass	215901.05	
35-121	Maincolumns Right 1st Pass	514870.23	
35-122	Main Columns Right 2nd Pass	215901.05	
35-130	Main Columns Middle	287487.34	
35-140	Auxiliary Columns-Left Side	348248.21	
35-150	Auxiliary Columns-Rightside	348242.04	
35-190	Girder Pin Connections	24090	
35-211	Ceiling Structuremain Girders 1st Pass	338639	
35-212	Ceiling Structuremain Girders 2nd Pass	211745	
35-213	Ceil Struct -Cross Welded Beams 1st Pass	208216	
35-214	Ceil Struct -Cross Welded Beams 2nd Pass	113544	
35-221	Ceiling Structure Rolled Beam 1st Pass	59994	
35-222	Ceiling Structure Rolled Beam 2nd Pass	45264	
35-231	Ceiling Structure Horbracing 1st Pass	37592	
35-232	Ceiling Structure Horibracing 2nd Pass	21942	
35-311	Horizontal Bracing I Pass I Mbl	28386	
35-312	Horiz Bracing li Pass Imbl	18873	
35-321	Horiz Bracing I Pass li Mbl	37592	
35-322	Horiz Bracing li Pass li Mbl	13809	
35-331	Horiz Bracing I Pass lii Mbl	31301	
35-332	Horiz Bracing li Pass lii Mbl	34524	
35-341	Horiz Bracing I Pass Iv Mbl	27312	
35-342	Horiz Bracing li Pass Iv Mbl	59841	
35-351	Horiz Bracing I Pass V Mbl	25456.213	
35-352	Horiz Bracing li Pass V Mbl	18782.002	
35-361	Horiz Bracing I Pass Vi Mbl	43730	
35-362	Horiz Bracing li Pass Vi Mbl	27312	
35-381	Land Platform Lower	88534	
35-382	Land Platform Middle	48180	
35-383	Land Platform Upper	64291	
35-390	Platform At Drum Floor Level	91603	
35-441	Horizontal Beams-Lower	204081.652	
35-442	Horizontal Beams Middle	144699.8	
35-443	Horizontal Beams-Upper	194846.67	
35-451	Horizontal Beams - Lower 2nd Pass	153676.22	
35-452	Horizontal Beams - Middle - 2nd Pass	152378.6	
35-453	Horizontal Beams - Upper - 2nd Pass	67184.28	
35-511	Front Bracing-Lower	31408.2	
35-512	Front Bracing Middle	29173.4	
35-513	Front Bracing-Upper	17757.768	
35-521	Side Bracing-Lower	144889	
35-522	Side Bracing Middle	77506.6	

35-523	Side Bracing-Upper	118484.604	
35-531	Rear Bracing-Lower	90847.6	
35-532	Rear Bracing- Middle	64154.2	
35-533	Rear Bracing-Upper	125555.824	
35-700	Hsfg Fasteners For Pg 35	32376	
35-811	Floor Grills And Guard Plate	290231.87	
35-821	Stairs ? Lower	9488.612	
35-822	Stairs - Middle	6932.966	
35-823	Stairs ? Upper	10364.292	
35-851	Hand Rails And Posts	36672	
	TOTAL WT. OF PG - 35	6187056	

36-110	Columns Near Air Pre Heaters	292364	
36-130	Middle Columns In Boiler	138873	
36-150	Beamsandbracings Near Air Pre Heater	211152	
36-311	Main Floor I Mbl 1st Pass	60097	
36-312	Main Floor I Mbl 2nd Pass	65782	
36-313	Non-Mbl Floor Between Mbl Iandii	58473	
36-314	Non-Mbl Floor Between Mbl Iandii	31186	
36-315	Non-Mbl Floor Between Mbl Iandii	40769	
36-316	Non-Mbl Floor Between Mbl Iandii	56849	
36-321	Main Floor Ii Mbl 1st Pass	129940	
36-322	Main Floor Ii Mbl 2nd Pass	49377	
36-323	Non-Mbl Floor Between Mbl Iiandiii	63346	
36-324	Non-Mbl Floor Between Mbl Iiandiii	54900	
36-325	Non-Mbl Floor Between Mbl Iiandiii	102652	
36-326	Non-Mbl Floor Between Mbl Iiandiii	67569	
36-327	Non-Mbl Floor Between Mbl Iiandiii	134812	
36-331	Main Floor Iii Mbl 1st Pass	44667	
36-332	Main Floor Iii Mbl 2nd Pass	146182	
36-333	Non-Mbl Floor Between Mbl Iiiandiv	62533	
36-334	Non-Mbl Floor Between Mbl Iiiandiv	48727	
36-335	Non-Mbl Floor Between Mbl Iiiandiv	77964	
36-341	Main Floor Iv Mbl 1st Pass	75527	
36-342	Main Floor Iv Mbl 2nd Pass	22739	
36-343	Non-Mbl Floor Between Mbl Ivandv	30861	
36-344	Non-Mbl Floor Between Mbl Ivandv	36546	
36-345	Non-Mbl Floor Between Mbl Ivandv	107200	
36-346	Non-Mbl Floor Between Mbl Ivandv	25176	
36-347	Non-Mbl Floor Between Mbl Ivandv	30861	
36-348	Non-Mbl Floor Between Mbl Ivandv	128315	
36-351	Main Floor V Mbl 1st Pass	29236	
36-352	Main Floor V Mbl Ii Nd Pass	11370	
36-353	Non-Mbl Floor Between Mbl Vandvi	76340	
36-354	Non-Mbl Floor Between Mbl Vandvi	35733	
36-355	Non-Mbl Floor Between Mbl Vandvi	50352	
36-361	Main Floor Vi Mbl 1st Pass	45479	
36-362	Main Floor Vi Mbl 2ndpass	30861	
36-363	Non_Mbl Floor Above Mbl Vi	33297	
36-391	Miscellaneous Platforms-Part I	118570	

36-392	Miscellaneous Platforms-Part Ii	124255	
36-393	Miscellaneous Platforms Part Iii	105576	
36-394	Miscellaneous Platforms Part Iv	32485	
36-395	Miscellaneous Platforms Part V	14618	
36-610	Boiler Roof Structure	154953	
36-611	Boiler Roof Sheeting	35733	
36-613	Rain Water Pipes And Gutter	38982	
36-620	Boiler Side Cladding Structure	113697	
36-621	Boiler Side Cladding Sheeting	29236	
36-740	Posts And Hangers	108824	
36-811	Floorgrillsandguardplates-Lower	129452	
36-812	Floorgrillsandguardplate Middle	243637	
36-813	Floorgrillsandguardplates-Upper	243637	
36-814	Floorgrillsandguardplate Miscellaneous	139685	
36-820	Stairs And Ladders	49539	
36-851	Handrails And Posts Lower	25501	
36-852	Handrails And Posts Middle	25501	
36-853	Handrails And Posts Upper	81212	
36-993	Consumablesanderecition Materials	26800	
	TOTAL WEIGHT OF PG - 36	4550000	

38-210	Inter Conn Platformsbetn Boiler/Elevat	56250	
38-299	Mill Handling Monorails	134477	
38-310	Conn Platforms To Mill Deaerator Bay	26163	
38-381	Eco Handling Structure	37936	
38-410	Mill Maintanance Platforms	194259	
38-510	Lift Beams And Bracings	116424	
38-610	Elevator Cladding Structure	84375	
38-611	Elevator Cladding Sheeting	43169	
38-710	Lift Machine Room Detailsandmisc Struct	77965	
38-810	Floorgrills And Guard Plate	113808	
38-820	Stairs And Ladders	5233	
38-850	Hand Rails And Hand Rail Posts	9941	
	TOTAL WEIGHT OF PG - 38	900000	
39-012	Foundation Materials I.D.Duct Supports	26098	
39-101	Columns Frames Before ESP- Left	130492	
39-102	Columns Frames Before ESP -Right	313180	
39-141	Cols Frames Near ID Fan - Left	168334	
39-142	Cols Frames Near ID Fan - Right	339278	
39-150	Col Frames Betn I.D.Fan And Chimney	65246	
39-300	Platforms - External Structure	208786	
39-301	Struc and Platform For Fans	8482	
39-302	Struc for Motor Hood Covering	8482	
39-304	Fan Handling Structure For FD Fan	19574	
39-305	Fan Handling Structure For PA Fan	14354	
39-306	Fan Handling Structure For ID Fan	65246	
39-700	HSFG Fasteners For PG 39	1435	
39-810	Floor Grill	65246	
39-820	Stairs	28056	

39-850	Hand Rail and Hand Rail Posts	37711	
	TOTAL WEIGHT OF PG 39	1500,000	
89-610	EP GALLERIES&STAIRS	115000	
89-611	ESP ROOF HANDRAILS	11000	
	TOTAL WEIGHT OF PG 89	126000	
TOTAL WEIGHT OF STRUCTURES = 13,263 MT			

<u>PGMA WISE WEIGHT SCHEDULE</u>			
B) PRESSURE PARTS			
PGMA	PGMA DESCRIPTION	Estimated Weight in Kgs	REMARKS
04-126	Upper Drum Without Intl Id 61-71	258971	
04-136	Upper Drum Internals Only For Id 61-71	12090	
04-146	Upper Drum Sspn Id 61-71	18619	
04-196	Upper Drum Trans Strr Id 61-71	5320	
	TOTAL WEIGHT OF PG - 04	295000	
05-137	Inlet Front Lower Ww Header	48181	
05-139	Lower Inlet Header Internals	107	
05-147	Inlet Rear Lower Ww Header	45838	
05-158	Inlet Side Waterwall Header (Left)	40721	
05-159	Inlet Side Water Wall Header (Right)	40721	
05-227	Waterwall Rear Hanger Outlet Header	5330	
05-229	Waterwall Rear Screentube Outlet Heade	7462	
05-231	Outlet Front Upper Ww Header	7249	
05-251	Outlet Side Upper Ww Header	14391	
	TOTAL WEIGHT OF PG - 05	210000	
06-400	Unclassified Burner Panel	25227	
06-631	Front Upper Ww Pnl	66548	
06-633	Front Upper Inter Ww Pnl	62554	
06-634	Front Intermediate Ww Pnl	29222	
06-637	Waterwall Lower Front Panel	34130	
06-641	Rear Upper Ww Pnl	33217	
06-643	Rear Upper Inter Ww Pnl	63124	
06-644	Rear Intermediate Ww Pnl	28765	
06-647	Rear Lower Ww Pnl	55818	
06-651	Side Upper Ww Pnl	86182	
06-653	Side Intermediate Ww Pnl	95998	
06-655	Side Lower Ww Pnl	74082	
06-670	Extended Side Ww Pnl	20889	
	TOTAL WEIGHT OF PG - 06	675756	
07-102	Downcomer Piping-Controlled Circulatio	91912	
07-104	Discharge Line	29369	
07-106	Suction Manifold	16884	
07-107	Suction Spools	8323	
07-215	Relief Tubes From Side Wall Outlet Hea	49345	
07-216	Relief Tubes From Rear Hanger Header	5826	
07-217	Screen Relife Tubes Header	33530	

07-218	Relief Tubes From Front Outlet Header	10582	
07-223	Furnace Screen Tubes	32223	
07-225	Furnace Rear Hanger Tubes	20451	
07-226	Furnace Rear Arch Tubes	9988	
07-231	Lower Corner Transition Tubes	5826	
07-232	Upper Corner Transition Tubes	951	
07-402	Ww Front Header Suspension	12960	
07-403	Ww Side Header Suspension	20689	
07-404	Ww Hanger Header Suspension	21640	
07-405	Ww Screen Header Suspension	2378	
07-420	Downcomer Guides	7491	
07-431	Riser Tube Support	3448	
07-500	Misc Components - Pressure Parts	595	
07-601	Pressure Seals	3567	
07-992	Imported Electrodes	238	
07-993	Consumables & Erection Materials	1784	
	TOTAL WEIGHT OF PG - 07	390000	
08-001	Furnace Upper Buckstay-Frontand Rear	85802	
08-003	Furnace Upp.Inter Buckstay- Side	137236	
08-006	Furnace Inter.Buckstay	105970	
08-007	Furnace Lower Buckstays	94872	
08-111	Furnace Rear Arch Buckstay	44512	
08-380	Furnace Bottom Support	55491	
08-382	Furnace Bottom Support Rear	55491	
08-400	Furnace Guide	7757	
08-501	Furnace Backpassbuckstayfrontand Rear	90098	
08-503	Furnace Back Pass Buckstayside	103822	
08-901	Furnace Key Buckstay Upper	5370	
08-907	Furnace Key Buckstay Lower	2387	
08-910	Ex.Movement Measurement Components.	1192	
	TOTAL WEIGHT OF PG - 08	790000	
09-001	Seal Boxes For Furnace Opening	11464	
09-002	Seal Boxes For Instrument Inserts	2893	
09-003	Material For Instrument Inserts	643	
	TOTAL WEIGHT OF PG - 09	15000	
10-135	Horizontal Spaced Shinlet Header	5541	
10-178	Vertical Platen Sh 1inlet Header	35371	
10-182	Sh Rear Wall Inlet Header	5306	
10-183	Sh Frontwall Inlet Header	10611	
10-185	Sh Rear Roof Inlet Header	10022	
10-191	Sh Radiant Wall Roof Inlet Hdr	5306	
10-195	Sh Division Panel Inlet Header	23581	
10-218	Rear Lower Sh Outlet Hdr	2594	
10-235	Horizntl Spaced Sh Outlet Header	20633	
10-278	Vertical Platen Sh Outlet Header	40087	
10-283	Sh Frontwall Outlet Header	8253	
10-291	Sh Radiant Wall Roof Outlet Hdr	8607	
10-295	Sh Division Panel Outlet Header	23581	
10-315	Sh Rear Intermedhate Header	10965	
10-687	Sh Radiant Wall Junction Header	5306	

	TOTAL WEIGHT OF PG - 10	215764	
11-036	Sh Rear Hori Spaced Coil Upper Left	78900	
11-038	Sh Reor Hori Spaced Coil Lower Left	117364	
11-077	Sh Reor Vertical Spaced Coil Left	52107	
11-078	Sh Vertic1l Platen Coil Left	86026	
11-095	Sh Division Panel Coil Left	105689	
11-336	Sh Hor Spaced Upper Coil + Hdr	136413	
11-338	Sh Hor Spaced Lower Coil + Hdr	116012	
11-377	Sh Vertical Spaced Rear Coil + Header	54565	
11-378	Sh Vertical Platen Coil + Header	58989	
11-395	Sh Division Panel Coil Right	40555	
11-606	Sh Front Upper Panels	10200	
11-608	Sh Front Lower Panels	19049	
11-716	Sh Rear Upper Pnl + Atch	8971	
11-717	Sh Rear Inter Pnl + Atch	7497	
11-718	Sh Rear Lower Pnl + Atch	7865	
11-767	Sh Stm Cool Side Wall Panel Upper Left	66363	
11-768	Sh Stm Cool Side Wall Panel Inter Left	11429	
11-769	Sh Stm Cool Side Wall PoneL Lower Left	17205	
11-787	Sh Rear Roof Panel + Attachment	3933	
11-791	Sh Radiant Wall Roof Panel + Attachmen	23596	
11-916	Sh Stm Cool Rear Wall Panel Upper Ri7h	7865	
11-917	Sh Stm Cool Reor Wall Panel Inter Righ	6759	
11-918	Sh Stm Cool Rear Wall Panel Lower Righ	10446	
11-967	Sh Stm Cool Side Wall Panel Upper Righ	15608	
11-968	Sh Stm Cool Side Wall Panel Inter Righ	11552	
11-969	Sh Stm Cool Side Wall Panel Lower Righ	17328	
11-987	Sh Stm Cool Rear Roof Panel Right	11675	
11-991	Sh Radiant Roof Panel Right	22858	
	TOTAL WEIGHT OF PG - 11	1126819	
12-178	Sh Vertical Platen Inlet Pipe	81499	
12-395	Sh Division Panel Inlet Tubes	13927	
12-495	Sh Div9sion Panel Outlet Tubes	13025	
12-515	Sh Rear Hanger Tube	61899	
12-619	Sh Horizontal Support Tubes	12251	
12-803	Sh Steam Cooled Spacer Tubes	4513	
12-805	Super Heater Hanger Tubes	14701	
12-850	Sh Conn Pipes-Saturated	8640	
12-852	Sh Desh Links	59062	
12-900	Sh Desh	9027	
12-903	5h Miscl Components	79308	
12-906	Sh Suprts For Lines & Links	18957	
12-914	Suspension Of Sh Radiant Roof Headers	10317	
12-917	Suspension Of Radiant Roof	30950	
12-924	Suspension Of Sh Back Pass Headers	11735	
12-927	Suspension Of Rear Roof	1161	
12-928	Suspension Of Sh Rear Wall	34560	
12-944	Suspension Of Sh Platen Headers	1032	
12-948	Suspension Of Vertical Spaced Assembly	22567	
12-954	Suspension Of Vertical Spaced Headers	25147	

12-968	Suspension Of Platen Assembly	34045	
12-991	Indegenous Electrodes	129	
12-992	Imported Electrodes	129	
12-993	Consumables & Erection Materials	645	
	TOTAL WEIGHT OF PG - 12	549226	
15-174	Reheater Vert Spaced Inlet Header Rhh1	19776	
15-177	Rh Vertical Spaced Rear Inlet Header	16425	
15-278	Reheater Vert Platen Outlet Header Rhh	23464	
15-279	Rh Vertical Platen Front Outlet Header	40223	
	TOTAL WEIGHT OF PG - 15	99888	
16-077	Rh Ver Spaced Rear Coil Assy Left	170084	
16-079	Rh Ver Platen Front Coil Assy Left	154925	
16-377	Rh Vertical Spaced Rear Coil + Header	170066	
16-379	Rh Ver Platen Front Coil Assy Right	154925	
	TOTAL WEIGHT OF PG - 16	650000	
17-174	Rh Vertical Spaced Inlet Pipe	45981	
17-807	Rh Steam Cooled Spacers	1631	
17-904	Rh Hdr Suprts & Suspensions Above Roof	15116	
17-919	Rh Front Suspension	58071	
17-929	Rh Rear Suspension	114066	
17-991	Indegenous Electrodes	135	
	TOTAL WEIGHT OF PG - 17	235000	
18-002	First Pass Roof Skin Casing	19091	
18-003	Second Pass Roof Sk9n Casing	3977	
18-010	Pr Pts Attachmnts In Furn Roof Skn Cas	1591	
18-020	Vibration Snubbers	341	
	TOTAL WEIGHT OF PG - 18	25000	
19-701	Inlet Eco Headers	13072	
19-702	Outlet Eco Headers	86275	
19-814	Economisercoil Assy Upper Left	67887	
19-824	Economiser Coil Assy Lower Left	132462	
19-850	Eco Feed Pipe	3486	
19-851	Eco Links To Drum	6100	
19-884	Eco.Coil Assy Intermediate Left	174292	
19-903	Eco. Miscellaneous Components	871	
19-905	Eco Suprts & Suspensions Below Roof	523	
19-906	Eco Suprts For Lines & Links	2789	
19-907	Eco Supports/Feed Pipe Suspension	1743	
19-914	Econ-Miser Coil Assy Upper Right	67625	
19-924	Economiser Coil Assy Lower Right	120261	
19-984	Economiser Coil Middle Right	174292	
19-991	Indegenous Electrodes	87	
19-992	Imported Electrodes	87	
	TOTAL WEIGHT OF PG - 19	851852	
21-600	Soot Blower Piping And Fittings	13972	
21-601	Sootblower Piping Supports	9382	
21-700	Bulked Bps Components For Sb Piping	898	
21-800	Sb Valves (Bhel)	1996	
21-825	Sb Valves (Sub Delivery)	1597	
21-850	SB safety valve (BHEL)	55	

21-992	Imported Electrodes	100	
21-987	Commg Spares For Sb Safety Valve	50	
21-988	Commg Spares For Sub Deliveries	50	
	TOTAL WEIGHT OF PG - 21	28100	
24-300	Boiler Trim Piping And Fittings	81659	
24-301	Boiler Trim Piping Supports	15437	
24-315	Spray Water System Cc Rh Blr	6281	
24-316	Rh Dsh	2662	
24-320	Safety Valve Esc Pipe&Drain - Cc Rh Bl	45673	
24-325	Silencer Support-Safety Valves	23742	
24-335	SIncr&Suprt-Starting Vent - Cc Rh Blr	3513	
24-340	Sample Cooler And Supports	852	
24-350	Boiler Filling Piping	2555	
24-351	Hangers And Supports Of Blr Filling Pipe	532	
24-355	Circulating Pump Components(Sd)	31088	
24-360	Valves (Bhel) Cc Rh Blr	67925	
24-365	Valves & Fittings (Sd) Cc Rh Blr	6602	
24-373	Direct water level gauge	298	
24-374	Cooler & Strainer Assy For Bwcp	2129	
24-375	Headers For Trim Piping	2768	
24-380	Erv And Safety Valves(Bhel)	8730	
24-385	Safety Valve/Erv Silencers(Bhel)	67925	
24-700	Bulked Bps Components For Trim Pipes	1171	
24-950	Special Tools	213	
24-955	Lapping Tools for SV & ERV	128	
24-960	Lapping Tools for conventional val (BHEL	43	
24-992	Imported Electrodes	106	
24-993	Consumables & Erection Materials	106	
24-994	Name Plates	319	
24-987	commissioning spares for safty val / ERV	21	
24-988	Commissioning spares for CW Pump	16	
24-989	Commg spares for conventional val	22	
24-316	Rh Dsh	533	
	TOTAL WEIGHT OF PG - 24	373049	
31-010	Skin Casing Comps Welded To Pressure P	8180	
31-102	Furnace Bottom Skin Casing	1063	
31-104	Furnace Rear Arch Skin Casing	6163	
	TOTAL WEIGHT OF PG - 31	15412	
32-010	Fixing Comp For Blr Pr Parts Insul	6625	
32-110	Fixing Comp For Blr Mountings Insul	2944	
	TOTAL WEIGHT OF PG - 32	9569	
97-297	MTM CLAMPS & PADS	40	
TOTOL Wt. OF PRESSURE PARTS = 6555 MT			

PGMA WISE WEIGHT SCHEDULE			
C) NON - PRESSURE PARTS			
PGMA	PGMA DESCRIPTION	Estimated Weight in Kgs	REMARKS
20-051	Long Retractable Soot Blower T30 Mk Ii	59828	
20-054	Wall Box Non Pressurised For Lrsb Mk I	1206	

20-201	Wall Deslagger Rw5e	14689	
20-204	Wall Box Non Pressurised For Rw5e	1825	
20-511	Da Head Valve Assy	234	
20-794	Wall Box Non 7ressurised For Temp Prob	67	
20-962	Temp Probe Duplex With Power Trcack&Ac	2135	
	TOTAL WEIGHT OF PG - 20	79984	
28-220	Doors	12100	
28-700	Bps Fasteners	900	
	TOTAL WEIGHT OF PG - 28	13000	
30-103	Seal Plate Assy	4053	
30-105	Furnace Bottom Enclosure Framing	10189	
30-211	Furnace Rear Arch Enclosure Framing	5905	
30-212	Furnace Extd Side Bottom Enclosure Fra	4168	
30-215	Main Boiler	14589	
30-219	Vertical Roof Enclosure Framing	74684	
30-220	Deck Sprt And Seal	75727	
30-235	Enclosure Support Steel	30685	
	TOTAL WEIGHT OF PG - 30	220000	
31-105	Second Pass Skin Casing	531	
31-993	Erection Materials	1063	
	TOTAL WEIGHT OF PG - 31	1594	
41-350	Air Cooled Oil Gun Assy,	1246	
41-390	Oil Gun Vice Assy And Rack	1246	
41-500	High Energy Arc Ignitor	559	
41-988	Oil&Gas Burner Commissioning Spare	4	
	TOTAL WEIGHT OF PG - 41	3055	
42-001	Pneumatic Fittings	472	
42-002	Steam Blow Materials	2834	
42-005	Instrument Fittings	945	
42-010	Lfo Pump Set	7557	
42-020	Hfo Pump Set	12280	
42-030	Hfo Heater Set	28338	
42-046	Drain Oil Pump-Motor Assy	567	
42-065	Drain Oil Tank	10391	
42-070	Burner Station Skid Assembly	9446	
42-120	Piping, Pump House-Fuel Oil	9446	
42-128	Piping,Pump House Steam - Ibr	1889	
42-150	Piping, Operating Floor Hfo & Tracer	11807	
42-152	Piping,Opr'G Floor Lfo	5668	
42-154	Piping,Opr'G Floor Drain Oil	4440	
42-157	Piping,Opr'G Floor Atm Air	2928	
42-158	Piping,Opr'G Floor Steam-Ibr	6707	
42-200	Subdelivery Fuel Oil System	5668	
42-300	Bhel Valve F.O. System	2173	
42-358	Bhel Valve,Opr'G Floor Stm-Ibr	1984	
42-700	Bps Fasteners	2739	

42-800	Electrical Tracer,Fuel oil system	2264	
42-992	Imported Electrodes	38	
42-988	Oil&Gas System Commissioning Spare	28	
	TOTAL WEIGHT OF PG - 42	130609	
43-004	Assy Comp Scanner & Gun Air System	2814	
43-005	Assy Comp Mill Seal Air System	17230	
43-104	M/C Comp Scanner & Gun Air System	21882	
43-105	M/C Comp Mill Seal Air System	34459	
43-200	Subdel,Ignitor&Scanner Air System	8041	
	TOTAL WEIGHT OF PG - 43	84426	
45-321	Wind Box Support 32-In Width	12042	
45-325	Windbox For One And Three Corners	72807	
45-326	Windbox For Two And Four Corners	72807	
	TOTAL WEIGHT OF PG - 45	157656	
47-281	Fuel Pipe Supports	46175	
47-283	Fuel Pipe Coupling Coller & Orifice	46175	
47-286	Fuel Pipe St Pipes For Mill A & B	131928	
47-287	Fuel Pipe St Pipes For Mill C & D	131928	
47-288	Fuel Pipe St Pipes For Mill E & F	131928	
47-289	Fuel Pipe St Pipes For Mill G & H	65964	
	TOTAL WEIGHT OF PG - 47	554098	
48-012	Rect Duct Bet F.D Fan And Airheater	115393	
48-014	Expn Piecesbet F.D Fan And Airheater	6975	
48-015	Supportsetcbet F.D Fan And Airheater	12680	
48-019	Foundation Materials	2500	
48-022	Rect Duct Sec.Air Interconnection	15851	
48-032	Rect Duct A.H Bypass Sec Air Side	53892	
48-112	Rect Ducts Pri Fan To Airheater Prisd	71518	
48-114	Expn Piecespri Fan To Airheater Prisd	6341	
48-115	Supportsetcpri Fan To Airheater Prisd	30433	
48-132	Rect Duct Pri Air Fan To Coldairbusdu	38295	
48-141	Seal Air Line for HAG	7609	
48-142	Rect Duct Coldairbus(Temp Air To Mill	49454	
48-144	Expn Piecescoldairbus(Temp Air To Mill	5073	
48-145	Supportsetccoldairbus(Temp Air To Mill	7609	
48-152	Rect Duct Pri Air Fan Interconnection	54270	
48-200	Instrument Tappings On Ducting	2500	
48-202	Rect Ductsairheater To Windboxduct	274146	
48-204	Expn Piecesairheater To Windboxduct	12681	
48-205	Supportsetcairheater To Windboxduct	25108	
48-207	Flowmeters For Secondary Air Flow	34238	
48-212	Wind Box Connecting Ducts - Rectangula	63404	
48-214	Expn Pieceswindbox Connecting Duct	6341	
48-215	Supports Wind Box Connecting Duct	5000	
48-222	Rect Duct-Airheater Prisdetohotair B	133145	
48-224	Expn Piecesairheater Prisdetohotair B	15217	
48-225	Supports For Hot P.A (Ah To Hot Bus)	13949	
48-232	Rect Ducts Hot Air Busduct(Hotairtomil	166115	

48-234	Expn Pieceshot Air Busduct(Hotairtomil	6000	
48-235	Support Hot Air Bus	2790	
48-382	Rect Duct Economiser To Airheater2nop	408572	
48-384	Expn Pieceseconomiser To Airheater2nop	30434	
48-385	Supportsetceconomiser To Airheater2nop	46158	
48-432	Rect Duct Airheater Boiler Outlet-Gas	187548	
48-434	Expn Piecesairheater Boiler Outlet-Gas	16485	
48-435	Supportsetcairheater Boiler Outlet-Gas	23079	
48-662	Rect Duct Hot Air Bus To Mills	101446	
48-664	Expn Pieceshot Air Bus To Mills	12681	
48-665	Supports For Hot Pa To Mills	19782	
48-667	Venturi-Primary Air Flow	24855	
48-700	Bulked Bps Components	3500	
48-993	Erection Materials	10362	
48-019	Foundation Materials	2826	
48-200	Instrument Tappings On Ducting	2,573	
48-462	Rect Duct Boiler Outlet To Elec Precp	532,715	
48-464	Expn Piecesboiler Outlet To Elec Precp	25,362	
48-465	Bof To Ep Ducting Supports	5,960	
48-482	Rect Ducts-Elec Prptr/M.S To Inddraftf	376,364	
48-484	Expn Pieceselec Prptr/M.S To Inddraftf	25,362	
48-485	Supportsetcelec Prptr/M.S To Inddraftf	41,593	
48-492	Rect Duct Ind Draft Fan To Chimney	413,390	
48-494	Expn Piecesind Draft Fan To Chimney	7,609	
48-495	I.D.System Duct Supports	85,215	
48-700	Bulked BPS Components	3,602	
48-993	Erection Materials	15,000	
	TOTAL WEIGHT OF PG - 48	3661000	
50-510	STEAM COIL A P H	15500	
	TOTAL WEIGHT OF PG - 50	15500	
52-000	SPECIAL TOOLS/CONTRA	1000	
52-010	LARG AH-ROTOR ASSY	999000	
52-011	LARG AH-ROTOR POST	47000	
52-012	LARG AH-ROTORPINRACK	6500	
52-013	LARG AH-ROTORSEALS	12000	
52-030	LARG AH-ROTORHOUSING	67000	
52-041	HOT END CONN PLATE	104000	
52-042	COLD END CONN PLATE	170000	
52-054	LARG AH-AXIAL SEAL	600	
52-055	LARG AH-BY PASS SEAL	1400	
52-100	LARGE AH ROTOR DRIVE	12000	
52-210	LARG AH-ACCESS DOOR	1265	
52-211	LARG AH-AIRSEAL PIPE	900	
52-212	LARG AH-OBSER. PORTS	85	
52-217	LARG AH-STOP.ALARMS	60	
52-220	LARG AH-GENS DETAILS	12000	
52-261	LARG AH-GUIDE BEARNG	8100	

52-262	LARG AH-SUPRT BEARNG	18000	
52-271	OIL PIPING GUIDE BRG	600	
52-272	OIL PIPING SUPRT BRG	600	
52-274	LUB OIL CIRCULN UNIT	1230	
52-301	WASH MANIFLD GAS INL	2000	
52-302	WASH MANIFLD GAS OUT	2000	
52-340	LARG AH-CLEANING EQPT	8200	
52-360	FIRE SENSING SYSTEM	200	
52-988	LARG AH COMMG SPARE	700	
	TOTAL WEIGHT OF PG - 52	1476440	
57010	Gate Fd Fan Outlet	21400	
57013	Dampers Bet Fd Fan & APH	9300	
57033	Dampers Ah By Pass Sec Air	16400	
57110	Guillotene Gate Pa Fan To APH	22250	
57113	Dampers Between Pa Fan & APH	10550	
57141	Seal Air Hag	9000	
57143	Damper Cold Air Bus(Temp Air To Mill)	3750	
57160	Cold Airgate, Cold Airbus To Mill	15100	
57203	Damper APH To Windbox Duct	15000	
57209	Linkages For Dampers	10000	
57223	Damper APH Pri Side To Hot Air Bus	9950	
57270	Guillotene Gate Duct To Mills	27000	
57383	Damper Economiser To APH	48600	
57433	Damper APH Boiler Outlet To Gas	28000	
57577	Elect Actuator For Dampers	10000	
57663	Damper Hot Air Bus To Mill	11500	
57988	Commissioning Spares	150	
57141	SEAL AIR ID FAN	9000	
57460	GUILLOTENE GATE EP INLET	57200	
57466	PLATFORMS AND LADDERS	40000	
57470	EP OUTLET GATE	57200	
57480	GUILLOTENE GATE EP OUTLET	76000	
57490	GUILLOTENE GATE ID FAN	80000	
57491	BLOWER WITH MOTOR	3800	
57497	KNIFE GATE VALVE	2000	
57577	ELECT ACTUATOR FOR GATE	10000	
	TOTAL WEIGHT OF PG - 57	603150	
99-400	Airheater, Steam coil Airheater Handlg E	37500	
99-514	FOUR WALL COVERAGE-FURN.MTCE CRADDLE	37500	
99-501	QUICK ERCN. SCAFFOLDING	37500	
99-100	Fan Handling Equipment	37500	
	TOTAL WEIGHT OF PG - 99	150000	
TOTOL Wt. OF NON-PRESSURE PARTS = 7151 MT			

<u>PGMA WISE WEIGHT SCHEDULE</u>
D) ROTATING EQUIPMENTS

PGMA	PGMA DESCRIPTION	Estimated Weight in Kgs	REMARKS
55011	FD FAN FOUNDATION MATL	1600	
55017	FD FAN C&I ITEMS	18	
55031	PA FAN FOUNDATION MATL	1600	
55037	PA FAN C&I ITEMS	24	
55215	1 REACT FD FAN	28600	
55334	2 REACT PA FAN	24000	
55810	AXIAL FDFAN COUPLING	800	
55830	AXL PAFAN COUPLING	1350	
55910	AXL FDFAN ACCESSORY	2900	
55911	AXIAL FDFAN SILENCER	60500	
55930	AXL PAFAN ACCESSORY	3000	
55931	PA FAN SILENCER	62000	
	TOTAL WEIGHT OF PG – 55	186392	
56000	TOOLS & FIXTURE/CONT	800	
56021	ID FAN FOUNDATION MATL	5500	
56027	ID FAN C&I ITEMS	12	
56077	SEAL AIR FAN C&I ITEMS	12	
56161	BAC 1 SUC SA FAN	1600	
56173	BAC 1 SUC IGNTR FAN	8500	
56228	BAC 2 SUC ID FAN	190000	
56670	IGNTR FAN MOTOR	1500	
56820	RADL IDFAN COUPLING	200	
56870	SEAL AIR FAN COUPLING	100	
56920	RAD IDFAN ACCESSORY	4000	
56988	RADIAL FAN COMMG SPA	10	
	TOTAL WEIGHT OF PG – 56	212234	
61904	Foundation Fastener Assembly	58504	
61004	Journal Assembly	352080	
61104	Mill Drive and Bowl Assembly	324180	
61204	Mill Side and Liner Assembly	230166	
61304	Classifier Assembly	465750	
61404	MDV Assembly	60210	
61704	Mill Motor Coupling	1620	
61804	Lubricating Oil	17826	
61804	Tools and Accessories with Mill Handling System(per Unit)	51700	
	TOTAL WEIGHT OF PG – 61	1562036	
65-736	36 Inch Gravimetric Feeder	59017	
	TOTAL WEIGHT OF PG – 65	59017	
67-204	Raw Coal Gates Needle Type	7219	
67-272	Coal Valve-36 Inch Motor Operated	14438	
67-276	Raw Coal Gate Chain Op 36" Circular	14438	
67-283	Feeder Outlet Isolation Gate	18047	
67400	Seal Air Header Assembly	27000	
67-801	Down Spout	33748	
67-802	Bunker Emptying Chute	51430	

67-803	Feed Pipe To Mill	30680	
	TOTAL WEIGHT OF PG – 67	197000	
	HT Motors – Weight Approximately		
	Mill Motor	100000	
	ID Fan	75000	
	FD Motor	25000	
	PA Fan Motor	35000	
	TOTAL WEIGHT OF HT Motors	235000	
TOTAL Wt. OF ROTATING EQUIPMENTS = 2452 MT			

NCTPS, STAGE - II : 2 x 600 MW ESP - APPLICABLE PGMA & ITS WEIGHT			
E.) ESP			
Sl.No.	PGMA	Description	Design Wt(Kg)
1	79001	ROLL/SLIDE SUPPORTS	28000
2	79005	ESP-SUB-DELIVERY COMPO	800
3	79006	INSULATOR HOUSING AS	65000
4	79008	GAS DIST. ASSY	95000
5	79009	GD-RAPPING MECHANISM	17500
6	79010	GD_DRIVE ARRANGEMENT	900
7	79011	GAS SCREEN-EP	46500
8	79013	EMIT SYST SUSPENSION	22000
9	79014	SUPPORT INSULATORS	9700
10	79015	EMITTING ELECTRODES	33900
11	79016	EMIT ELECT RAPP MECH	54000
12	79017	DRIVE ARGT. FOR EMIT.	42400
13	79019	COL ELEC SUSPENSION	155000
14	79020	COLLECTING ELECTRODE	1525000
15	79021	EMIT SYS FRAME-TOP	200000
16	79022	EMIT SYS FRAME BOTOM	240000
17	79023	INSPECTION DOORS	17000
18	79024	SHOCK BARS	124600
19	79025	COLL ELECT RAPP MECH	137000
20	79026	COLL ELEC RAPP DRIVE	8800
21	79028	ESP ROOF PANELS	235000
22	79031	GEARED MOTORS FOR RAPP	30000
23	79032	EMIT SYS FRAME-MIDLE	200000
24	79042	OUTER ROOF-EP	332000
25	79043	HOPPER RIDGES	105000
26	79044	HOPPER UPPER PART	540000
27	79045	HOP MLD&LOWER PART	650000
28	79046	INSULATOR SUPP PANEL	140000
29	79047	ROOF PANEL ASSY	180000
30	79048	CASING STRUCTURE	570000
31	79049	CASING SHELL/PANEL	721000

32	79050	INLET-OUTLET FUNNEL	200000
33	79055	PENT HOUSE FOR E P	290000
34	79057	SPLITTER&GUIDE VANES	26500
35	79063	ASH LEVEL INDICATOR	3100
36	79065	APP PLATFORM-HOPPER	225000
37	79066	WATER WASHING SYSTEM	6500
38	79072	INTERLOCKS-EP	3000
39	79073	ELECTRICALLY OPERTD HO	7000
40	79080	FOUNDATION MATLS FOR E	25000
41	79081	SUPPOTING STRUCTURES F	670000
42	79090	HEATING ELEMENTS	5000
43	79094	STATCON PANEL	1100
44	79996	TOOLS & TACKLES	300
45	79xxx	ESP HV Rectifier Transformer (Approx Wt.)	300000
		TOTAL WEIGHT	8288600

F). COOLING WATER PIPING

NCTPS STAGE - II - 2 X 600 MW			
WEIGHT SCHEDULE SUMMARY- CW PIPING			
Details of piping to be erected .			
SI No.	OD(mm) x Thick (mm)	Length in M	Approx. Wt. (MT)
A) STEEL PIPING			
1	Pipe 1800 x 14.2	125	500
2	Pipe 2000 x 18	125	
3	Pipe 2800 x 20	80	
4	Pipe 4000 x 20	50	
5	SS Pipes	-	25
6	Other Pipes and Fittings		75
A) GRP PIPING			
7	Pipe OD 2800	1750	500
Total weight of CW piping to be erected			1100 MT

Erection notes for cooling water piping :

1. The above piping bill of material indicated is approximate. To be considered on account of variation in layout and addition in scope if any.

2. The straight length of pipe indicated in BOM does not include the length of fittings. E.g : Tees, Reducers, ELBOW Mitre bends and other pipe fittings , clamping / trailing length required for bends etc.. are to be erected as part of pipe length and will not be paid separately .

4. Pressure and temperature stubs for normal as well as performance measurement are not included in BOM and same as per contract drawing, performance measurement are to be erected as per requirement.

5. Material specification of fittings shall conform to pipe line material specification.
6. All fittings above 50 NB shall be butt welded end type as per ANSI B16.9 unless otherwise specified.
7. All fittings below 50 NB shall be socket welded end type as per ANSI B16.11 unless otherwise specified.
8. All BW fitting shall be edge prepared in shop. Thickness of fittings shall not be less than that of connecting pipes.
9. Counter flanges along with fasteners and Gaskets for Butterfly valves, Air release valves, Strainers, Expansion bellows etc., will be supplied. Hence included here.
10. All other piping not covered in this BOM but required for CW system shall also be erected under this contract and shall be paid on tonnage as per PG or shipping list.
11. All 90 deg mitres are 4 piece bends & 45 deg, 65 deg mitres are 3 piece bends.
12. Gaskets and fasteners shall be supplied along with the flanges that are mentioned in the BOM.
13. The piping materials specification are as follow:
 - a. Piping up to & including 350 NB shall be SS316 ERW
 - b. Piping 400 NB and above shall be carbon steel (IS:2062), rolled and welded confirming to IS:3589. And carbon steel cooling water pipes shall be line with PU (Polyurethane) coating internally as per AWWA C222.
 - c. Underground piping from CW Pump discharge to condenser & after condenser to seal pit shall be GRP pipe. The design of GRP pipe shall be as per AWAA M 45 / AWWA C950.
 - d. For drains & vents of sizes Nb 50 and below the thickness shall be minimum sch. 80. for sizes above Nb 50 thickness as per BHEL standard procedure.
14. Underground protection for the buried carbon steel pies:- wherever pipelines are buried, underground protection shall be provided with anti - corrosive tape of 4 mm thick conforming to IS-10221 and AWWA C 203-93. Pipe surfaces shall be cleaned by shot blasting before application. Tests to be carried out after application - (a) Bond/Adhesion test (b) Holiday test.

SECTION – VII APPENDIX - III

Tools & Plants

AA) The Following minimum Tools & Plants shall be arranged by the contractor for execution of this contract with in the quoted rate

S. No	Description	Qty
1	75 T Crawler Crane	02
2	18 T Crawler Crane	02
3	08 T Mobile Crane	02
4	Tractor trailer 20T & 30T	Each 1 no.

NOTE: FOR DRUM LIFTING ARRANGEMENT

Any additional arrangements/structures/civil foundations required to carry out the drum lifting shall be arranged by the contractor within the quoted rate.

- a. The contractor shall arrange all tools and plants including cranes / tractors / trailers / trucks etc at his own cost.
- b. The contractor has to furnish a list of Tools and plants including cranes / tractors / trailers / trucks etc which he has proposed to deploy for this work.
- c. The contractor shall arrange crane operator, diesel, petrol and other consumables required for the tools and plants, equipments etc. Preventive and routine maintenance of T & P are also to be arranged by the contractor at his cost without any delay.
- d. For transportation, loading & unloading of heavier components / equipments like boiler drum etc., the contractor has to make his own arrangements at his own cost. BHEL will not provide any crane / T & P's for unloading the above components.
- e. Copy of ownership of the above T&Ps or the Documents with respect to the tie-up in the form of a registered agreement with a resourceful party are to be enclosed along with offer.

BB) List of Tools & Plants to be made available by BHEL to contractor free of hire charges on sharing basis

S.No	Description	Qty
1	Higher capacity cranes above 75T	As decided by BHEL
2	75T Crawler Crane	2 Nos.
3	Hydraulic Pressure Testing Pump with accessories	Set as Required.
4	Chemical Cleaning Pumps with Motor	As required
5	Sky Climber	1 set
6	Passenger cum Goods Lift	1 no.
7	Boiler fill pump	1 no.
8	AIR BLOWER for air leak test	As required
9	Drum Lifting Winches 15T with Rope and multi	2 sets
10	sheave pulley blocks 200T/ 300T.	

NOTE: HEAVY LIFT CRANE WILL BE PROVIDED FOR CEILING GIRDER LIFTING AS WELL AS COLUMNS FROM 6TH TIER ONWARDS BY BHEL. THIS CRANE WILL BE RETAINED TILL TWO MONTHS AFTER DRUM LIFTING.

- 1) All the above T&Ps shall be given to contractor on sharable basis and the allotment is made by BHEL/Site in Charge, on need basis.
- 2) In case of non-availability of these equipments, due to any reason i.e., unavoidable breakdown, major overhaul or any other reason etc., the contractor should make arrangement at his own cost to meet the erection targets. No extra claim will be admitted due to non-availability of any of the above equipments. No delay in execution of work shall be accepted on this account.
- 3) The contractor shall arrange trained operators and fuel for 75T capacity BHEL cranes at his cost. For higher capacity cranes, BHEL will provide operator and contractor has to provide fuel for the operation of BHEL cranes.

- 4) For all the cranes, the contractor within the quoted rate shall provide fuel.
- 5) Cranes are only for erection purpose and shall not be available for material handling and for transportation purpose for which contractor shall make his own arrangement.
- 6) The day-to-day and routine maintenance for the BHEL T&Ps will be carried out by the contractor at his own cost. However, BHEL shall supply spare parts free of charges for normal wear and tear only.
- 7) Filling pump for hydro test will be provided by BHEL.
- 8) Any loss/damage of tools by the contractor shall have to be replaced or otherwise cost thereof shall be recovered from the contractor.
- 9) For movement crane for erection of material/equipment, the required consolidation and preparation for placing crane for operation (complete civil work with material) is covered in the scope of contract. The scope also includes raising the ground level, if required upto 0.5 Mtrs.
- 10) BHEL may provide either BHEL owned cranes or hired cranes at the discretion of BHEL. Bidder to note the following :-
In the event of providing BHEL Cranes :
For 75 T cranes - Operator and fuel has to be arranged by the bidder.

For higher capacity cranes, BHEL will provide Operator. Fuel has to be arranged by the bidder.

In the event of providing hired cranes:
Operator will be provided by BHEL through hiring agency free of charges for higher capacity cranes. Contractor has to provide operator for 75 T crane.
The fuel charges shall be recovered as given below :

For 75 T crane : Rs 120/hr
For 150 T/ 135 T crane : Rs 200 /hr
For Heavy duty crane : Rs 250 /hr
- 11) Cranes are for erection purpose and shall not be available for material handling and for transportation purpose for which contractor shall make his own arrangement.

- 12) The lubricant and filters for BHEL supplied cranes will be provided by BHEL free of cost.
- 13) The contractor has to erect (including civil works) Passenger cum goods lift as per the instruction of BHEL Engineer including transport of materials from BHEL stores. The dismantling of the erected lift, transport/handing over to BHEL stores is also covered in the scope of work. The contractor has to arrange operators, technicians round the clock operation and maintenance is to be carried out by the contractor at his cost. Spares will be arranged by BHEL.
- 14) TIG welding filler wires for CS,AS &SS welding will be provided by BHEL as per PGMA qty supplied by Mfg. units. Excess qty required if any, bidders to arrange with in his quoted rate. All other electrodes, gases, consumables etc.. is in the scope of the contractor .
- 15) **Apart from the above, any other tools and plants required for satisfactory completion of the work has to be arranged by the contractor.**

**SECTION – VII - APPENDIX – IV
FIELD WELDING SCHEDULE**

2x600MW NCTPS STAGE –II UNIT- BOILER

NOTE: The no. of welds given below is only a tentative quantity. The anticipated qty will be approximately 15% to 20% more. The approved EWS/ Drgs which will be released by Mfg. units will specify the actual qty of welds. The Bidder to consider this while quoting the rate.

A). CIRCULATING SYSTEM

SI No	Description	Material Specification	Sizes	No. of welds approx.
1	Down comer pipes	SA106 Gr.C	D368.0 x 36.0	42
2	Spool Pipe	SA106 Gr.C	D508.0 x 50.0	6
3	Discharge Line	SA106 Gr.C	D355.6 x 40.0	18
4	WW Upper Headers	SA106 Gr.C	D273.0 x 40.0	3
5	WW Upper Headers	SA106 Gr.C	D273.0 x 50.0	2
6	Suction Manifold	SA106 Gr.C	D609.6 x 60.0	1
7	Bottom Ring Header	SA299 / SA106 Gr.C	D914.4 x 85.0	4
8	Riser Tubes	SA106 Gr.C	D159.0 x 15.0	360
9	WW Panels	SA210 Gr.C	D51.0 x 5.6	7600
10	Screen Tubes Extd. Side Wall Tubes, Rear Arch Tube.	SA210 Gr.C	D63.5 x 7.1	900
11	Hanger Tubes	SA210 Gr.C	D63.5 x 12.0	96
12	Header Nipple	SA210 Gr.C	D63.5 x 8.8	1185

B). COILS

SI No	Description	Material Combination	Sizes	No. of welds approx.	
1	LTSH Coils	SA213 T11 + T11	D51.0 x 6.6	2600	
2	LTSH Coils	SA213 T11 + T11	D51.0 x 6.0	1800	
3	LTSH Coils	SA213 T11 + T11	D51.0 x 6.3	1000	
4	LTSH Coils	SA210 Gr.C + Gr.C	D51.0 x 6.3	1400	
5	SH Divisional Panellete Coils	SA213 T22 + T22	D51.0 x 7.6	200	
6	SH Divisional Panellete Coils	SA213 T22 + T22	D51.0 x 6.3	800	
7	SH Divisional Panellete Coils	SA213 T11 + T11	D51.0 x 5.0	800	
8	SH Platen	SA213 T22 + T22	D63.5 x 12.0	30	
9	SH Platen	SA213 T22 + T22	D63.5 x 6.3	30	
10	SH Platen	SA213 T22 + T22	D51.0 x 11.0	1000	
11	SH Platen	SA213 T22 + T22	D51.0 x 6.3	60	
12	RH Stage-I Coils	SA213 T11 + T11	D54.0 x 4.0	160	
13	RH Stage-I Coils	SA213 T11 + T11	D54.0 x 9.0	320	
14	RH Stage-I Coils	SA213 T91 + T91	D63.5 x 4.0	160	
15	RH Stage-I Coils	SA213 T91 + T91	D57.0 x 4.0	400	
16	RH Stage-II Coils	SA213 T22 + T22	D57.0 x 4.0	80	
17	RH Stage-II Coils	SA213 T22 + T22	D57.0 x 4.0	480	
18	RH Stage-II Coils	SA213 T91 + T91	D54.0 x 5.0	1120	
19	RH Coils Stage-I (Coil with Bifurcate)	SA213 T22 + T22	D63.5 x 4	1760	**
20	RH Coils Stage-II (Coil with Bifurcate)	SA213 T22 + T22	D63.5 x 5	1120	**
21	Eco Coils	SA210Gr.A1 + Gr.A1	D38.1 x 4.5	3600	
**These welding to be done in the ground as access will not available in position					

C). HEADERS & PANELS

SI No	Description	Material Combination	Sizes	No. of welds approx.
1	SH Sat. Pipes	SA106 Gr.C + Gr.C	D159.0 x 18.0	78
2	SH Rad. Roof Inlet Header	SA106 Gr.C + Gr.C	D273.0 x 50.0	1
3	SH Rad. Roof tubes	SA213 T11 + T11	D63.5 x 6.3	170
4	SH Rad. Roof tubes	SA213 T11 + T11	D57.0 x 6.0	340
5	SH Rad. Roof Outlet Header	SA106 Gr.C + Gr.C	D406.4 x 55.0	1
6	SH BP Side wall Headers	SA106 Gr.C + Gr.C	D368.0 x 48.0	2
7	SH BP Side wall Tubes front	SA 210Gr.C + Gr.C	D63.5 x 6.3	240
8	SH BP Side wall Tubes rear	SA210 Gr.C + Gr.C	D63.5 x 6.3	160
9	BP Side Headers	SA106 Gr.C + Gr.C	D406.4 x 60.0	2
10	BP Rear Headers	SA106 Gr.C + Gr.C	D323.9 x 50.0	3
11	BP Front Header	SA106 Gr.C + Gr.C	D406.4 x 60.0	1
12	BP Front Wall tubes	SA 210 Gr.C + Gr.C	D51.0 x 5.0	280
13	BP Hanger tubes	SA 210Gr.C + Gr.C	D51.0 x 6.3	280
14	BP Roof tubes	SA 210 Gr.C + Gr.C	D51.0 x 5.0	240
15	BP Eco. Support tubes	SA 210 Gr.C + Gr.C	D38.1 x 5.0	1200
16	BP Eco. Hanger tubes	SA 210 Gr.C + Gr.C	D44.5 x 7.1	1200
17	BP SH Inter Hanger Headers	SA106 Gr.C + Gr.C	D219.1 x 28.0	4
18	BP SH Hanger tubes	SA 210 Gr.C + Gr.C	D51.0 x 11.0	2000
19	BP Rear Wall Tubes upper	SA 210 Gr.C + Gr.C	D51.0 x 5.0	450
20	BP Rear Wall Tubes Lower	SA 210 Gr.C + Gr.C	D44.5 x 5.0	300
21	SH DESH Links	SA335 P12 + P12	D508.0 x 65.0	10
22	SH DESH Links	SA335 P12 + P12	D609.6 x 70.0/ D508.0 x 65.0	6
23	SH Platen Inlet Links	SA335 P12 + P12	D558.8 x 65.0	20

24	RH Links	SA335 P22 + P22	D711.2 x 45.0	14
25	RH Links	SA335 P22 + P22	D660.4 x 40.0	4
26	Eco. Feed Pipes	SA106 Gr.C + Gr.C	D508.0 x 50.0	3
27	Eco. Inlet Header	SA106 Gr.C + Gr.C	D558.8 x 70.0	1
28	Eco. Outlet Header	SA106 Gr.C + Gr.C	D457.2 x 65.0	1
29	Eco. Outlet Links	SA106 Gr.C + Gr.C	D368.0 x 40.0	6
30	Eco. Outlet Links	SA106 Gr.C + Gr.C	D323.9 x 36.0	10

D). SOOT BLOWER PIPING & FINE FITTINGS:

The no. of welds, HT & NDT requirements given here is approximate and for information purpose. Actual no. of Welds, HT, NDT will be as per EWS. Bidder to consider this while quoting the rate.

SL. NO	PG NO	DESCRIPTION	MATERIAL	SIZE – OD X THK. (MM)	QTY	NDT METHOD QUANTUM
130	24	Drum Stub Safety valve	SA 105 + SA 105	DIA158.8x41.3	2	100% RT+100%MPI /LPI
131	24	Drum Stub Safety valve	SA 105 + SA 105	DIA172.0x47.9	4	
132	24	CRH Stub Safety valve	SA 105 + SA216 WCB	DIA222.3x34.9	4	
133	24	HRH Stub Safety valve	SA182 F22 + SA217 WC6	DIA209.6x28.6	4	
134	24	MS Line Stub Safety valve	SA182 F22 + SA182 F22	DIA 172.0x47.9	2	
135	24	MS Line Stub Safety valve	SA182 F22 + SA217 WC9	DIA 139.7x38.1	5	
136	24	ERV ISOL. Valve ERV (1538VX)	SA217 WC9 + SA 182 F22	DIA 139.7x39.7	5	
137	24	HRH line Stub ERV ISOL. valve	SA182 F22 SA217 WC9	DIA 223.0x26.55	4	
138	24	Pipe + Pipe (or) BW Con. Red.	SA106GrB+ SA106GrB(OR) SA234WPB	DIA 33.4x3.38	10	
139	24	Pipe + Pipe (OR) BW Con. Red.	SA106GrB+ SA106GrB(OR) SA234WPB	DIA 48.3x3.68	30	

140	24	Pipe + Pipe (or) BW Con. Red.	SA106GrB+ SA106GrB(OR) SA234WPB	DIA 21.3x3.73	175	10% RT MIN.1WELD / WELDER / SHIFT
141	24	Pipe + Pipe (or) Pipe Reducer.	SA106GrB+ SA106GrB(OR) SA234WPB	DIA 33.4 x 6.35	200	
142	24	Pipe + Pipe (or) BW con.Red.	SA106GrB+ SA106GrB(OR) SA234WPB	DIA 48.3x7.14	125	
143	24	Pipe + Pipe (or) BW Con. Red.	SA106GrB+ SA106GrB(OR) SA234WPB	DIA 60.3 x3.91	25	
144	24	Pipe + Pipe (or) BW Con. Red.	SA106GrB+ SA106GrB(OR) SA234WPB	DIA 60.3x8.74	60	
145	24	BW EQ Tee + Connector	SA 234 WPB+ SA182F12CL.2	DIA 73.0 x 9.52	1	
146	24	Pipe + Pipe (or) tee	SA106 GrB+SA106GrB (OR)SA234WPB	DIA 73.0 x 9.52	450	
147	24	Pipe + Valve	SA106 GrB+ SA216 WCB	DIA 73.0 x 9.52	50	
148	24	Pipe + Pipe (or) Tee (OR) Reducer	SA106GrB+ SA106GrB(OR) SA234WPB	DIA 88.9 x 5.49	70	
149	24	Pipe + Valve	SA106 GrB+ SA216 WCB	DIA 88.9 x 5.49	8	
150	24	Pipe + Pipe	SA106 GrB+ SA106 WCB	DIA 88.9x11.13	100	
151	24	Pipe + Valve	SA106 GrB+ SA216 WCB	DIA 88.9 x 11.13	8	

152	24	Pipe + Pipe	SA106GrB+ SA106GrB	DIA 108 x 16	70	10% RT MIN.1WELD / WELDER / SHIFT
153	24	Pipe + Valve	SA106GrB+ SA216WCB	DIA 108 x 16	6	
154	24	Pipe + Pipe (or) Tee (or) End Cover	SA106GrB+ SA106GrB(OR) SA234WPB (OR)SA105	DIA 168.3x21.95	30	
155	24	Pipe + Valve	SA106GrB+ SA216WCB	DIA 168.3x21.95	10	
156	24	Pipe+Pipe (or) be. Con Red.	SA 335 P22+ SA335P22 (OR) SA234WP22CL	DIA 21.3x2.77	15	
157	24	Pipe+Pipe (or) be. Con Red.	SA 335 P22+ SA335P22 (OR) SA234WP22CL1	DIA 21.3x4.78	125	
158	24	Pipe+Pipe (or) Connector	SA 335 P22+ SA335P22 (OR) SA234WP22CL3	DIA 33.4 x 3.33	30	
159	24	Pipe+Pipe	SA213 T22+ SA213 T22	DIA 33.4 x 0.09	100	
160	24	Tube + Tube	SA335 P22+ SA335 P22	DIA47.63x10	25	
161	24	Pipe+Pipe	SA335 P22+ SA335 P22	DIA 48.3x3.68	40	
162	24	Pipe+Pipe	SA335 P22+ SA335 P22	DIA 48.3x7.14	220	
163	24	Pipe + Pipe	SA335 P22+ SA335 P22	DIA60.3x8.74	10	

164	24	Pipe + Valve (or) Valve (or) HDR. Nipple	SA335 P22+ SA335P22(OR) SA217 WC9(OR) SA182F22CL3	DIA 88.9x21.0	60	
165	24	Pipe + Pipe (or) Valve (or) Tee (or) Connector	SA335 P22+ SA335P22(OR) SA217 WC9(OR) SA182F22CL3	DIA 108x16.0	35	10%RT MIN.2 WELD / WELDER / SHIFT
166	24	Pipe + Pipe (or) Valve	SA335 P22+SA335P22 (or) SA217 WC9	DIA 127x12.5	35	
167	24	Tube + Tube	SA213TP304H+ SA213TP304H	DIA 31.8x5	7	
168	24	Valve(E1 Outlet) Valve (E2 Inlet)	SA216 WCB + SA 216 WCB	DIA 508.0x71	1	100%RT+100%MPI (OR) LPI
169	24	Elbow Down val. + Pump	SA216 WCB + SA106 GR.B	DIA 371.5x39.75	6	
170	24	Pipe (or) Reducer + Val+ VE (or) Tee	SA 106GrB(or) SA234WPB+ SA105	DIA 21.3x3.73	40	10%MPI (OR) LPI
171	24	Pipe (or) Reducer + Val+ VE (or) Tee	SA 106GrB(or) SA234WPB+ SA105	DIA 33.4x3.38	8	
172	24	Pipe (or) Reducer + Val+ VE (or) Tee	SA 106GrB(or) SA234WPB+ SA105	DIA 33.4x6.35	400	
173	24	Pipe (or) Reducer + Val+ VE (or) Tee	SA 106GrB(or) SA234WPB+ SA105	DIA 48.3x3.68	60	
174	24	Pipe (or) Reducer + Val + VE(or) Tee (or) Conn.	SA 106GrB(or) SA234WPB+ SA105	DIA 48.3x7.14	160	10%MPI (OR) LPI
175	24	Pipe (or) Reducer + Valve (or) Tee	SA106GrB(or) SA234WPB+ SA105	DIA 60.3x3.91	7	

176	24	Pipe (or) Reducer + Valve (or) Tee	SA106GrB(or) SA234WPB+ SA105	DIA 60.3x8.74	35	
177	24	Pipe (or) Reducer + Valve (or) Tee (or) Conn.	SA335P22(or) SA234WP22+ SA182F22	DIA 21.3x2.77	20	100%MPI (OR) LPI
178	24	Pipe (or) Reducer + Valve (or) Tee (or) Conn.	SA335P22(or) SA234WP22+ SA182F22	DIA 21.3x4.78	40	
179	24	Pipe (or) Reducer + Valve (or) Tee (or) Conn.	SA335P22(or) SA234WP22+ SA182F22	DIA 33.4x3.38	36	
180	24	Pipe (or) Reducer + Valve (or) Tee (or) Conn.	SA335P22(or) SA234WP22+ SA182F22	DIA 33.4x9.09	60	
181	24	Tee + Tube	SA182F22+ SA213 T11	DIA 47.63x7.1	-	
182	24	Tube + Valve	SA213 T22 + SA182F22	DIA 47.63x10	10	
183	24	Pipe + Valve (or) Tee	SA213 T22 + SA182F22	DIA 48.3x3.68	16	
184	24	Pipe + Valve (or) Tee	SA213 T22 + SA182F22	DIA 48.3x7.14	33	
185	24	Pipe + Conn.	SA335P22 + SA182F22CL3	DIA 60.3x8.74	2	
186	24	Conn. + Tube	SA182F12CL2+ SA213TP304H	DIA 14x2.9	1	100% LPI
187	24	Pipe + Orifice. Fitting Coupling	SA106 GrB+ SA182F12CL2	DIA 33.4x6.35	8	100%LPI (OR) LPI
188	24	Tube + Valve (or) Socket (or) Tee	SA213TP304H+ SA182F316 (or) SA182F304H	DIA 14x2.9	900	100%LPI

189	24	Tube + Valve	SA213TP304H+ SA182F22	DIA 31.8x5	6	100% LPI
190	24	Pipe + Pipe	SA335P22 + SA335P22	DIA 114.3x20	18	10%RT MIN.2 WELD/ WELDER / SHIFT
191	24	De. Nipple + Pipe	SA182F22CL3+ SA335P22	DIA 114.3x20	2	
192	24	Pipe + Conn.	SA335P22 + SA182F12CL2	DIA114.3x20	2	
193	24	Pipe + Conn.	SA106 GrC+ SA182F12CL2	DIA114.3x20	2	
194	24	Pipe + Pipe	SA106 GrC + SA106 GrC	DIA114.3x20	49	
195	24	Pipe + Valve	SA106 GrC+ SA216WCB	DIA 114.3x20	26	10%RT MIN. 2WELD / WELDER / SHIFT
196	24	Valve + Valve	SA216WCB + SA 216 WCB	DIA114.3x20	4	
197	24	Pipe + Valve	SA106 GrC + SA216 WCB	DIA219.1x36	1	100%RT + 100% MPI/ LPI
198	24	Tee + Reducer	SA234WPC + SA234 WPC	DIA219.1x36	1	100%RT + 100% MPI/ LPI
199	24	Pipe (or) Conn. + Tee (or) Valve	SA106GrB (or) SA105+ SA105	DIA 33.4 x 6.35	88	10%MPI/LPI
200	24	Pipe + Conn. (or) Valve	SA106 GrB + SA105	DIA21.3x4.78	72	
201	24	Pipe + Valve	SA335P22 + SA182F22	DIA 33.4 x 6.35	8	100% MPI / LPI
202	24	Pipe + Pipe	SA335P22 + SA335P22	DIA 33.4 x 6.35	10	10%RT MIN. 1 WELD / WELDER / IFT
203	24	Pipe + Pipe	SA106 GrB + SA106 GrB	DIA 33.4 x 6.35	20	

204	24	Pipe (or) Valve + Valve	SA106 GrB (or) SA216WCB + SA216WCB	DIA 73.0 x 9.53	32	
205	24	Pipe + Pipe	SA106GrB + SA106 GrB	DIA73.0x9.53	90	10% RT MIN. 1 WELD/ WELDER / SHIFT
206	24	Pipe + Valve	SA106 GrB + SA216WCB	DIA 88.9x11.13	1	
207	24	Pipe + Flange	SA106 GrB + SA515GR70	DIA 48.3x3.68	20	10% MPI (OR) LPI
208	24	Reducer + Flange	SA 234 WPB + SA515GR70	DIA 73.0x9.53	24	
209	24	Pipe + Flange	SA106 GrB + SA515GR70	DIA 88.9x5.49	8	
210	24	Pipe + Flange	SA106 GrB + SA515GR70	DIA 60.3x3.91	4	
211	24	Pipe + ELL	SA 106 Gr.B + SA 234 WPB	DIA 168.3 x 7.11	12	100% RT. Min 1 Weld/ Welder Shift
212	24	Pipe + ELL	SA 106 Gr.B + SA 234 WPB	DIA 273.0 x 6.35	8	100% RT. Min 1 Weld/ Welder Shift
213	24	Pipe + ELL	SA 335 P.22 + SA 234 WP22	DIA 168.3 x 7.11	8	100% RT. Min 1 Weld/ Welder Shift
214	24	Pipe + ELL	SA 335 P.22 + SA 234 WP22	DIA 219.1 x 10	8	100% RT. Min 1 Weld/ Welder Shift
215	24	Pipe + Flange	SA 106 Gr.B + SA 515 Gr.70	DIA 168.3 x 7.11	6.4 M	100% MPI (Off) LPI
216	24	Pipe + Flange	SA 106 Gr.B + SA 515 Gr.70	DIA273.0 x 6.35	6.9 M	100% MPI (Off) LPI
217	24	Pipe + Flange	SA 335 P.22 + SA 387 GR22	DIA 168.3 x 7.11	2.1 M	100% MPI (Off) LPI
218	24	Pipe + Flange	SA 335 P.22 + SA 387 GR22	DIA 219.1 x 10	11.0 M	100% MPI (Off) LPI

219	24	Pipe + Flange	SA 335 P.22 + SA 387 GR22	DIA 114.3 x 6.02	3.6 M	100% MPI (Off) LPI
220	24	Pipe + Drippan	SA 106GrB + IS2FE410A	-	6.6 M	100% MPI (Off) LPI
221	24	Pipe + Drippan	SA 335 P22 + IS2062FE410A	-	8.36 M	100% MPI (Off) LPI
222	24	Pipe + ELL (or) Socket	SA 106GrB + SA 105	DIA 48.3 x 3.68	48	100% MPI (or) LPI
223	24	Pipe + Pipe (Or) Socket (Or) ELL	SA 106Gr.B + SA 106Gr.B (or) SA 105(or) WPB	DIA 73.0 x 7.01	38	100% MPI (or) LPI
224	24	Pipe + ELL (or) Socket	SA 335 P22 + SA 182F22	DIA 21.3 x 4.78	28	100% MPI (or) LPI
225	24	Pipe + ELL (or) Socket	SA 335 P22 + SA 182F22	DIA 48.3 x 3.68	20	100% MPI (or) LPI
226	24	Pipe + ELL (or) Socket	SA 335 P 22 + SA234WP22 (or) SA 182F22	DIA 76.1 x 6.3	40	100% MPI (or) LPI
227	24	Tube + Socket	ISI239 + SA 105	DIA 27.3 x 2.65	10	10% MPI (or) LPI
228	24	Tube + Socket	ISI239 + SA 182F22	DIA 27.3 x 2.65	22	10% MPI (or) LPI
229	24	Pipe + Socket (or) ELL	SA 335 P22 + SA 182F22	DIA 33.4 x 3.38	4	10% MPI (or) LPI
230	24	Tube + Tube	IS 1239 + IS 1239	DIA27.2 x 2.65 DIA34.2 x 3.25	24	10% MPI (or) LPI
231	24	Tube + Tube	IS 1239 + IS 1239	DIA 34.2 x 3.25 DIA113.9 x 3.65	24	100% MPI (Off) LPI
232	24	Tube + Tube	IS 1239 + IS 1239	DIA 34.2 x 3.25	40	100% MPI (Off) LPI
233	24	Tube + Tube	AP15LGRB+	-	50 M	100% MPI

			IS2062FE410A			(Off) LPI	
234	24	Pipe + Pipe	AP15LGRB + AP15LGRB	6.35	100 M	100% MPI (Off) LPI	
235	21	Pipe Reducer + Condensing Loop (or) Pipe	SA234WP22CL1+ SA335P22(OR) SA335 P22	DIA 21.3 (1/2') X 4.78 (SCH160)	2	10% RT MIN.1 WELD/WELDER	
236	21	Pipe + Pipe (or) Welded Tee	SA335 P22 + SA335 P22	DIA 33.4 (1") X 6.35 (SCH 160)	2		
237	21	Pipe + Pipe (or) Welded Tee	SA335 P22 + SA 335 P22 (OR) SA217WC9 (OR) SA234WP22CL1	DIA 108 X 16	16		
238	21	Pipe + PRV	SA335 P12+SA217 WC9	DIA 108 X 8	2		
239	21	Pipe Reducer + Condensing Loop	SA234 WPB + SA 106 Gr.B	DIA 21.3(1/2') X 2.77 (SCH40)	10		
240	21	Pipe + Pipe (or) Pipe Reducer (or) Orifice Pl. Assembly	SA106Gr.B+ SA106Gr.B (OR) SA234 WPB	DIA 33.4 (1") X 6.35 (SCH 160)	70		
241	21	Pipe + Pipe (or) Bend (or) Pipe Reducer	SA106 GrB+ SA106Gr.B+(OR) SA234 WPB	DIA 60.3(2") x 3.91 (SCH40)	725		
242	21	Pipe + Pipe	SA335 P22 + SA106 GrB	DIA 108 X 8	2		
243	21	Pipe + PRV	SA335 P22 + SA217 WC9	DIA 60.3(2") x 8.74 (SCH106)	2		
244	21	Pipe + Pipe	SA213T 11+ SA106 GrB	DIA 60.3(2") x 3.91 (SCH40)	2		
245	21	Pipe + Pipe (or) Bend	SA335 P22 + SA335 P22	DIA 60.3 (2") x 8.74 (SCH160)	4		10% RT MIN.1 WELD / WELDER
246	21	Pipe + Pipe	SA213 TEE 11 + SA 217 WC9	DIA 60.3 x 4	2		100% MPI (OR) LPI

247	21	Pipe + Valve (or) Tee	SA335 P22 + SA182 F22 CL.3 (OR) SA182 f 22 CL.3	DIA 60.3 (2") x 8.74 (SCH 160)	7	100% MPI (OR) LPI
248	21	Pipe + Pipe (or) Pipe Reducer	SA106 GrB (or) SA234 WPB (OR) SA234 WPB	DIA 88.9 (3') x 5.49 (SCH 40)	30	10% RT MIN.1 WELD / WELDER
249	21	Tee + S.V.Flange	SA 105 + SA 105	DIA 88.9 x 12.7	1	
250	21	Pipe + Pipe Or pipe Reducer (or) Tee (or) Valve	SA106 GrB + SA 106 GrB (OR) SA234WPB SA216WCB	DIA 108 x 8.0	52	
251	21	Valve + Pipe (or) Pipe Reducer	SA 182 F22 CL.3 + SA335 P22 (OR) SA234 WP 22 CL1	DIA 33.4 (1') X 6.35 (SCH160)	4	100% MPI (OR) LPI
252	21	Pipe (or) Reducer Tee (or) Valve	SA 106 GrB (OR) SA234 WPB + SA 105	DIA 33.4 (1") x 3.38 (SCH 40)	145	10% RT MIN.1 WELD / WELDER
253	21	AHB. Inlet + Pipe Reducer	SA 105 + SA 234 WPB	DIA 48.3 (1 1/2') x 3.68 (SCH40)	4	
254	21	Pipe + Tee (or) Valve (or) The RMO Couple Assy (or) Thermowel Assy. (or) LRSBINLET (or) WBINLET (or) ELL	SA 106 GrB + SA 234 WPB (or) SA 06 GrB (or) SA105 (or) SA 105	DIA 60.3 (2') X 3.91 (SCH 40)	750	10% RT MIN. 1 WELD / WELDER
255	21	Pipe + Pipe	ISI239 + SA 106 GrB	DIA 21.3 (1/2') x 2.77 (SCH40)	4	

**Section VII – APPENDIX V
DETAILS OF ELECTRODES
(To be provided by Bidder)**

SNo	Type of Electrodes	General Sizes in mm	Specification/Brand/Vendor Name of Electrode
1	E6013	2.50, 3.15 & 4.00	As per Approved Vendors of Welding Electrodes for Sites issued by BHEL-PSSR, Chennai, which will be updated periodically. Bidder to use the same only.
2	E 6013 IBR	2.50, 3.15 & 4.00	
3	E 7016	2.50,3.15 & 4.00	
4	E 7018	2.50, 3.15 & 4.00	
5	E 7018 IBR	2.50, 3.15 & 4.00	
6	E 7018 A1	2.50, 3.15 & 4.00	
7	E 7013 A1	2.50	
8	E 8018 B2	2.50, 3.15 & 4.00	
9	E 9018 B3	2.50, 3.15 & 4.00	
10	E 310	2.50, 3.15 & 4.00	
11	E 347	2.50	
12	E 308	2.50 & 3.15	
13	E 309	2.50, 3.15	
14	E 9013 B3	2.50, 3.15 & 4.00	

NOTE:

- i. The specifications are subject to variation depending upon the site conditions. This should not be taken as final.
- ii. If any other type and size of electrodes not specified above, but considered suitable by BHEL Engineer for erection work, the contractor shall purchase at his cost and use the same as per BHEL's instructions.

iii. Use of 6013 Electrodes:

It is to be noted by the tenderer that E 6013 electrodes are not to be used in pressure parts, columns, ducts and other works. Unless otherwise specified in the drawing. All welding has to be done as specified in the detailed drawing using E 7018, E 8018, and E 9018 electrodes as the case may be. This shall be taken into account while quoting.

SECTION VII APPENDIX – VI

SUGGESTIVE PAINTING SCHEDULE

NCTPS 2 X 600 MW, Unit –

1.0 SCOPE

- 1.1 This section covers the painting requirements for the power plant equipment, structures, piping etc. and any other surface required to be painted.

2.0 CODES AND STANDARDS

Painting of equipment shall be carried out as per the specifications indicated below and shall conform to the relevant IS specification for the material and workmanship.

The following Indian Standards may be referred to for carrying out the painting job:

IS: 5	: Colours for ready mixed paints and enamels
IS:1303	: Glossary of terms relating to paints
IS:2379	: Colour code for identification of pipelines
IS:1477	: Code of practice for painting of ferrous metals in buildings (Parts I & II)
IS:2524	: Code of practice for painting of non-ferrous metals in buildings (Parts I & II)
IS:2395	: Code of practice for painting of concrete, masonry and plaster surfaces (Parts I & II)
IS:2338	: Code of practice for finishing of wood and wood based materials (Parts I & II)
IS: 6278	: Code of practice for white washing and colour Washing
IS: 3140	:Code of practice for painting asbestos cement building Products
IS: 158	: Ready mixed paint, brushing, bituminous, black, leadfree, acid, alkali, water and heat resisting
IS: 2074	:Ready mixed paint, air drying, red Oxide Zinc Chrome, priming
IS:104	: Ready mixed paint, brushing, Zinc Chrome, priming

IS: 2932 : Enamel, synthetic, exterior (a) undercoating (b) finishing

3.0 PREPARTION OF SURFACES

All surfaces to be painted shall be thoroughly cleaned of all grease, oil, loose mill scale, dust, rust and any other foreign matter. Mechanical cleaning by power tool and scrapping with steel wire brushes shall be adopted to clear the surfaces. However, in certain locations where power tool cleaning cannot be carried out, sand scrapping may be permitted with steel wire brushes and/or abrasive paper. Cleaning with solvents shall be resorted to only in such areas where other methods specified above have not achieved the desired results. Cleaning with solvents shall be adopted only after written approval of the OWNER / OWNER REPRESENTATIVE.

4.0 PRIMER PAINT

After the surface is prepared, one coat of Zinc Phosphate primer conforming to IS: 2074 shall be applied. After this first coat is dried up completely, second coat of red oxide primer shall be applied. Primer shall be applied by brushing to ensure a continuous film without 'holidays'. The dry film thickness of each coat shall be minimum 30 microns and as per painting schedule.

5.0 FINISH PAINT

Synthetic enamel paint conforming to IS:2932 shall be used for finish coats. The colour/shade shall be as approved by the OWNER. After cleaning the dust on the dried up primer, first coat of synthetic enamel shall be applied. After this first coat dries up hard, the surface is wet scrubbed cutting down to a smooth finish and ensuring that at no place the first coat is completely removed. After allowing the water to get evaporated completely, the second finish coat of synthetic enamel paint or as per paint schedule shall be applied.

6 PS1A 1	Components < 95° C Insulated / uninsulated (other than structural items) 07-500,601;21-601,987 24-301,325,335,340,350,374, 987,989 30-215;35-995;36-613,740;37-010 39-301,302;41-350,390 42-002,005,010,065; 42-070,120,128,150,152,154,157,158 43-004,005; 45-321,325,326; 47-286.287,288,289 48-012, 014, 022,032, 112,114,132,142, 48-144,152,65-736, 67-204,272,276, 283,801,802,803	SSPC-SP3/ Power Tool Cleaning	Red Oxide Zinc phosphate Primer (Alkyd Base) to IS 12744 DFT= 30µm per coat	2	--	--	Syn. Enamel paint (Long Oil Alkyd) to IS 2932 DFT= 20µm per coat	2	Smoke Grey Shade No: 692 of IS5	80
8 PS15	For CLH & VLH PGs 07,08,12,17,19,21,24,47,48 &80 07-402,403,404,405,420,431 17-904,919,929 19-905,906,907 24-351	Abrasive blast cleaning to Sa 2 ½ 35- 50 microns	Epoxy zinc rich primer To IS 14589 Gr.II %VS=35, DFT=40 µ/ coat	1	--	--	Aliphatic acrylic Poly- urethane paint DFT=30.0 µ/ coat	1	Phirozi Blue Shade No. 176 of IS5	70
9 PS 9/10	Components >95° C uninsulated other than components coming in gas path 09-001,002,003; 21-800,850 24-320,360,373,380,385 28-220; 42-300,358	SSPC-SP3/ Power Tool Cleaning	Heat Resistant Aluminium Paint to IS 13183 Gr.II/I DFT 20 µm per coat	2	--	--	--	--	--	40
	Supporting structure of ESP AND Hopper approach platform (other than floor grills, step treads, hand rails), stringer for staircase & guard plates, frames/ brackets for galleries, walkways and staircase.	Blast cleaning to SA2 ½ (Near white metal) with surface profile 35-50 µm	Inorganic Ethyl Zinc Silicate Primer aas per IS-14946 (soild by volume min. 60%) DFT=75µm min.	1	Epoxy Based TiO2 Pigmented (soild by volume min. 60%) Intermed -iate Coat DFT=75µm min.	1	#Epoxy based polyamide cured finish paint as per IS-14209 (soild by volume min. 60%) DFT=75µm min. +Aliphatic Polyurethane paint as per IS-13213 (soild by volume min. 40%) DFT=30µm	2 1	Smoke Grey Shade No: 692 of IS5	250 µm min.

9 PS6	Floor Grills, Step treads ,Hand rails and posts, ladders / rungs 35 – @ 811,821,822, @823,851 36 – @811 to 814,820,851,852,853 38 – @810,820,850 39 – @810,820,850	a) Hot dip Galvanizing to a coating weight of 610 gm per sq.m (minimum) and to a coating thickness of 85.0 microns (minimum). Refer Notes given below **
	Supporting structure of ESP AND Hopper approach platform (other than floor grills, step treads, hand rails), stringer for staircase & guard plates, frames/ brackets for galleries, walkways and staircase.	b)

Notes :

** The Guard plates, channels for stairs and Stringer channels shall be painted as per painting scheme prescribed in Sl. No: 03.

Second coat of Epoxy finish and one coat of aliphatic Polyurethane paint shall be applied at site.

PAINTING SCHEME FOR VALVES

11 1AS2	Soot Blower components 20- 051,054,201,204,511,794,96 2	SSPC-SP3/ Power Tool Cleaning	Red Oxide Zinc phosphate Primer (Alkyd Base) to IS 12744 DFT= 30µm per coat	2	--	--	Syn. Enamel paint (Long Oil Alkyd) to IS 2932 DFT= 20µm per coat	2	Verdigris Green Shade No. 280 of IS5	80
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NOTES:

1. Ground shade/colour of Finish paints & identification tag/Band for equipments, pipings pipe service, boiler supporting structures and other boiler components shall be followed as per agreed tender resolution

2. PGMA's under Sub-Vendor items are not indicated. For all bought-out and sub-vendors items including PGMA's mentioned above falling under the scope of BHEL the same scheme as for main equipment as covered in this document shall be followed.
3. These Painting Schemes are valid for only Customer No: 1600-North Chennai TPS
4. No painting is required for Stainless Steel, non-ferrous & galvanized components.
5. Wherever inside surfaces of components under PGMA 48 – XXX, need protection till erection, two coats of Red-oxide zinc phosphate primer paint to IS12744 to a DFT of 60 microns shall be applied, after power tool cleaning.
6. The Temporary Rust Preventive coating that already been applied on any components, tubes, pipes etc., shall be removed by suitable solvents / heating to 350 –400 °C for an hour before primer paint application –but, in this case, it should be ensured that the minimum surface cleanliness required for primer paint application shall be SSPC – SP2 (equivalent – Hand Tool cleaning).
7. In components, wherever plates / sheets of thickness less than or equal to 5 mm and rods/tubes/drain water pipes are used, power tool / hand tool cleaning to SSPC – SP3 / SP2 shall be followed and the painting shall be done as described in Scheme No: 06.
8. For all commissioning components-erection materials (xx-993) one coat of Red oxide Zinc Phosphate Primer shall be applied to meet the temporary protection till erection, after power tool cleaning.
9. Touch-up painting of damaged areas shall be carried out as per agreed clause of tender.
10. All components covered under different PGMA's are to be painted In case any component is left out, the same shall be deemed to be included under the relevant section based on paint logic approved.
11. For very small components like clamps etc. scheme no.6 shall be followed.
12. For very small components with weldable primer at edges, the entire component shall be applied with weldable primer.

Painting Scheme – Details for procurement & application purposes

Sl.No.	Generic nature of paint	Theoretical Covering Capacity Sq.m per Litre.	No. of pack	Volume solids, % (min)**	DFT in microns (min) per coat	Shade	Shade No. to IS5	Mode of appln.	Over coating interval, Hrs.
1	Inorganic ethyl zinc silicate to IS 14946 –Main Coat	8	2	60	75	Grey	--	Spray only	16
2	Poly amide cured Epoxy based Tio2/MIO pigmented intermediate coat	6	2	60	100	Grey / Brown	--	## Spray	24
3	Epoxy based polyamide cured finish paint to IS 14209	10	2	40	40	Smoke Grey	692	Spray	24

4	Aliphatic acrylic polyurethane paint to IS 13213	10	2	40	30	Grey Phirozi – Blue.	RAL 9002 176	Spray Spray	24 24
5	Heat resistant aluminium paint to IS 13183 Grade I	10	1	-	-	-	--	Brush / Spray	24
6	Red oxide zinc phosphate primer paint to IS 12744	10	1	--	--	-	--	Brush / Spray	12
7	Red oxide Zinc Phosphate Dip coat primer paint to PR: CHEM: 09-03	10	1	--	--	-	---	Dip	12
8	Long oil alkyd synthetic enamel finish paint to IS2932	10	1	--	--	Reqd. shade	Corrpdg. Shade no.	Brush / Spray	12
9	Temporary Rust preventive fluid to PR: CHE: 09 – 04	10	1	--	--	-	--	--	12
10	Epoxy Zinc rich primer to IS14589 Gr.II	8	2	35	40	Grey	--	Spray	24

Brush painting is accepted, if recommended by the Paint suppliers. The covering capacity of paints specified is only approximate. The paints and Rust Preventive fluid shall be procured from BHEL's approved suppliers. ** Values are indicative.

Painting of Damaged Areas

(Areas where the paint has deteriorated badly by erosion and areas where the paint film has lost its adhesion and where the steel has rusted appreciably, should be repainted as follows)

Sl.No.	Components	Surface Prepa- ration	Primer coat		Intermediate coat		Finish coat			Total DFT µm (min)
			Paint	No. of coats	Paint	No. of coats	Paint	No. of coats	Shade	
1	Paint damaged components fall under Sl.no: 3	Power tool cleaning to bare metal	Epoxy zinc rich primer to IS 14589 Grade II to a DFT of 40 mic/coat	1	As given in scheme	1	As given in scheme	3	As given in scheme	250
2	Paint damaged components fall under Sl.no: 8	Power tool cleaning to bare metal	One coat of Epoxy zinc rich primer to IS 14589 Grade II to a DFT of 40 microns	1	--	--	As given in scheme	1	As given in scheme	70

3	Paint damaged components fall under Sl.no: 1,2,4,5,6,7,9,10,11.	Power tool cleaning to bare metal	As given in scheme	As given in scheme	--	--	As given in scheme	As given in scheme	As given in scheme	As given in scheme
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SECTION VII

APPENDIX - VII

ERECTION OF BOILER STRUCTURES AND POINTS TO BE TAKEN CARE OF FOR ACHIEVING VERTICALITY OF BOILER COLUMNS.

The column pieces are to be pre-assembled at site and match marks are to be provided:

- 1 Pre-assembly checks to detect and deviations in the columns like length, camber sweep, twist etc.
- 2 Checking of the foundations for its levels, distance, diagonal distance etc.
- 3 Proper tightening of the foundation bolts
- 4 Erection of columns tier by tier and box by box. Grouting to be done immediately after first tier erection.
- 5 Ensuring the availability of adequate guy ropes, pulllifts etc., during column erection and the removal of guy ropes to be done only after tie-up of the columns with adjacent columns after ensuring their verticality.
- 6 Using a calibrated theodolite for verticality measurement of the columns and cross checking these readings with plumb bob at random.
- 7 Tightening of the HSFG bolts to be done by turnoff nut method only. This should be done only in position after ensuring the verticality of the columns.
- 8 Measuring the adjacent diagonals of the ceiling girders after its erection.

v) Ensuring the verticality of the columns before and after drum lifting.

The above will enable to achieve verticality of columns which, intern, will enable to achieve correct furnace dimensions as well as second pass dimensions

SECTION VII

APPENDIX – VIII

DECLARATION SHEET

I, _____ hereby certify that, all the information and data furnished by me with regard to this TenderSpecification No: BHEL: PSSR: SCT: 1331 are true and complete to the best of my knowledge. I have gone through the specifications, conditions, stipulations in detail and agree to comply which the requirements and intent specifications.

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

TENDERER'S NAME & ADDRESS

AUTHORISED REPRESENTATIVE'S
SIGNATURE WITH NAME &
ADDRESS

SECTION VII

APPENDIX – IX

TENDER SPECIFICATION NO BHEL: PSSR: SCT: 1331

**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
690, Anna Salai, Nandanam, Chennai – 600 035.

SECTION VII
APPENDIX - X
CHECK LIST

TENDER SPECTFICATION NO, BHEL: PSSR: SCT: 1331

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
5. Whether the following details are furnished : YES/NO
 - a) Previous Experience : YES/NO
 - b) Present assignments : YES/NO

SIGNATURE OF THE TENDERER

- c) organization chart of the company : YES/NO
- d) Company financial status : YES/NO
- e) Incase of company, proof of Registration of the company : YES/NO
- f) Memorandum & Articles of Association of company/copy of Partnership deed : YES/NO
- g) Profit & Loss account for the Last 3 years : YES/NO
- h) Audited Balance sheet for the Last 3 years : YES/NO
- i) Income Tax clearance certificate (latest) : YES/NO
- j) Solvency Certificate from a Nationalised Bank : YES/NO
- k) Power of Attorney of the person Signing the tender duly attested By a Notary Public : YES/NO
- l) Manpower organization chart With deployment plan at site For posting of Engineers/super Visitors and workers/labourers For satisfactory completion of Work under this specification : YES/NO
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

SIGNATURE OF THE TENDERER

8. Whether the Declaration sheet (as per appendix) enclosed : YES/NO
9. Time required for mobilization 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 : YES/NO
13. Whether PF exemption No. is allotted by RPFC of your area if so, indicate number : YES/NO

SIGNATURE OF THE TENDERER

GUIDELINES FOR

WELDING, NDE

AND

HEAT TREATMENT

THIS BOOKLET IS GIVEN AS A GENERAL GUIDELINE TO THE TENDERERS ABOUT WELDING, NDE & HT FOR THE PIPING SYSTEMS, HOWEVER INSTRUCTIONS GIVEN IN THE DRAWINGS & WELDING SCHEDULE ISSUED DURING EXECUTION OF THE WORK SHALL BE FINAL AND BINDING OF THE CONTRACTOR.

BHEL PSSR SCT :

BOOK NO :



BHARAT HEAVY ELECTRICALS LIMITED

(A Government of India Undertaking)

Power Sector – Southern Region

690, Anna Salai, Nandanam, Chennai – 600 035.

BASE MATERIALS

- 1.0 Scope:
- 1.1 This chapter contains tabulations of chemical compositions & mechanical properties of various materials generally used in BHEL sites.
- 2.0 Contents:
 - Table 1 - Pipes (ASME)
 - Table 2 - Tubes (ASME)
 - Table 3 - Forgings (ASME)
 - Table 4 - Castings (ASME)
 - Table 5 - Plates / Sheets (ASME)
 - Table 6 - Pipes (Other specifications)
 - Table 7 - Tubes (Other specifications)
 - Table 8 - Forgings (Other specifications)
 - Table 9 - Barstock
- 3.0 The data are for general information purposes. The corresponding P Numbers are also indicated.
- 4.0 For materials not covered in this chapter, the supplier shall be contacted.

CHEMICAL COMPOSITION AND MECHANICAL PROPERTIES

Table - 1 Pipes

Sl. No	P.NO / Group No.	Material Specification (ASME)	Chemical Composition (%)								Mech. Properties (Min.)		
			C	Mn	P	S	Si	Ni	Cr	Mo	T.S. kg/mm ²	Y.S. kg/mm ²	%E Min
1	P 1/1	SA 106 Gr.B (Remarks: Carbon restricted to 0.25% Max.)	0.30 Max.	0.29- 1.06	0.048 Max.	0.058 Max.	0.10 Max	-	-	-	42	25	30
2	P 1/1	SA 672 Gr.B, Cl.22 Max	0.24 Max.	0.9 Max.	0.035 Max.	0.04 Max.	0.15- 0.30	-	-	N 0.009 Max.	42.2- 50.6	22.5	25
3	P 1/2	SA 106 Gr.C	0.35 Max.	0.29- 1.06	0.048 Max.	0.058 Max.	0.10 Max	-	-	-	49	28	30
4	P 4/1	SA 335 P 11	0.15 Max.	0.3- 0.6	0.03 Max.	0.03 Max.	0.5 Max.	-	1.0- 1.5	0.44- 0.65	42	21	30
5	P 4/1	SA 335 P 12	0.15 Max.	0.3- 0.60	0.045 Max.	0.045 Max.	0.5 Max.	-	0.8- 1.25	0.44- 0.65	42	21	30
6	P 5/1	SA 335 P 22	0.15 Max.	0.3- 0.61	0.03 Max.	0.03 Max.	0.5 Max.	-	1.9- 2.6	0.87- 1.13	42	21	30
7	P 8/1	SA 376 TP 321H (Titanium Stabilised)	0.04- 0.10	2.0 Max	0.04 Max.	0.03 Max.	0.75 Max.	9.0- 13.0	17.0- 20.0	-	53	21	35
8	P 8/1	SA 376 TP 304H	0.04- 0.10	2.0 Max	0.04 Max.	0.03 Max.	0.75 Max.	8.0- 11.0	18.0- 20.0	-	53	21	35
9	P 8/1	SA 376 TP 316H	0.04- 0.10	2.0 Max	0.04 Max.	0.03 Max.	0.75 Max.	11.0- 14.0	16.0- 18.0	-	53	21	35
10	P 8/1	SA 376 TP 347H (Cb+Ta Stabilised)	0.04- 0.10	2.0 Max	0.04 Max.	0.03 Max.	0.75 Max.	9.0- 13.0	17.0- 20.0	-	53	21	35

CHEMICAL COMPOSITION AND MECHANICAL PROPERTIES

Table – 2 Tubes

Sl. No	P.NO / Group No.	Material Specification (ASME)	Chemical Composition (%)								Mech. Properties (Min.)		
			C	Mn	P	S	Si	Ni	Cr	Mo	T.S. kg/mm ²	Y.S. kg/mm ²	%E Min
1	P 1/1	SA 192	0.06-0.18	0.27-0.63	0.048 Max.	0.053 Max.	0.25 Max.	-	-	-	33	18	35
2	P 1/1	SA 210 Gr A1	0.27-0.18	0.93 Max	0.048 Max.	0.058 Max.	0.10 Max.	-	-	-	42	26	30
3	P 1/1	SA 179	0.062-0.18 Max.	0.27-0.63	0.048 Max.	0.058 Max.	-	-	-	-	-	-	-
4	P 1/2	SA 210 Gr. C	0.35 Max.	0.29-1.06	0.048 Max.	0.058 Max.	0.10 Max	-	-	-	49	28	30
5	P 1/2	SA 556 Gr C2	0.3 Max.	0.29 Max.	0.048 Max.	0.048 Max.	0.10 Max	-	-	-	49	28	25
6	P 3/1	SA 209 T1	0.10-0.20	0.3-0.8	0.045 Max.	0.045 Max.	0.10-0.50	-	-	0.44-0.65	39	21	30
7	P 3/1	SA 209 T1a	0.05-0.25	0.3-0.8	0.045 Max.	0.045 Max.	0.10-0.50	-	-	0.44-0.65	42	22.4	30
8	P 3/1	SA 209 T1b	0.14 Max.	0.3-0.8	0.045 Max.	0.045 Max.	0.10-0.50	-	-	0.44-0.65	37	20	30
9	P 4/1	SA 213 T11	0.15 Max.	0.30-0.60	0.03 Max.	0.03 Max.	0.5-1.0	-	1.0-1.5	0.44-0.65	42	21	30
10	P 4/1	SA 213 T12	0.15 Max.	0.30-0.61	0.045 Max.	0.045 Max.	0.5 Max.	-	0.8-1.25	0.44-0.65	42	21	30

CHEMICAL COMPOSITION AND MECHANICAL PROPERTIES

Table – 2 Tubes (Contd..)

Sl. No	P.NO / Group No.	Material Specification (ASME)	Chemical Composition (%)								Mech. Properties (Min.)		
			C	Mn	P	S	Si	Ni	Cr	Mo	T.S. kg/mm ²	Y.S. kg/mm ²	%E Min
11	P 5/1	SA 213 T22	0.15 Max.	0.30-0.60	0.03 Max.	0.03 Max.	0.50 Max.	-	1.9-2.60	0.87-1.13	42	21	30
12	P 5/1	SA 213 T5	0.15 Max.	0.30-0.60	0.030 Max.	0.03 Max.	0.50 Max.	-	4.0-6.0	0.45-0.65	42	21	30
13	P 5/2	SA 213 T9	0.15 Max.	0.30-0.60	0.03 Max.	0.03 Max.	0.25-1.00	-	8.0-10.0	0.9-1.10	42	21	30
14	P 8/1	SA 213 TP 321H (Ti Stabilised)	0.04-0.10	2.0 Max.	0.04 Max.	0.03 Max.	0.75 Max.	9.0-13.0	17.0-20.0	-	53	21	35
15	P 8/1	SA 213 TP 304 H	0.04-0.10	2.0 Max.	0.04 Max.	0.03 Max.	0.75 Max.	8.0-11.0	18.0-20.0	-	53	21	35
16	P 8/1	SA 213 TP 304	0.08 Max.	2.0 Max.	0.04 Max.	0.03 Max.	0.75 Max.	8.0-11.0	18.0-20.0	-	53	21	35
17	P 8/1	SA 249 TP 304	0.08 Max.	2.0 Max.	0.04 Max.	0.03 Max.	0.75 Max.	8.0-11.0	18.0-20.0	-	53	21	35
18	P 8/1	SA 688 TP 304	0.08 Max.	2.0 Max.	0.04 Max.	0.03 Max.	0.75 Max.	8.0-11.0	18.0-20.0	-	53	21	35
19	P 8/1	SA 213 TP 316 H	0.04-0.10	2.0 Max.	0.04 Max.	0.03 Max.	0.75 Max.	11.0-14.0	16.0-18.0	2.0-3.0	53	21	35
20	P 8/1	SA 213 TP 347 H (Cb+Ta Stabilised)	0.04-0.10	2.0 Max.	0.04 Max.	0.03 Max.	0.75 Max.	9.0-13.0	17.0-20.0	-	53	21	35

CHEMICAL COMPOSITION AND MECHANICAL PROPERTIES

Table – 3 Forgings

Sl. No	P.NO / Group No.	Material Specification (ASME)	Chemical Composition (%)								Mech. Properties (Min.)		
			C	Mn	P	S	Si	Ni	Cr	Mo	T.S. kg/mm ²	Y.S. kg/mm ²	%E Min
1	P 1/2	SA 105	0.35 Max	0.6- 1.05	0.04 Max.	0.05 Max.	0.35 Max.	-	-	-	49	25.2	30
2	P 4/1	SA 182 F12	0.10- 0.20	0.3- 0.8	0.04 Max.	0.04 Max.	0.1- 0.6	-	0.8- 1.25	0.44- 0.65	49	28	20
3	P 5/1	SA 182 F22	0.15 Max.	0.3- 0.6	0.04 Max.	0.04 Max.	0.5 Max.	-	2.0- 2.5	0.87- 1.13	52.5	31.5	20
4	P 8/1	SA 182 F321 H (Ti Stabilised)	0.04- 0.10	2.0 Max.	0.04 Max.	0.03 Max.	1.00 Max.	9.0- 12.0	17.0- Min	-	52.5	21	30
5	P 8/1	SA 182 F304 H	0.04- 0.10	2.0 Max.	0.04 Max.	0.03 Max.	1.00 Max	8.0- 11.0	18.0- 20.0	-	52.5	21	30
6	P 8/1	SA 182 F316 H	0.04- 0.10	2.0 Max.	0.04 Max.	0.03 Max.	1.00 Max	10.0- 14.0	16.0- 18.0	2.0- 3.0	52.5	21	30
7	P 8/1	SA 182 F347 H (Cb+Ta Stabilised)	0.04- 0.10	2.0 Max.	0.04 Max.	0.03 Max.	1.00 Max	9.0- 13.0	17.0- 20.0	-	52.5	21	30

CHEMICAL COMPOSITION AND MECHANICAL PROPERTIES

Table – 4 Castings

Sl. No	P.NO / Group No.	Material Specification (ASME)	Chemical Composition (%)								Mech. Properties (Min.)		
			C	Mn	P	S	Si	Ni	Cr	Mo	T.S. kg/mm ²	Y.S. kg/mm ²	%E Min
1	P 1/2	SA 216 WCB	0.3 Max.	1.0 Max.	0.04 Max.	0.045 Max.	1.60 Max.	0.5 Max.	0.5 Max.	0.20 Max.	49	25.2	22
2	P 1/2	SA 216 WCC	0.25 Max.	1.20 Max.	0.04 Max.	0.045 Max.	0.60 Max.	0.5 Max.	0.5 Max.	0.20 Max.	49	28	22
3	P 3/1	SA 217 WC1	0.25 Max.	0.5-0.8	0.04 Max.	0.045 Max.	0.6 Max.	-	-	0.45-0.65	45.5	24.5	24
4	P 4/1	SA 217 WC6	0.2 Max.	0.5-0.8	0.04 Max.	0.045 Max.	0.6 Max.	-	1.0-1.5	0.45-0.65	49	28	20
5	P 5/2	SA 217 C 5	0.2 Max.	0.4-0.7	0.04 Max.	0.045 Max.	0.75 Max.	-	4.0-6.5	0.45-0.65	63	42	18
6	P 5/1	SA 217 WC 9	0.18 Max.	0.4-0.7	0.04 Max.	0.045 Max.	0.6 Max.	-	2.0-2.75	0.9-1.20	49	28	20
7	P 8/1	SA 351 CF 8	0.08 Max.	1.5 Max.	0.04 Max.	0.04 Max.	2.0 Max.	8.0-11.0	18.0-21.0	0.5 Max.	49	21	35
8	P 8/1	SA 351 CF 8M	0.08 Max.	1.5 Max.	0.04 Max.	0.04 Max.	1.5 Max.	9.0-12.0	18.0-21.0	2.0-3.0	49	21	30
9	P 8/1	SA 351 CF 8C	0.08 Max.	1.5 Max.	0.04 Max.	0.04 Max.	2.0 Max.	9.0-12.0	18.0-21.0	0.5 Max.	49	21	30
10	P 8/2	SA 351 CH 20	0.20 Max.	1.5 Max.	0.04 Max.	0.04 Max.	2.0 Max.	12.0-15.0	22.0-26.0	0.5 Max.	49	21	30

CHEMICAL COMPOSITION AND MECHANICAL PROPERTIES

Table – 5 Plates / Sheets

Sl. No	P.NO / Group No.	Material Specification (ASME)	Chemical Composition (%)								Mech. Properties (Min.)		
			C	Mn	P	S	Si	Ni	Cr	Mo	T.S. kg/mm ²	Y.S. kg/mm ²	%E Min
1	P 1/1	SA 516 Gr 60	0.21-0.25	1.85-1.20	0.035 Max.	0.04 Max.	0.15-0.40	-	-	N 0.009	56	26	25
2	P 1/2	SA 516 Gr 70	0.35 Max.	0.85-1.20	0.035 Max.	0.04 Max.	0.15-0.40	-	-	N 0.009	49-63	27	21
3	P 1/3	SA 299	0.30 Max.	0.84 Max.	0.035 Max.	0.04 Max.	0.13-0.45	-	-	-	52.5-66.5	29.4	19
4	P 1/2	SA 515 Gr 70	0.35 Max.	1.3 Max.	0.035 Max.	0.04 Max.	0.13-0.45	-	-	-	49.2-63	26.6	21
5	P 4/1	SA 387 Gr 12	0.17 Max.	0.35-0.73	0.035 Max.	0.04 Max.	0.13-0.45	-	0.74-1.21	0.40-0.65	38.5-56.0	23.1	22
6	P 5/1	SA 387 Gr 22	0.15 Max.	0.25-0.66	0.035 Max.	0.035 Max.	0.5 Max.	-	1.88-2.62	0.85-1.1	42-59.5	21	18
7	P 8/1	SA 240 TYPE 321 (Ti Stabilised)	0.08 Max.	2.0 Max.	0.045 Max.	0.03 Max.	1.0 Max.	9.0-12.0	17.0-19.0	-	52.5	21	40
8	P 8/1	SA240 – TYPE 304	0.08 Max.	2.0 Max.	0.045 Max.	0.03 Max.	1.0 Max.	8.0-10.5	18.0-20.0	-	52.5	21	40
9	P 8/1	SA240 – TYPE 316	0.08 Max.	2.0 Max.	0.045 Max.	0.03 Max.	1.0 Max.	10.0-14.0	16.0-18.0	2.0-3.0	52.5	21	40
10	P 8/1	SA240 – TYPE 347 Ca+Ta Stabilised	0.08 Max.	2.0 Max.	0.045 Max.	0.03 Max.	1.0 Max.	9.0-13.0	17.0-19.0	-	52.5	21	40

CHEMICAL COMPOSITION AND MECHANICAL PROPERTIES

Table – 6 Pipes
(Other Specifications)

Sl. No	P.NO / Group No.	Material Specification	Chemical Composition (%)									Mech. Properties (Min.)		
			C	Mn	P	S	Si	Ni	Cr	Mo	V	T.S. kg/mm ²	Y.S. kg/mm ²	%E Min
1	P 1/1	DIN St 35.8	0.17 Max.	0.4- 0.8	0.04 Max.	0.04 Max.	0.10- 0.35	-	-	-	-	36.7- 48.96	24	25
2	P 1/ 1	DIN St 45.8	0.21 Max.	0.45- 1.20	0.04 Max.	0.04 Max.	0.10- 0.35	-	-	-	-	41.8- 54.1	26	21
3	P 1/1	BS 3602 410	0.21 Max.	0.40- 1.20	0.045 Max.	0.045 Max.	0.35 Max.	-	-	-	-	41.82- 56.1	25	22
4	P 1/1	BS 3602 / 460	0.22 Max.	0.80- 1.40	0.045 Max.	0.045 Max.	0.35 Max.	-	-	-	-	46.9- 61.2	28.6	21
5	P 4/1	BS 3604 620- 460 HFS or	0.10- 0.15	0.40 Max.	0.04 Max.	0.04 Max.	0.10- 0.35	-	0.70- 1.10	0.45- 0.65	-	46.9- 62.22	18.36	22
		CDS 620-440	0.10- 0.18	0.40- 0.70	0.04 Max.	0.04 Max.	0.10- 0.35	-	0.70- 1.10	0.45- 0.65	-	44.9- 60.2	29.58	22
6	P 5/1	BS 3604 622 HFS or CDS	0.08- 0.15	0.40- 0.70	0.04 Max.	0.04 Max.	0.5 Max.	-	2.0- 2.5	0.9- 1.2	-	48.8	26.8	17
7	-	BS 3604 HFS 660 or CDS 660	0.15 Max.	0.4- 0.7	0.04 Max.	0.04 Max.	0.10- 0.35	-	0.25- 0.50	0.5- 0.7	0.22- 0.30	47.3	30	17

CHEMICAL COMPOSITION AND MECHANICAL PROPERTIES

Table – 7 Tubes
(Other Specifications)

Sl. No	P.NO / Group No.	Material Specification	Chemical Composition (%)								Mech. Properties (Min.)		
			C	Mn	P	S	Si	Cr	Mo	V	T.S. kg/mm ²	Y.S. kg/mm ²	%E Min
1	P 1/1	DIN St 35.8	0.17 Max.	0.40- 0.80	0.04 Max.	0.04 Max.	0.10- 0.35	-	-	-	36.70- 48.96	24	25
2	P 1/ 1	DIN St 45.8	0.21 Max.	0.40- 1.20	0.04 Max.	0.04 Max.	0.10- 0.35	-	-	-	41.80- 54.06	26	21
3	P 1/1	BS 3059 / 360	0.17 Max.	0.4- 0.8	0.045 Max.	0.045 Max.	0.35 Max.	-	-	-	36.70- 51.00	22	24
4	P 1/1	BS 3059 / 440	0.12- 0.18	0.9- 1.20	0.040 Max.	0.035 Max.	0.10 0.35	-	-	-	44.88- 59.2	25	21
5	P 3/1	DIN 15 Mo3	0.12- 0.20	0.40 0.80	0.035 Max.	0.035 Max.	0.10- 0.35	-	0.25- 0.35	-	45.9- 61.2	27.5	22
6	P 4/1	DIN B Gr. Mo 4	0.10- 0.18	0.4- 0.7	0.035 Max.	0.035 Max.	0.10- 0.35	0.7- 1.10	0.45- 0.65	-	44.88- 60.18	29.6	22
7	P 4/1	BS 3059 / 620	0.10 0.15	0.4- 0.7	0.04 Max.	0.04 Max.	0.10- 0.35	0.7- 1.1	0.45- 0.65	-	46.9- 62.2	18.4	22

CHEMICAL COMPOSITION AND MECHANICAL PROPERTIES

Table – 7 Tubes (Contd.)
(Other Specifications)

Sl. No	P.NO / Group No.	Material Specification	Chemical Composition (%)								Mech. Properties (Min.)		
			C	Mn	P	S	Si	Cr	Mo	V	T.S. kg/mm ²	Y.S. kg/mm ²	%E Min
8	P 5/1	DIN 10 Cr Mo 910	0.08 0.15	0.4- 0.7	0.035 Max.	0.035 Max.	0.5 Max.	2.0- 2.5	0.9- 1.2	-	45.9- 61.2	28.6	20
9	P 5/ 1	BS 3059(622) – 440	0.08- 0.15	0.4- 0.7	0.04 Max.	0.04 Max.	0.5 Max.	2.0- 2.5	0.9- 1.20	-	44.9- 60.18	17.85	20
10	P 5/1	BS 3059(622)-490	0.08- 0.15	0.4- 0.7	0.04 Max.	0.04 Max.	0.5 Max.	2.0- 2.5	0.9- 1.20	-	49.98- 65.0	28.05	20
11	-	DIN 14 Mo V63	0.10- 0.18	0.4- 0.7	0.035 Max.	0.035 Max.	0.10- 0.35	0.3- 0.6	0.5- 0.7	0.22- 0.32	46.9- 62.22	32.6	20

CHEMICAL COMPOSITION AND MECHANICAL PROPERTIES

Table – 8 Forgings
(Other Specifications)

Sl. No	P.NO / Group No.	Material Specification	Chemical Composition (%)										Mech. Properties (Min.)		
			C	Mn	P	S	Si	Ni	Cr	Mo	V	Cu	T.S. kg/mm ²	Y.S. kg/mm ²	%E Min
1	P 1/1	IS 1875 CL II	0.15- 0.25	0.60- 0.90	0.05 Max.	0.05 Max.	0.15- 0.35	0.25 Max.	0.25 Max.	0.05 Max.	0.05 Max.	-	44	24	24
2	P 1/ 1	BS 1503 161 Cr 28	0.25 Max.	0.65- 1.20	0.05 Max.	0.05 Max.	0.15- 0.35	0.40 Max.	0.25 Max.	0.10 Max.	-	0.30 Max.	44.1- 52	22.1	22
3	-	BS 1503 660	0.08- 0.15	0.40- 0.70	0.04 Max.	0.04 Max.	0.10- 0.35	0.3 Max.	0.25- 0.50	0.50- 0.70	0.22- 0.32	0.25 Max.	47.2- 63	29.9	21

CHEMICAL COMPOSITION AND MECHANICAL PROPERTIES

Table – 9 Bar stock
(Other Specifications)

Sl. No	P.NO / Group No.	Material Specification	Chemical Composition (%)									Mech. Properties (Min.)		
			C	Mn	P	S	Si	Ni	Cr	Mo	V	T.S. kg/mm ²	Y.S. kg/mm ²	%E Min
1	P 1/1	IS 1570 - 1508	0.1-0.2	0.6-0.9	0.055 Max.	0.055 Max.	0.05-0.35	-	-	-	-	43	-	25
2	P 1/ 1	IS 226 (St 42)	0.23 Max.	-	0.055 Max.	0.055 Max.	-	-	-	-	-	42-54	25	23
3	P 1/1	CSN 11416.1	0.2 Max.	0.65 Max.	0.045 Max.	0.045 Max.	0.35 Max.	0.30 Max	0.30 Max.	-	-	41-50	24	25
4	-	VX22 Cr Mo V121V	0.18-0.23	0.3-0.8	0.035 Max.	0.02 Max.	0.1-0.5	0.3-0.5	11.5-11.9	0.8-1.2	0.25-0.35	95	60	15

RECEIPT INSPECTION OF WELDING ELECTRODES / FILLER WIRES

1. All electrodes / filler wires received at site stores shall be segregated for type and size of electrode.
2. Ensure that electrode packets received are free from physical damage.
3. Where electrodes are damaged, the same shall be removed from use.
4. Only electrodes identified in the "Rationalised List of Electrodes" are to be accepted.
5. Where filler metals are supplied by manufacturing unit, inspect for damages, if any.
6. Ensure availability of relevant test certificates. Refer tables of chemical compositions and mechanical properties for acceptance.
7. Endorse acceptance / rejection on the test certificate.

STORAGE & IDENTIFICATION OF WELDING

ELECTRODES / FILLER WIRES

- 1.0 Scope
- 1.1 This procedure is applicable for storage of welding electrodes / filler wires used at sites.
- 2.0 Procedure:
 - 2.1 Only materials accepted (based on receipt inspection) shall be taken into account for storage.
 - 2.2 Storage Facility:
 - 2.2.1 The storage facility shall be identified.
 - 2.2.2 Access shall be restricted to authorized personnel.
 - 2.2.3 The storage area shall be clean and dry.
 - 2.2.4 Steel racks may be used for storage. Avoid storing wood inside the storage room.
 - 2.2.5 Maintain the temperature of the storage facility above the ambient temperature. This can be achieved by the use of appropriate heating arrangements.
 - 2.3 The electrodes / filler wire shall be segregated and identified for
 - a. Type of electrode e.g. E7018.
 - b. Size of electrode e.g. Dia 3.15 mm.

2.4 Colour coding for filler wires:

2.4.1 On receipt of GTAW filler wires, codify the filter wires as per table I below . Both ends shall be coloured.

Table - 1

Specification	Brand Name*	Colour Code
RT 1/ 2 Mo (ER80s-D2)	TGSM	Green
RT 1 Cr 1 / 2 Mo (ER80S-B2)	TGS 1CM	Silver grey/White
RT 2 1/ 4 Cr 1 Mo (ER90S-B3)	TGS 2CM	Brown / Red
RT 347 (ER 347)	TGS – 347	Blue

(* or other approved equivalents)

2.4.1.1 Where another set of colour code is followed, maintain a record of coding used

2.4.2 where the filter wire is cut, apply the appropriate colour code at both ends of the piece.

2.4.3 For other filler wires, a suitable colour distinct from table 1 shall be applied.

BAKING AND HOLDING OF WELDING ELECTRODES

- 1.0 Purpose:
 - 1.1 This section details activities regarding baking and holding of welding electrodes used at sites.
- 2.0 Procedure:
 - 2.1 While handling, avoid contact of oil, grease with electrodes. Do not use oily or wet gloves.
 - 2.1.1 It is recommended that not more than two days requirements are baked.
 - 2.2 GTAW Filler Wires:
 - 2.2.1 These wires do not require any baking.
 - 2.3 Covered Electrodes:
 - 2.3.1 Baking and holding:
 - 2.3.1.1 Identify baking oven and holding oven.
 - 2.3.1.2 They shall have a temperature control facility upto 350⁰C for baking oven and 200 Deg. C for holding oven.
 - 2.3.1.3 A calibrated thermometer shall be provided for monitoring temperature.
 - 2.3.2 On opening a packet of electrodes, segregate and place them in the baking oven. Avoid mix up.
 - 2.3.2.1 After loading, raise the baking oven temperature to the desired range as per Table in 2.3.2.5.
 - 2.3.2.2 Note the time when the temperature reaches the desired range. Maintain this temperature for the duration required as per Table in 2.3.2.5.
 - 2.3.2.3 On completion of baking, transfer the electrodes to holding oven, maintain a minimum temperature of 100⁰C till issue.
 - 2.3.2.4 The electrode shall not be subjected to more than two cycles of baking.

2.3.2.5 Maintain a register containing following details :

- a) Brand name (e.g. Supratherme)
- b) Size (e.g Dia 4.0 mm)
- c) Quantity (e.g. 110 pieces)
- d) Time at required temperature ie. Above 250⁰C
- e) Time of Transfer to holding oven. Activities a,b,c to be recorded before loading into the oven.

Baking and Holding Parameters

AWS Classification (*)	Baking		Holding Temperature ⁰ C (@)
	Temperature ⁰ C	Time (Hours)	
E7018	250 – 300	2	100 min
E7018-1	250 – 300	2	100 min
E7018-A1	250 – 300	2	100 min
E8018-B2	250 – 300	2	100 min
E9018-B3	250 – 300	2	100 min
E8018-B2L	250 – 300	2	100 min
E9018-B3L	250 – 300	2	100 min
E309 & E347	250 - 300	1	100 min

Note : (*) For other electrodes, supplier's recommendations shall be followed.

(@) Maintain the temperature in the oven till issue.

2.3.2.6 After issue, maintain the electrodes in a portable oven at a minimum temperature of 65⁰C till use (not applicable for E6013, E309 & E347 electrodes).

2.3.3 Unused, returned electrodes shall be segregated and kept in the holding oven.

SELECTION AND ISSUE OF WELDING ELECTRODES / FILLER WIRES

- 1.0 Purpose:
- 1.1 This procedure details methods for selection and issue of welding electrodes / filler wires for site operations.
- 2.0 Procedure:
- 2.1 Selection:
 - 2.1.1 The type of filler wire / electrode for welding shall be based on the details given in the contract documents like Erection Welding Schedules, drawings, Welding Procedure Specifications as supplied by the Manufacturing Units.
 - 2.1.2 Where not specified by the Manufacturing Units, selection shall be based on the tables enclosed.
 - 2.1.3 Where electrodes / filler wire are not covered in the documents mentioned in 2.1.1, 2.1.2, refer to manufacturing Units.
- 2.2. Issue:
 - 2.2.1 Issue of welding electrodes / filler wires shall be based on authorized Welding Electrodes Issue Voucher.
 - 2.2.2 It is recommended to restrict quantity issued to not more than 4 hours requirements.
 - 2.2.3 Redried low hydrogen electrodes shall be carried to the work spot in a portable oven.
 - 2.2.4 Maintain the temperature in the portable oven at the work spot above 65 Deg. C.
 - 2.2.5 Unused electrodes shall be returned and kept in the holding oven till reissue.

TABLE – 1 SELECTION OF GTAW FILLER WIRE, SMAW ELECTRODE
FOR BUTT WELDS IN TUBES, PIPES, HEADERS

MATERIAL	WELDING PROCESS	P1 GROUP 1 P1 GROUP 2	P3 GROUP 1	P4 GROUP 1	P5 GROUP 1	P8	Cr Mov
P1 Group 1 P1 Group 2	GTAW SMAW	RT 1 / 2 Mo E7018 (ATT) Note – 1					
P3 Group 1	GTAW SMAW	RT 1 / 2 Mo E7018 (ATT)	RT 1 / 2 Mo E7018 A1				
P4 Group 1	GTAW SMAW	RT 1 / 2 Mo E7018 (ATT)	RT 1 / 2 Mo E7018 A1	RT 1 Cr 1/ 2 Mo E8018- B2			
P5 Group 1	GTAW SMAW	RT 1 / 2 Mo E7018 (ATT)	RT 1 / 2 Mo E7018 A1	RT 1 Cr 1/ 2 Mo E8018- B2	RT 2 1/ 4 Cr 1 Mo E9018 – B3		
PS	GTAW SMAW			ERMiCr3 ENiCrFe2	ERNiCr3 ENiCrFe2	RT347 E347	
Cr Mo V Note- 2	GTAW SMAW				RT 2 1/ 4 Cr 1 Mo E9018-B3		RT 2 1/ 4 Cr 1 Mo E9018- B3

Note – 1 E7018 - A1 For P1 Gr 2 + P1 Gr 2 and Dia > 127 mm.

Note – 2 DIN 14MoV63 or equivalent.

**TABLE – 2 SELECTION OF ELECTRODES
FOR WELDING ATTACHMENTS TO TUBES**

TUBE MATERIAL	ATTACHMENT MATERIAL				
	P1 GROUP 1	P3 GROUP 1	P4 GROUP 1	PS GROUP 1	P8
P1 Group 1 P1 Group 2	E7018	E7018	E7018	E7018	E7018-A1
P3	E7018-A1	E7018-A1	E7018-A1	E7018-A1	E7018-A1
P4 Group 1	E8018-B2		E8018-B2	E8018-B2	E7018-A1
P5 Group 1	E9018-B3		E9018-B3	E9018-B3	E7018-A1
P8			E 309 Note – 1	E 309 Note - 1	E347

Note – 1 Used as circumferential attachment only.

**TABLE – 3 SELECTION OF ELECTRODES, PREHEAT, PWHT
FOR ATTACHMENT TO ATTACHMENT WELDS**

(Seal bands, High crown bars, End bars,
End bar lifting lugs and Collector plates etc.)

MATERIAL	WELDING REQUIREMENTS	P1	P4	P5	P8 GRUP 1	P8 GROUP 2
P1	Electrode Preheat PWHT	E7018 Nil Nil				
P4	Electrode Preheat PWHT	E7018 (Note-2) Nil (Note – 2) Nil (Note – 2)	E8018-B2 Nil Nil			
P5	Electrode Preheat PWHT	E7018 Note 1 & 2 Nil (Note-2)	E8018-B2 Note-1 Nil	E9018-B3 Note-1 Nil		
P8	Electrode Preheat PWHT	E309 Nil Nil	E309 Nil Nil	E309 Nil Nil	E347 Nil Nil	E309 Nil Nil

- Note : 1. When P5 material thickness is more than 10mm, 150 Deg.C preheat is required.
2. Electrode, Preheat and PWHT requirement for welding end bar lifting lug are as follows:

END BAR LIFTING LUG	END BAR	ELECTRODE	PREHEAT DEG.C	PWHT DEG.C
P1	P4	E8018-B2	120	650 – 680
P1	P5	E9018-B3	150	680-720

**TABLE – 4 SELECTION OF ELECTRODES FOR WELDING NOZZLE ATTACHMENTS,
HANDHOLE PLATE, RG PLUG ETC TO HEADERS, PIPES**

HEADER, PIPE MATERIAL	ATTACHMENT MATERIAL				
	P1	P3	P4	P5	P8
P1	E7018 (ATT)	-	E7018 (ATT)	-	ENiCrFe2
P4	-	-	E8018-B2	E8018-B2	-
P5	-	-	-	E9018-B3	ENiCrFe2
Cr Mo V Note-1	-	-	-	E9018-B3	ENiCrFe2

**TABLE – 5 SELECTION OF ELECTRODES FOR NON-PRESSURE PARTS
(INCLUDING STRUCTURES)**

MATERIAL	ELECTRODES
P1 + P1 Carton Steel + P1 Carton + Carton Steel Steel	a. For butt welds, upto 6mm including : E6013
	Over 6 mm : E7018
	b. For fillets, upto 8 mm including : E6013
	Over 8 mm : E7018
	E6013 or E7018
	E8018-B2

WELDER QUALIFICATION

1.0 Scope:

1.1 This chapter details the procedure for qualification of welder at site.

2.0 Contents:

1. Qualification of Welders at Site.
2. Table-1 – Welder qualification Requirements.
3. Record of Welder Performance Qualification Tests.
4. Figure- 1 Fillet Weld Break Specimen.
Figure-2 Method of Rupturing.
Figure-3 Positions.
Figure-4 Plate Butt Weld specimen.
Figure-5 Pipe Butt Weld Specimen.
Figure-6 Bend Specimen.
Figure-7 Bend Jig.

QUALIFICATION OF WELDERS AT SITES

- 1.0 Base Metal:
 - 1.1 For selection refer tables in chapter II.
- 2.0 Test coupon:
 - 2.1 Depending on the range to be qualified, choose the appropriate test coupon from table-1.
 - 2.2 For plate butt welds, details of edge preparation shall be as per Figure-4.
 - 2.3 For pipe butt welds, details of edge preparation shall be as per Figure-5.
 - 2.4 For structural tack welds, refer Figure-1.
- 3.0 Requirement of Tests:
 - 3.1 For Structural Tack Welders:
 - 3.1.1 Break Test as per Figure-2.
 - 3.2 For Plate Butt Welds:
 - 3.2.1 Minimum of 2 specimens for bend test; one for root bend and other for face bend. Width of specimen shall be 38 mm for plate thickness upto 9.5 mm. For thickness greater than 9.5 mm, width of specimens shall be 10 mm and they shall be side bend tested.
 - 3.3 For Pipe Welder:
 - 3.3.1 The order of removal of test specimens shall be as per Figure-6.

3.3.2 For width and number of bend specimens, refer table below:

TABLE

OD	W	No. of Bend Specimens		
		Face	Root	Side
> 101.6	38.0	2	2	(**)
50.8 – 101.6	19.0	2	2	(**)
< 50.8	9.5	2	2	(**)
<= 25.4	(+ +)	2	2	-

(**) for thickness greater than 9.5 mm, side bend test of width 9.5 mm may be substituted.

(++) Cut into 4 equal sections (with allowance for saw cuts or machine cutting); sharp corners to be rounded off.

OD Outer diameter of pipe in mm

W Width of bend test specimen in mm

3.4 For bend jig refer Figure-7, for thickness of bend specimen 9.5 mm; for other thicknesses (t) the dimension shall be as below:

$$A = 4t$$

$$B = 2t$$

$$C = 6t + 3.2 \text{ mm}$$

$$D = 3t + 1.6 \text{ mm}$$

The above values are nominal.

3.5 Radiographic examination of test welds may be carried out in lieu of bend tests. Procedure and acceptance criteria are as per NDE Manual.

4.0 Essential Variables:

4.1 Changes to the following variables require requalification.

4.1.1 Process:

Example: Change from GTAW to SMAW or vice versa.

4.1.2 Joint:

A Change from one type of bevel to another.

Example: vee bevel to u bevel.

4.1.3 Base Metal:

A change in thickness or pipe diameter beyond the limits prescribed in Table-1.

4.1.4 Filler Metal:

A change from one F number to another F number, except as specified in table-1,

4.1.5 Positions:

Note: This procedure envisages qualification of welders to perform in all positions. Deviation to this are not recommended.

4.1.6 Gas:

Note: This procedure envisages test to pre-prescribed gas as for production welds.
Deviation to this are not recommended.

4.1.7 Electrical Characteristics:

a. AC to DC and vice versa.

b. In DC, DCEN (Electrode Negative) to DCEP (Electrode Positive) and vice versa.

4.1.8 Technique:

Note:- This procedure envisages only use of uphill progression technique.

5.0 Acceptance Criteria:

5.1 Structural Tack Welding:

5.1.1 No cracks.

5.1.2 No lack of fusion.

5.1.3 Undercut not exceeding 1 mm.

5.1.4 Not more than 1 porosity (max. diameter of porosity 2 mm).

5.2 Plate / pipe Welding:

5.2.1 Visual Inspection:

- a. No cracks.
- b. No lack of fusion or incomplete penetration.
- c. Not more than 1 porosity in a length of 100 mm of length of weld (max. porosity diameter 2 mm).

5.2.2 Bend Test results:

The convex surface of the bend test specimen shall be visually examined for surface discontinuities. For acceptance, the surface shall contain no discontinuities exceeding the following dimensions.

1. 3 mm measured in any direction on the surface.
2. The sum of the greatest dimensions of all discontinuities exceeding 1 mm but less than or equal to 3 mm, shall not exceed 10 mm.
3. The maximum corner crack of 6 mm, except when that corner crack resulted from visible slag inclusion or other fusion type discontinuities, then the 3 mm maximum shall apply. Specimens with corner cracks exceeding 6 mm with no evidence of slag inclusions or other fusion type discontinuities shall be disregarded, and a replacement test specimen from the original weldment shall be tested.

6.0 Retests :

6.1 A welder who fails to meet the acceptance criteria for one or more test specimens, may be retested as per this procedure after adequate practice.

7.0 Validity :

7.1 When a welder meets the requirements of this procedure, the validity will be for a maximum of 2 years from the date of test, limited to Validity specified by statutory authority, as applicable.

7.2 The validity may be extended by one year each time, based on satisfactory performance.

8.0 Requalification :

8.1 Requalification is required for the following :

- a. Where there is a specific reason to doubt the skill of the welder.
- b. Due to non-engagement of the welder for a continuous period of 6 months.

9.0 Records ;

9.1 The welding in charge at site shall maintain the following records.

A. Record of welder performance Qualification Test (as per format).

B. Register of qualified welders (employer-wise) containing the following details :

1. Name of welder.
2. Age.
3. Tested for pipe / plate / tack.
4. Performance Test No.
5. Validity.
6. Welder Code.
7. Remarks.

The above register shall be updated for deletions also.

9.2 Copies of welder identity card (including details as in 9.1 B and relevant variables qualified).

9.3 Pertinent radiography reports.

10.0 Enclosures :

1. Table – 1 - Welder qualification Requirements.
2. Record of Welder Performance Qualification Test.
3. Figure-1 - Structural Tack weld specimen.
4. Figure – 2 - Break Test.
5. Figure – 3 – Weld Positions.
6. Figure – 4 - Plate Butt Weld Specimen.
7. Figure – 5 - Pipe Butt Weld Specimen.
8. Figure – 6 - Order of Removal of Test Specimen.
9. Figure – 7 - Bend Jig

WELDER'S QUALIFICATION REQUIREMENTS

TABLE - 1

S L. N O	TEST FOR	BASE METAL Note -1	TEST COUPON DIMENSION OD, t	ELECTRODE TO BE USED Note 2.4	WELD POSITIONS	REFEREN CE FIGURE	RANGE QUALIFIED DIA. & T	POSI TION QUA LIFI ED	ELECTROD E QUALIFIED Note 2,4 REMARKS	
1.	Structural Tack	P1 Gr1	t=10 mm OR 12 mm	(E 6013 F2)	3F & 4F	Fig. 1 & 2	T = Unlimited	ALL	F2, F1	Refer Fig.1,3
				(E 7018) F4	3F & 4F	-do-	T = Unlimited	ALL	F4 & Below	
2.	Plate Welder (Structural)	-do-	t>=>25 mm	F4	3G & 4G	Fig . 3	T>=>3.2 mm	ALL	F4 & Below	
			t>25 mm	F4	3G & 4G	-do-	T>3.2 mm <=2t	ALL	F4 & Below	
3.	Plate Welder (Other than Structural)	-do-	t>=>25 mm	F4	2G 3G & 4G	-do-	T = Unlimited OD=>600 mm	ALL	F4 & Below	
			t>25 mm	F4	2G 3G & 4G	-do-	T<=2t OD=>600 mm	ALL	F4 & Below	
4.	Pipe Welder	-do-	OD=>25 mm	F4	6G	-do-	OD=> Above	ALL	F4 & Below	
			OD=>25 mm & <=73 mm	F4	6G	-do-	OD & 25 mm	ALL	F4 & Below	
			OD>=73 mm	F4	6G	-do-	OD>73 mm T <=2t	ALL ALL	F4 & Below F4 & Below	
			t<19 mm	F4	6G	-do-	T= Unlimited	ALL	F4 & Below	
			t.>=19 mm	F4	6G	-do-				

TACK WELDER QUALIFICATION

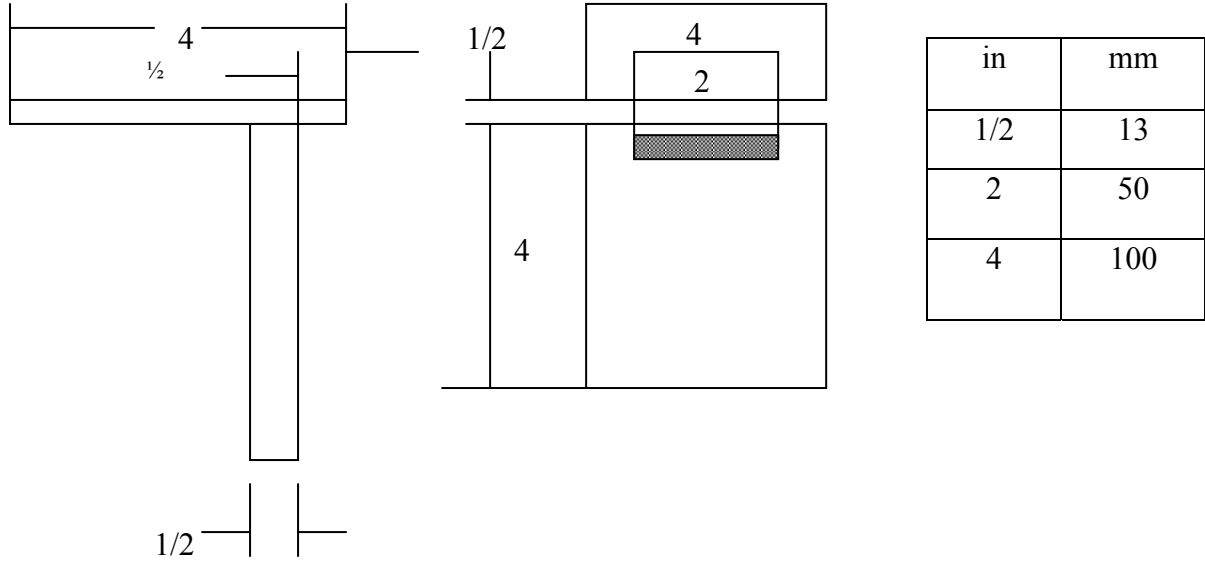


Fig 1 – Fillet Held Break specimen

FORCE

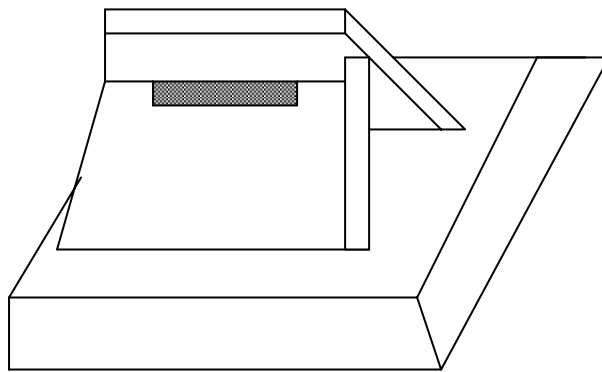
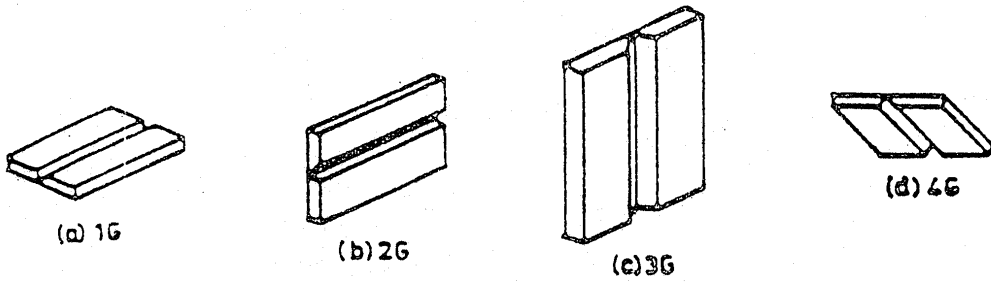
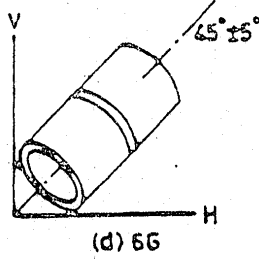
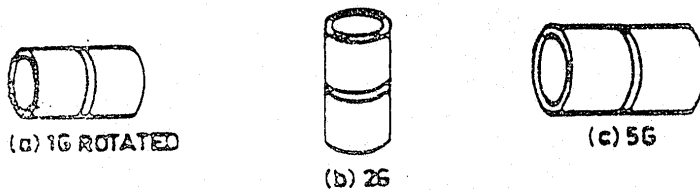


Fig – 2 – Method of Rupturing

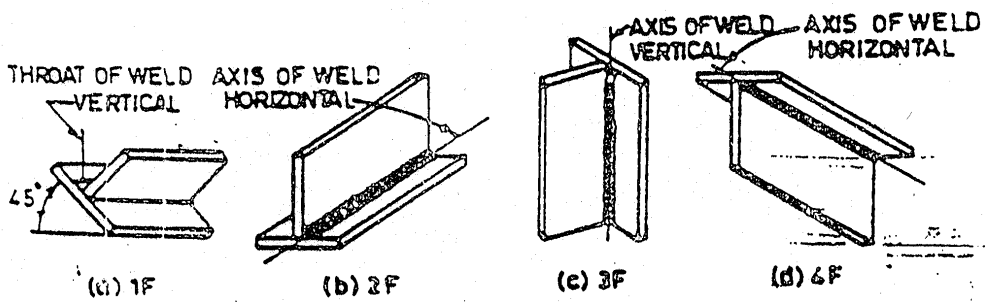
Fig. 3 - POSITIONS



GROOVE WELDS IN PLATE



GROOVE WELDS IN PIPE



FILLET WELDS PLATE

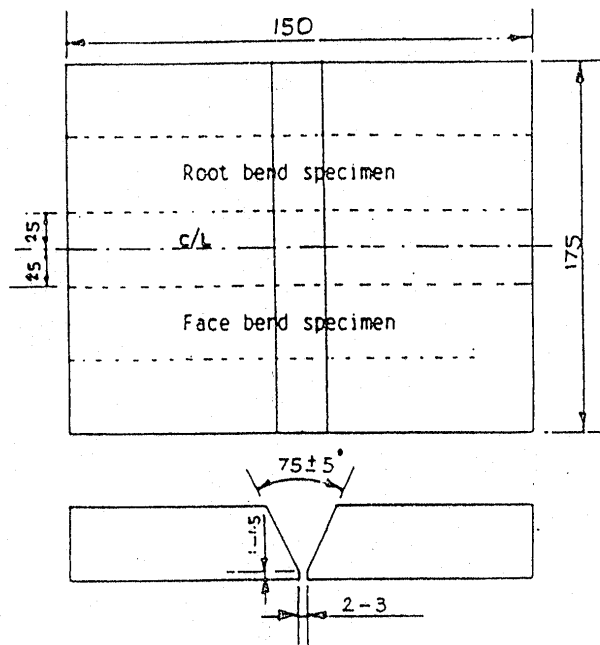
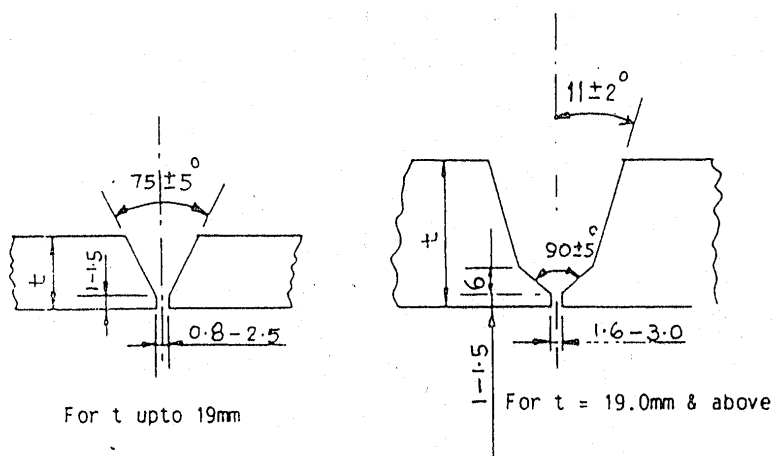
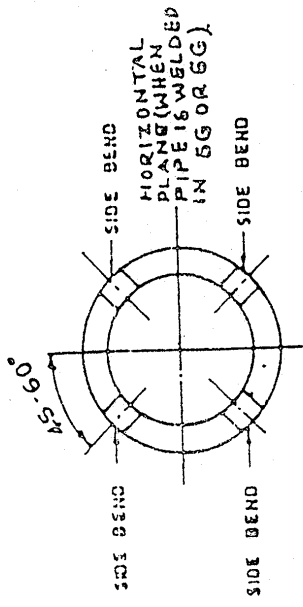


Fig.4: Plate Butt Weld Specimen

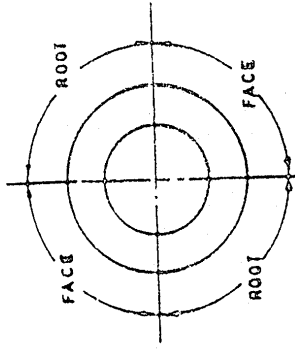


All dimensions in mm

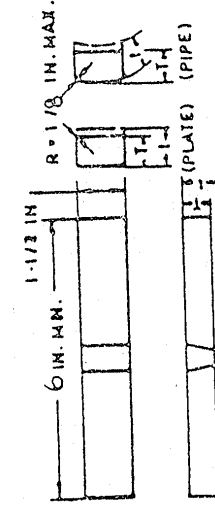
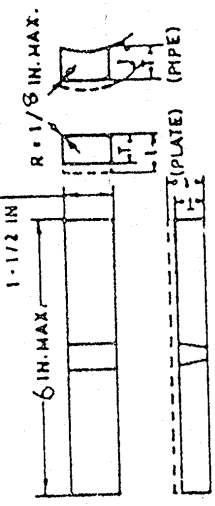
Fig.5: Pipe Butt Weld Specimen



PIPE TEST COUPON

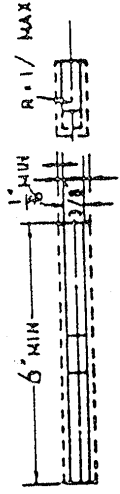
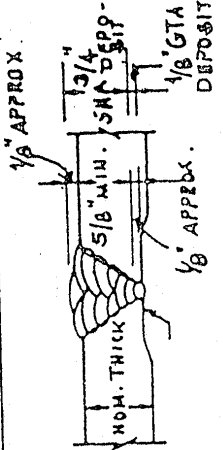


PIPE TEST COUPON



ROOT BEND SPECIMEN - PLATE AND PIPE

FACE BEND SPECIMEN - PLATE AND PIPE



SIDE BEND

Figure - 6

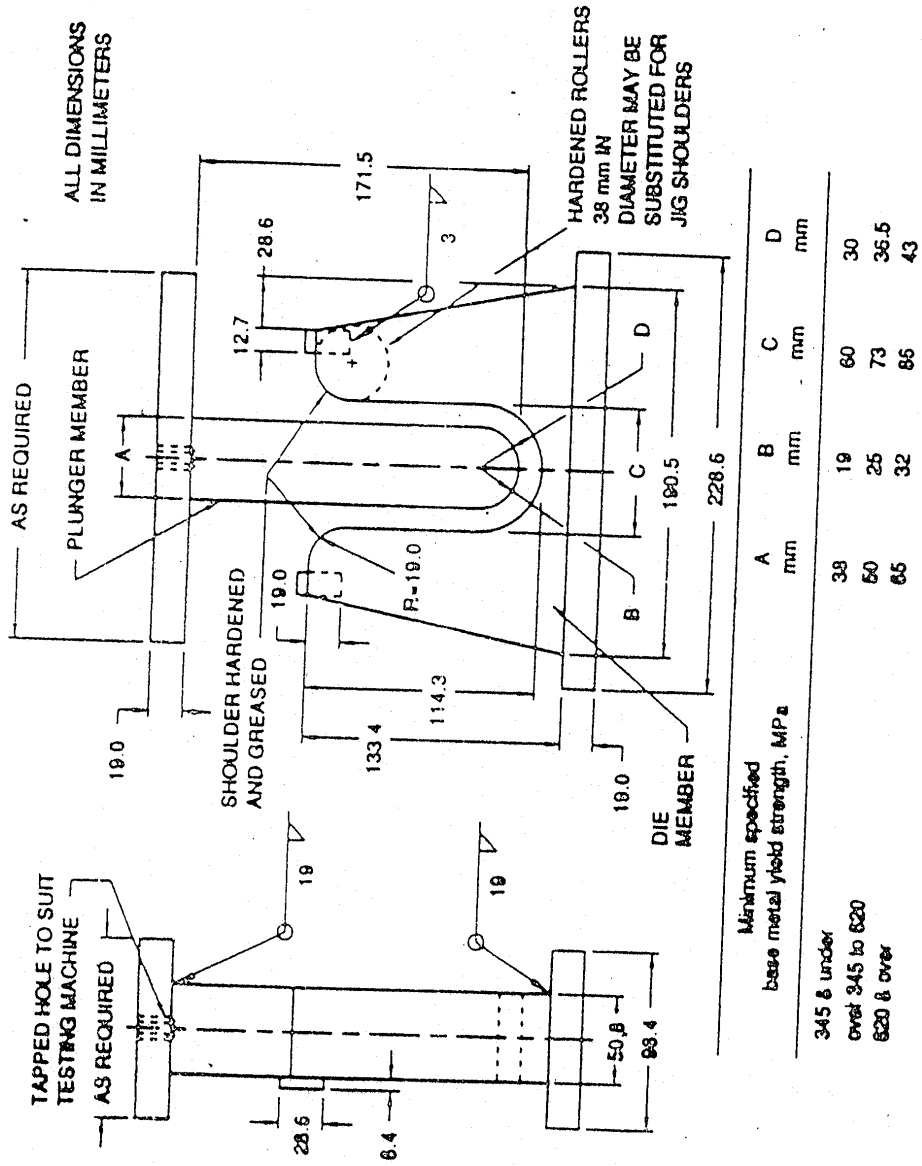


Figure - 7

RECORD OF WELDER PERFORMANCE QUALIFICATION TEST

**Performance Test No.,
Date :**

Site :

Welder's Name & Address :

Welder Code :

Material groupings permitted :
Thickness Qualified :
(This performance test is as per
Procedure No.

Welding Processes :
Position(s) Qualified :
Dia Qualified :

TEST MATERIAL

Specification :
Thickness (and Dia. Of Pipe) :
Shielding Gas(es)

Filler Metal :
SFA No. :
AWS Classification :

PROCESS VARIABLES

Position of test weld :

Current :

Polarity :

Pre-heat temp ;
Test joints

inter Pass Temp:

Post-heat Temp :

Test Results

Type Bend

Results

Type Bend

Results

Type Bend

Results

Type Bend

Results

Radiography Ref. & Results :

(Sketch)

Welder's signature

Agency Conducting Test

We certify that the statements in this record are correct and that the test weld were prepared, welded and tested in accordance with requirements.

This is valid upto -----

Welding In-charge / BHEL.

INSPECTION OF WELDING

1.0 Purpose :

This procedure provides details for performing visual inspection of weld fit-ups, welding in progress and completed welds.

2.0 Reference :

2.1 Contract drawings

2.2 Erection welding schedule (supplied by Units) or equivalent.

2.3 Welding procedure specification, where supplied.

2.4 Indian Boiler Regulations (for boilers erected in India).

3.0 General Requirements :

3.1 Ensure that the components to be welded are in accordance with the contract drawings, Welding Schedule and other relevant documents.

3.2 The condition of welded Surfaces to be inspected must be clean and dry.

3.3 There shall be sufficient lighting to allow proper interpretation of visual inspection.

4.0 Weld fit-up Inspection :

4.1 The surface to be welded shall be smooth and free from deep notches, irregularities, scale, rust, oil, grease and other foreign materials.

4.2 Piping, tubing and headers to be jointed shall be aligned within allowable tolerances on diameters, wall thicknesses and out-of-roundness as below:

Maximum Permissible out-of-alignment at bore

Bore (mm)	Max. Misalignment (mm)	
	For GTAW	For SMAW
Upto 100	1.0	1.0
Over 100 to 300	1.6	1.6
Over 300	1.6	2.4

- 4.3 When fit, components to be welded shall not show an appreciable off-set or misalignment when viewed from positions apart.
- 4.4 The root opening of components to be joined shall be adequate to provide acceptable penetration.
- 4.5 On fillet welds, the parts to be jointed shall be brought as close to contact as practical, although in most instances a small opening between the parts is desirable.
- 4.6 Root gaps should be maintained at 1.6 mm – 2.4 mm (refer relevant document).
- 4.7 Weld area should be protected from drafts and wind, to maintain inert gas shield.
- 5.0 Checks during welding operation:
 - 5.1 Ensure the required minimum preheat temperature is applied and established during welding.
 - 5.2 Ensure correct electrode / filler metal is used for welding.
 - 5.3 Tack welds are examined by the welder before they are incorporated in the final weld.
 - 5.4 Ensure proper drying / holding of electrodes prior to use.
 - 5.5 Ensure the correct interpass temperature is maintained.
 - 5.6 Ensure proper cleaning of weld between beads.
- 6.0 Checks on the completed weld:
 - 6.1 No visible cracks, pin-holes or incomplete fusion.
 - 6.2 The weld surface must be sufficiently free of coarse ripples, grooves, overlaps, abrupt ridges and valleys, visible slag inclusions, porosity and adjacent starts and stops.
 - 6.3 Undercuts not to exceed 1 mm.
 - 6.4 Where inside surface is readily accessible, the same shall be inspected for excess penetration and root concavity. The permissible limits are given below.

Root concavity: max of 2.5 mm or 20% of thickness at weld, whichever is lesser, provided adequate reinforcement is present.

Excess penetration: upto and including 3.2 mm.

- 6.5 For plate butt welds, the weld reinforcement should not exceed 3.2 mm.
- 6.6 For circumferential joints in piping and tubing the maximum weld reinforcements permitted are given below:

Maximum Permissible Reinforcements

Thickness of of base metal	For service above 400 Deg.C	Temperature upto & incl. 400 Deg.C
Upto 3.2	1.6	2.4
Over 3.2 – 4.	1.6	3.2
Over 4.8 – 12.7	2.4	4.0
Over 12.7 – 25.4	3.2	4.8
Over 25.4	4.0	6.3

All Dimensions in mm

- 6.7 There shall be no overlaps.

The faces of fillet welds are not excessively convex or concave and the weld legs are of the proper length.

- 6.8 In case of weld joints in pressure parts and joints like ceiling girder, the weld joint must be suitably identified.

WELDER PERFORMANCE MONITORING

- 1.0 Purpose:
 - 1.1 This procedure deals with monitoring the performance of welders engaged at sites. This procedure is applicable where radiography is performed.
- 2.0 Procedure:
 - 2.1 The welder performance shall be monitored on a calendar month basis.
 - 2.2. Extent of radiography shall be representative of weekly outputs of the welder.
 - 2.3 Quantum of radiography shall be as per contractual requirements.
 - 2.4 Evaluation of welds radiographed shall be as per NDE manual or other documents as specifically applicable.
 - 2.5 Welder performance evaluation:
 - 2.5.1 For welds dia 88.9 mm and below:
 - 2.5.1.1. The percentage defectives (repairable) is calculated as a percentage of number of unaccepted to those radiographed.
 - 2.5.1.2 Upto and including 5% defectives performance is satisfactory else unsatisfactory.
 - 2.5.2 For welds over dia 88.9 mm and plate welds:
 - 2.5.2.1 The percentage defectives is calculated as a percentage of length of defectives repairable to the length radiographed.
 - 2.5.2.2 Upto an including 2.5% defectives performance is satisfactory else unsatisfactory.
 - 2.6 When a welder gives unsatisfactory performance for a continuous period of 3 months he shall be requalified
 - 2.6.1 Requalification of welder shall be called for when there is a specific reason to question his ability to make acceptable welds. This shall override requirements of cl.2.6
 - 2.7 Welds produced during any month shall be radiographed and evaluated latest by 10th of the succeeding month.

2.7.1 Under circumstances when cl.2.7 is not satisfied for any particular welder, he may be disengaged from the job till such time his performance can be evaluated for the month in study.

2.7.2 Site in-charge may waive the restriction imposed in 2.7.1 reviewing the situations for non-compliance of cl.2.7 and may allow engagement of the welder in question for a period not exceeding one successive month to the month in study.

3.0 Records:

3.1 Welding in-charge shall prepare and maintain Welder Performance Records, welderwise.

REPAIR WELDING

- 1.0 Purpose:
 - 1.1 This procedure details steps to be taken for weld repairs.
- 2.0 Procedure:
 - 2.1 Unacceptable welds, based on visual inspection or NDE, shall be repaired.
 - 2.2 Removal of Defects:
 - 2.2.1 The identified defect area shall be marked on the part.
 - 2.2.2 The defects may be removed by grinding / thermal gouging.
 - 2.2.2.1 Where thermal gouging is done, adopt the requirements of preheating as detailed in Heat Treatment Manual.
 - 2.2.2.2 However, only grinding is permitted for the last 6 mm from the root.
 - 2.3 Removal of defects shall be verified by visual inspection PT, MT, RT as appropriate.
 - 2.4 The profile of ground portion shall be smooth and wide enough to permit proper fusion during repair welding.
 - 2.5 Repair welding shall be carried out as per the procedure for the initial weld.
 - 2.6 Repair weld shall undergo the same type of NDE as the initial weld.
 - 2.7 Repeat steps 2.1 to 2.6 till acceptable weld is made.
 - 2.8 Where cutting, re-edge preparation and re-welding the joint will yield better results, the same shall be followed.
- 3.0 Where a specific repair procedure is supplied by the Manufacturing Unit, the same shall be followed.
- 4.0 Records:
 - 4.1 Records pertaining to the repairs like Welder, NDE records shall be maintained

APPENDIX A

Recommended Electrical Characteristics for Welding at Sites.

Electrical Classification	Process	Dia mm	Current		Voltage range
			Type	Amp range	
&&	GTAW	2.5	DCEN	70-120	12-20
		3.15	DCEN	110-160	12-20
E6013	SMAW	2.5	DCEP	50-100	18-26
		3.15	DCEP	90-140	18-26
		4.0	DCEP	130-190	18-26
@@ EXX18	SMAW	2.5	DCEP	70-120	18-26
		3.15	DCEP	100-160	18-26
		4.0	DCEP	150-220	18-26
## EXXX	SMAW	2.5	DCEP	70-100	18-26
		3.15	DCEP	100-140	18-26
		4.0	DCEP	120-170	18-26

Notes:

&& - The current ranges are applicable for all filler materials used in GTAW process

@@ - EXX18 include E7018, E7018-1, E7018-A1, E8018 B2, E9018 B3.

- EXXX include E309, E347 electrodes.

APPENDIX – B

Extract from AWS D 1.1. 1992

SAFE PRACTICES (Non-mandatory Information)

(This Appendix is not a part of ANSI/AWS D1.1-92, Structural Welding Code-Steel, but is included for information purposes only)

This appendix covers many of the basic elements of safety general to arc welding processes. It includes many, but not all of the safety aspects related to structural welding. The hazards that may be encountered and the practices that will minimize personal injury and property damage are reviewed here.

J1 Electrical Hazards

Electric shock can kill. However, it can be avoided. Live electrical parts should not be touched. Read and understand the manufacturer's instructions and recommended safe practices. Faulty installation, improper grounding, and incorrect operation and maintenance of electrical equipment are all sources of danger.

All electrical equipment and the work pieces should be grounded. A separate connection is required to ground the workpiece. The work lead should not be mistaken for a ground connection.

To prevent shock, the work area, equipment, and clothing should be kept dry at all times. Dry gloves and rubber soled shoes should be worn. The welder should stand on a dry board or insulated platform.

Cables and connectors should be kept in good condition. Worn, damaged, or bare cables should not be used. In case of electric shock, the power should be turned off immediately. If the rescuer must resort to pulling the victim from the live contact, nonconducting materials should be used. A physician should be called and CPR continued until breathing has been restored, or until a physician has arrived. See references 8,7 and 10

J2 Fumes and Gases

Many welding, cutting and allied processes produce fumes and gases which may be harmful to one's health. Fumes and solid particles originate from welding consumables, the base metal, and any coating present on the base metal. Gases are produced during the welding process or may be produced by the effects of process radiation on the surrounding environment. Everyone associated with the welding operation should acquaint themselves with the effects of these fumes and gases.

The possible effects of over-exposure to fumes and gases range from irritation of eyes, skin and respiratory system to more severe complications. Effects may occur immediately or at some later time. Fumes can cause symptoms such as nausea, headaches, dizziness, and metal fumes fever. Sufficient ventilation, exhaust at the arc, or both, should be used to keep fumes and gases from breathing zones and the general work area.

For more detailed information on fumes and gases produced by the various welding processes, see References 1,4 and 11

J3 Noise

Excessive noise is a known health hazard. Exposure to excessive noise can cause a loss of hearing. This loss of hearing can be either full or partial, and temporary or permanent. Excessive noise adversely affects hearing capability. In addition, there is evidence that excessive noise affects other bodily functions and behavior. Personal protective devices such as ear muffs or ear plugs may be employed. Generally, these devices are only accepted when engineering controls are not fully effective. See References 1,5 and 11.

J4 Burn Protection

Molten metal, sparks, slag, and hot work surfaces are produced by welding, cutting and allied process. These can cause burns if precautionary measures are not used.

Workers should wear protective clothing made of fire resistant material. Pant cuffs or clothing with open pockets or other places on clothing that can catch and retain molten metal or sparks should not be worn. High top shoes or leather leggings and fire resistant gloves should be worn. Pant legs should be worn over the outside of high top boots. Helmets or hand shields that provide protection for the face, neck, and ears, should be worn, as well as head covering to protect. Clothing should be kept free of grease and oil. Combustible materials should not be carried in pockets. If any combustible substance is spilled on clothing it should be replaced with fire resistant clothing before working with open arcs or flame.

Appropriate eye protection should be used at all times. Goggles or equivalent also should be worn to give added eye protection.

Insulated gloves protection should be worn at all times when in contact with hot items or handling electrical equipment.

For more detailed information on personnel protection Reference 2,3,8 and 11 should be consulted.

J5 Fire Prevention

Molten metal, sparks, slag, and hot work surfaces are produced by welding, cutting, and allied processes. These can cause fire or explosion if precautionary measures are not used.

Explosions have occurred where welding or cutting has been performed in spaces containing flammable gases, vapours, liquid, or dust. All combustible material should be removed from the work area. Where possible, move the work to a location well away from combustible materials. If neither action is possible, combustibles should be protected with a cover or fire resistant material. All combustible materials should be removed or safely protected within a radius of 35 ft. (11m) around the work area.

Welding or cutting should not be done in atmospheres containing dangerously reactive or flammable gases, vapours, liquid, or dust. Heat should not be applied to a container that has held an unknown substance or a combustible material whose contents when heated can produce flammable or explosive vapours. Adequate ventilation should be provided in work areas to prevent accumulation of flammable gases, vapours or dusts. Containers should be cleaned and purged before applying heat.

For more detailed information on fire hazards from welding and cutting operations, see References 6,8,9 and 11

J6 Radiation

Welding, cutting and allied operations may produce radiant energy (radiation) harmful to health. Everyone should acquaint themselves with the effects of this radiant energy.

Radiant energy may be ionizing (such as X-rays) or non-ionizing (such as ultraviolet, visible light, or infrared). Radiation can produce a variety of effects such as skin burns and eye damage, if excessive exposure occurs.

Some processes such as resistance welding and cold pressure welding ordinarily produce negligible quantities of radiant energy. However, most arc welding and cutting processes (except submerged arc when used properly), laser welding and torch welding, cutting, brazing, or soldering can produce quantities of non-ionizing radiation such that precautionary measures are necessary.

Protection from possible harmful radiation effects include the following:

- 1) Welding arcs should not be viewed except through welding filter plates (see Reference 2)
- 2) Transparent welding curtains are-not intended as welding filter plates, but rather, are intended to protect passers by from incidental exposure.

- 3) Exposed skin should be protected with adequate gloves and clothing as specified. See Reference 8.
- 4) The casual passerby to welding operations should be protected by the use of screens, curtains, or adequate distance from aisles, walkways, etc.
- 5) Safety glasses with ultraviolet protective side shields have been shown to provide some beneficial protection from ultraviolet radiation produced by welding arcs.

References Cited

1. American Conference of Governmental Industry Hygienist (ACGIH). Threshold limit values for chemical substances and physical agents in the workroom environment, Cincinnati, Ohio; American Conference of Governmental Industry Hygienists(ACGIH)
2. American National Standards Institute. Practice for occupational and educational eye and face protection, ANSI Z87.1 New York: American National Standards Institute.
3. -----Safety-toe footwear, ANSI Z41.1 New York: American National Standards Institute.
4. -----American Welding Society. Fumes and gases in the welding environment, AWS Report. Miami, Florida: American Welding Society.
5. -----Method for sound level measurement of manual arc welding and cutting processes, ANSI / AWS F6.1. Miami, Florida.
6. -----Recommended safe practices for the preparation for welding and cutting containers that have held hazardous substances, ANSI/AWS F4.1. Miami, Florida: American Welding Society.
7. -----Safe Practices.(Reprint from Welding Handbook, Volume 1, Eight Edition) Miami, Florida: American welding Society.
8. ----- Safety in welding and cutting, ANSI/ASC Z49.1 Miami, Florida: American Welding, society.
9. National Fire Protection Association: Cutting and welding processes NFPA Standard 51B. Quincy, Massachusetts: National Fire Protection Association
10. ----- National Electrical Code. NFPA No.70.Quincy, Massachusetts National Fire Protection Association.
11. Occupational Safety and Health Administration. Code of Federal Regulations, Title 20 Labour, Chapter XVII, Part 1910; OSHA General Industry Standards. Washington, DC:U.S Government Printing Office.

APPENDIX A

MINIMUM REQUIREMENTS OF NDE AS PER IBR

(Quantum of Radiography or other approved NDE methods for Butt Welds)

1.0 Boiler and Superheater Tubes (Regulation No.151 (h):

BORE, MM	PERCENTAGE OF NDE
OVER 178	100%
OVER 102 AND UPTO 178 INCLUDING	10% (MIN. 2 WELDS PER WELDER)
BELOW 102	5% (MIN 1 WELD PER WELDER)

2.0 Steam pipes and fittings (Regulation No.360 (d) – NDE Requirements:

2.1 Pipelines NDE requirement:

DESCRIPTION	BORE mm	PERCENTAGE OF NDE FOR EACH WELDER	PERCENTAGE OF CUTOUT JOINTS FOR VISUAL AND BEND TEST FOR EACH WELDER
CLASS I PIPELINES: A. WHERE THE COMPLETED PIPELINES ARE NOT SUBJECTED TO HYDRAULIC TEST	OVER 102	100%	—
	OVER 38 AND UPTO 102 INCLUDING BELOW 38	5% (MIN. 2 WELDS PER WELDER)	2% (Note.1)
B:WHERE THE COMPLETED PIPELINES ARE SUBJECTED TO HYDRAULIC TEST	OVER 102	10% (MIN. 2 WELDS PER WELDER)	—
	OVER 38 AND UPTO 102 INCLUDING BELOW 38 mm	2% (MIN 1 WELD PER WELDER)	2% (Note.1)
CLASS II PIPELINES: ALL PIPES	ALL SIZE	—	2% (Note –1)

Note. 1: It is suggested that in lieu of this radiography may be substituted at sites.

2.2 Retest:

If any test specimen is unsatisfactory, two further weld specimen for retest shall be selected from the production welds and subjected to tests.

APPENDIX B

Extract from ASME/ ANSI B 31.1/1992 MANDATORY MINIMUM NDE for pressure welds or welds to pressure retaining components.

- I. Piping service conditions temperature over 400 deg C and all pressures.

Type of weld	NDE
Butt welds	RT for over NPS 50 MT-& PT for NPS 50 And less
Fillet, Socket, attachment & seal welds	MT or PT for all sizes and Thicknesses

- II Piping service conditions: Temperatures between 175 deg C Inclusive and 400 deg C inclusive with all pressures above 7100 kPa(gauge)

Type of weld	NDE
Butt welds	RT for over NPS 50 with Thickness over 19 mm. Visual For others.
Fillet, socket, attachment and seal weld	Visual for all sizes & Thicknesses.

- III All others : Visual examination.

NOTES: 1) NPS - nominal pipe size

- 2) All welds must be given a visual examination in addition to the NDE specified.
- 3) The thickness of buttwelds is defined as the thicker of the two abutting ends after end preparation
- 4) Temperatures and pressures shown are design.
- 5) Fillet welds not exceeding 6 mm throat thickness which are used for the permanent attachment of nonpressure retaining parts are exempt from the PT & MT requirements.

APPENDIX C

NDE Requirements as per ASME Sec – I

Following buttwelds shall be radiographed or ultrasonically tested.

- A. For drums, shells excluding pipes, tubes, headers.
 - I NPS exceeding 250 mm or wall thickness greater than 28 mm. Bring against (B. For pipes, tubes and headers. Radiography is not mandatory for the following conditions.)
 1. For parts containing steam: NPS \leq 400 mm or wall thickness \leq 40 mm
 2. For parts containing water : NPS \leq 250 mm or wall thickness \leq 28 mm
 3. For parts in flue gas path but not subject to radiation: NPS \leq 150 mm or wall thickness \leq 19 mm
 4. For parts in flue gas path and subject to radiation: NPS \leq 100 mm or wall thickness \leq 12.5 mm
 - II Where radiography is to be performed and geometric unsharpness cannot be within 1.8 mm, ultrasonic testing shall be performed.

Note: NPS – nominated pipe size

HEAT TREATMENT

1.0 Purpose:

1.1 This procedure provides information, method and control for preheat (PH) and post weld heat treatment (PWHT) of welds at sites.

2.0 Document:

2.1 The following documents are referred in preparation of this procedure.

2.1.1 ASME Sec.1, II(a)

2.1.2 ANSI B 31.1

2.1.3 Indian Boiler Regulations

2.1.4 AWS D1.1/Steel

2.1.5 Welding Manual – PS:CMX:001:00:93

2.2 The following are referred to as Primary Documents

- Erection Welding Schedules or equivalent
- Contract Drawings
- Plant Standards, where supplied
- Welding Procedure Specification, where supplied

2.2.1 Where parameter for Preheating (PH) and PWHT are not available in the primary documents reference may be made to this manual.

2.2.2 Where such parameters are not contained either in the primary documents or in this manual reference may be made to Manufacturing Units.

3.0 Procedure:

3.1 Preheating:

3.1.1 When parts of two different thicknesses are welded together, the preheating requirements of the thicker shall rule.

3.1.2 When parts of two different P numbers are jointed together, the material requiring higher preheat shall govern (Please refer Welding Manual for P numbers)

3.1.3 Preheating shall be checked using thermal chalk (temperature indicating crayons) prior to start-up welding as well as at frequent intervals during welding. It is preferable to have a thermocouple and a temperature recorder in case of alloy steels of thickness greater than 50 mm.

3.1.4 In case of any interruption during welding, preheating temperature shall be maintained at joint by wrapping in dry thermal insulating blankets to ensure slow and uniform cooling.

3.1.5 Preheating Methods:

3.1.5.1 Preheating shall be applied by any of the methods given below:

- a. Electrical Resistance Heaters
- b. Induction Heating
- c. Oxy-Acetylene or other Gas Torches

3.2 Post Weld Heat Treatment(PWHT):

3.2.1 The method shall be by locally heating a circumferential band including the entire weld and adjacent area of base metal, by Induction or Electrical Resistance Heating.

3.2.2 Heat Band for PWHT

3.2.2.1 For Boilers:

- a. When heat treating welded joints in components in the boiler, proper width of the heated circumferential band on either side of the weld.

(W) must be as, $W = 3$ times the width of the widest part of the weld groove but in no case, less than twice the width of weld at reinforcement.

- b. When used in post weld heat treatment in sections – $W = 3$ times the plate thickness.

- c. For nozzle and other welded attachments – $W =$ must be wider than the nozzle or attachment or 3 times the wall thickness.

3.2.2.2 For Piping:

$W =$ Three times the wall thickness of thickest part, in case of nozzles and attachment welds, the width of the heat band shall extend beyond the nozzle or the attachment wall on each side by at least twice the higher thickness and shall extend completely around the header.

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3.2.2.3 Other Pressure Vessels:

Heat band width, placement of thermocouple and preheat and PWHT information shall be obtained from the supplier.

3.3 Condition of Welded Joints:

3.3.1 The weldment shall be free of grease, oil etc, prior to PH/PWHT.

3.4 Temperature Measurement for PWHT:

3.4.1 Post weld heat treatment temperature shall be measured and monitored by use of thermocouples with calibrated recorders.

3.4.2 The periodicity of calibration of the equipment must be every twelve months or before use.

3.4.3 Where the soaking temperature is found to be lesser than specified, the PWHT cycle shall be repeated.

3.4.4 In case interruption during PWHT, the following actions are to be taken depending on the stage during which interruption occurred.

a. Interruption during heating cycle:

- The whole operation to be repeated from the beginning

b. Interruption during soaking:

- The joint can be treated subsequently for the balance left over soaking period.

c. Interruption during cooling:

- Ensure slow cooling by covering with insulation to a minimum width of 1.5 times the outer diameter applied equally about the central line of weld, till the temperature reaches around 350 deg.C.

3.5 THERMOCOUPLE (t / c) Fixing:

3.5.1 Thermocouples shall be used for recording post weld Heat Treatment temperatures.

3.5.1.1 Following are guidelines regarding number and placement of thermocouples.

3.5.1.2 Minimum of two thermocouples per weld.

3.5.1.3 Thermocouples located 180 deg. Apart.

3.5.1.4 Thermocouples located top and bottom of weld.

3.5.1.5 Thermocouples located at a distance of approximately 1.5 times of the wall thickness about the centre line of weld.

3.5.2 The following guidelines may be used for attaching thermocouples to job.

a. For capacitor discharge method: Thermocouple elements should be attached within 6 mm of each other.

b. For other type of t / c Insert the elements in a ss tube of internal diameter approximately 6 mm. Apply force on tube and crimp it. Place this t / c and weld the crimped button to the pipe in area of interest. Do not weld the elements.

c. Insulate the t / c leads suitably and protect t / c ends from direct radiation from heating elements.

3.5.3 For Bunched Tubes:

3.5.3.1 Where a bunch of closely placed tube welds (e.g Super Heater / Reheater Coils) require to be stress relieved, the same shall be grouped together as if they form a single component.

3.5.3.2 In such cases attachment of a minimum of three thermocouples, two at the end tubes and one at the middle is recommended.

3.6 Soaking Time

3.6.1 Wherever not specified the soaking time shall be 2.5 minutes per mm. The minimum soaking shall be 30 minutes.

- 3.6.2 The following guidelines shall be used to determine the thickness and subsequent selection of the soaking time of PWHT.
- a. For butt welds, the thickness shall be the thickness of the material at the weld. For bar stock, the thickness shall be the diameter.
 - b. For fillet welds, the thickness shall be the throat thickness.
 - c. For partial penetration branch welds, the thickness shall be the depth of the groove prior to welding.
 - d. For repairs, the thickness shall be the depth of the groove as prepared for repair welding.
 - e. For combination of different welds in a component, the maximum thickness in the definitions given above shall govern.
- 3.6.3 Soaking time is to be reckoned from the time temperature of the joint crosses the recommended lower temperature of the cycle, to the time it comes down below the same recommended lower temperature of the cycle.
- 3.7 Heating and Cooling rates:
- 3.7.1 Whenever not specified, the heating rate above 400 deg. C and cooling rate after soaking upto 400 deg.C shall be as follows. This is applicable for all materials other than BS 3604:622 and 660 materials.

Thickness of Material	Maximum Heating Rate Above 400 Deg.C	Maximum Cooling Rate Upto 400 Deg.C
Upto and including 25 mm	220 Deg. C / Hour	110 Deg.C / Hour
Over 25 to 50 mm (incl)	110 Deg. C / Hour	110 Deg.C / Hour
Over 50 to 75 mm (incl.)	75 Deg. C / Hour	110 Deg.C / Hour
Over 75 mm	55 Deg. C / Hour	110 Deg.C / Hour

For Structural – 65 deg. C / Hour (Max.)

3.7.2 For BS:3604:622 and 660 materials, for a combination of diameter below 127 mm and thickness below 12.5 mm, maximum rate of heating is

$$\frac{250 \times 25}{T} \quad \text{or } 100 \text{ deg.C / Hour, whichever is less.}$$

Maximum rate of cooling is 50 deg C / hour.

T = Thickness of material in MM.

3.8 Temperature Records:

3.8.1 All the heat treatment cycles may be controlled within a tolerance of + or - 20 deg. C around the recommended temperature. The recommended temperature for stress relieving must be selected as the midpoint of recommended range of temperature for the material.

3.9 All the heat treatment cycles may be controlled within + / - 20 deg.C around the midpoint of the recommended range of temperature for the material.

4.0 SR Job Card:

4.1 Prior to start of stress relieving operations, a job card may be prepared including details of weld reference, soaking time, soaking temperature, maximum rates of heating and cooling, temperature recorder details, date of PWHT as per sample format.

4.2 On completion of PWHT the actuals may be recorded on the job card.

4.3 A chart number shall be given to each chart.

5.0 List of Tables:

Table – 1 PH, PWHT for GIRTH BUTT Welds in Tubes and Pipes Dia \leq 76.1 mm.

Table – 2 PH, PWHT for Headers

Table – 3 PH, PWHT for Pipes Dia $>$ 108 mm

Table – 4 Heat Treatment requirements for Non-Pressure Parts including Structurals.

Table – 5 PH for Flame Cutting

Annexure – 1 Soaking Time

Annexure – 2 Heat Treatment of X-20 materials.

6.0 Records:

6.1 Pertinent Records like Job Card, SR Charts, shall be maintained.

STRESS RELIEF (S.R) JOB CARD

Site: -----

Date: -----

Unit No. -----

Package: -----

Description -----

Temp. Recorder Details

Weld Reference -----

1. Make-----

Material Spec:-----

2. Type-----

Size: Dia-----mm

3. Sl.No:-----

Thick---(t) -----mm

4. Calibration
Due on:-----

NDE Cleared on:-----

Thermocouple Locations:

Minimum 2

$d = 1.5 \times t$

Heating Band = $6 \times t$

Insulation Band = $12 \times t$

Date of S.R-----

Start Time:-----

End Time-----

Chart No.:-----

Required

Actual

Rate of Heating (Max) deg C / h

Soak Temperature deg C

Soak Time (Minutes)

Rate of Cooling(Max) deg C / h

Contractor

B.H.E.L

Results

Accepted / Not Accepted:

Released for further processing

TABLE – I**GIRTH BUTT WELDS****(Tubes and Pipes Dia \leq 76.1)**

Applicable for Thickness upto 19 mm for P1ABC and Thickness
Upto 13 mm for other materials

MATERIAL		PROCESS	P1ABC	P3A	P4Gr.1,2	P5 Gr.1	P5 Gr.2	P8
P1	GTAW SMAW	PH	NIL					
		PWHT	NIL					
P3 Group 1	- do -	PH	NIL	NIL				
		PWHT	NIL	NIL				
P4 Group 1 & 2 (Note 1)	- do -	PH	120	120	120			
		PWHT	NIL	NIL	NIL			
P5 Group 1 (Note 1)	- do -	PH	200	200	200	200		
		PWHT	NIL	NIL	NIL	NIL		
P5 Group 2	- do -	PH	200	200	200	200	200	
		PWHT	680-720	680-720	680-720	680-720	680-720	
P8 Group 1 & Group 2	- do -	PH	NIL	NIL	120	150	200	NIL
		PWHT	NIL	NIL	NIL	NIL	680-775	NIL

Note: Preheating of P4 and P5 tubes can be waived off if PWHT is envisaged at site.

If Preheating is done for the above, PWHT can be waived off subject to the approval from Chief Inspector of Boilers of the respective region.

PH = Preheat; PWHT = Post Weld Heat Treatment.

TABLE – II

PREHEAT AND PWHT TO HEADERS

(Note – 4)

(Applicable for Welding of Header to Header Joints at Site)

Header Pipe Material (Note 3)	Thickness, (mm)	Preheat °C	Post Heating (Note 2) °C	PWHT °C
P1 Group 1 & 2 (Note 1)	$t \leq 25$	NIL	NIL	600-650
	$t \ 25 - 75$	100	NIL	600-650
	$t > 75$	150	NIL	600-650
P4 Group 1 & Group 2	$t \leq 75$	120	NIL	650-700
	$t > 75$	150	NIL	650-700
P5 Group 1	Plates & Pipes	150	250 ^o for 4 hours	700-750
	Castings & forgings	200		

Note 1: For SA 106 Gr. C materials, a minimum preheat of 100^oC is required for all thickness and a post heat of 150^oC for two hours after completion of welding.

Note 2: All P5 headers shall be interstage heat treated at 700-750^oC for 30 minutes soaking prior to any cold straightening operation. In lieu of this, the straightening can be done after final PWHT.

Note 3: Irrespective of the stub or attachment material, the PWHT cycles shall be governed by the header pipe material. However, the preheat for welding shall be as shown below:

P1 Header to P3 stub	-	120 ^o C (min.)
P1 Header to P4 stub	-	120 ^o C (min.)
P1 Header to P5 stub	-	150 ^o C (min.)

Note 4: Seal welding of hand hole plates, radiographic plugs and screws can be carried out after final PWHT, provided the preheat is carried out as per the table.

Note 5: Soaking time for BS 622 & 660 materials shall be 180 mts. (min) irrespective of thickness. However, when diameter is less than 127 mm and thickness less than 12.5 mm, soaking time shall be 30 minutes (min).

Note 6: Throat shall be as specified in the drawing. Wherever flanges are welded to pipes combined throat shall be taken into consideration.

TABLE - IV

Heat Treatment Requirements for Non Pressure Parts Including Structural (Note 7)

Material	Shearing	Gas cutting	Thickness	Welding		
	Post Forming Heat Treatment	Preheat		SMAW (Non-Low H ₂ Electrodes)	SMAW (Low H ₂ electrodes) GMAW, SAW etc.	PWHT (Note 7)
P1 A.36 Is 2062 IS 226	t ≤ 19 – Nil t > 19 – 600-650 ⁰ C No<- soaking <- is required. (Note 1)	t ≤ 50 – Nil t > 50, 100 ⁰ C	t ≤ 19 t - 19 – 38 t - 38 – 63 t > 63	Nil 100 120 150	Nil Nil 100 120	a. All butt welds when > 50 mm b. Any welds to a tension member (Note 2) SR at 600-650 ⁰ C
P4	All sheared edges at 650 – 700 ⁰ C for 15 mts.	t ≤ 25 – Nil t > 25, 120 ⁰ C	t < 75 t > 75	--- ---	120 150	a. All butt welds in tension member. b. All fabricated components when t>16 mm (Note 3) SR at 650 – 700 ⁰ C
P5	All sheared edges at 680-730 ⁰ C for 15 mts.	t ≤ 13, 120 ⁰ C t 13 – 25, 150 ⁰ C t > 25, 200 ⁰ C (Note 4)	All	---	150	All welds (Note 5 & 6) SR at 680-730 ⁰ C

- Note 1: Clip angles above 10 mm, used for beam connections, which are sheared to length, shall required heat treatment.
- Note 2 : All tension members, when thickness is above 50 mm, the entire assembly shall be post weld heat treated.
- Note 3 : All fabricated structural components of P-4 material, with any member above 16 mm thickness, the entire assembly shall be post weld heat treated.
- Note 4: All gas cut edges of P-5 material shall be heat treated at 680-730⁰C for 15 mts. As an alternative to this heat treatment, the gas cut edges may be chipped off, ground or machined to remove the HAZ with 6 mm minimum removal.
- Note 5 : All welds of P-5 material shall be post heated at 250⁰C for 2 hours or 150⁰ C for 4 hours immediately following welding.
- Note 6 : All fabricated structural members of P-5 material, the entire assembly shall be post weld heat treated after completion of fabrication.
- Note 7: For soaking time details refer Annexure – I.