TENDER SPECIFICATION

BHEL: PSSR: SCT: 1447

FOR

Handling at site stores / storage yard, transportation to site of work, Erection, Testing and Commissioning of Boiler Structures, Pressure Parts, Non Pressure Parts, Rotating Machines including Supply & Application of Final Painting for 6 X 150 MW sets

at

Aditya Aluminium Project

Lapanga

District Sambalpur, Orissa

VOLUME –I BOOK - I

TECHNOCOMMERCIAL BID (Book I & II)

Book-I consists of

- **Notice Inviting Tender,**
- **Volume-IA : Technical Conditions of Contract**

Book-II consists of

- **Volume-IB : Special conditions of Contract,**
- **Volume-IC : General conditions of Contract**
- **Volume-ID : Forms & Procedures**

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

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

Tender Specification No. BHEL: PSSR: SCT: 1447

for

Handling at site stores / storage yard, transportation to site of work, Erection, Testing and Commissioning of Boiler Structures, Pressure Parts, Non Pressure Parts, Rotating Machines including Supply & Application of Final Painting for 6 X 150 MW sets at Aditya Aluminium Project, Lapanga, District Sambalpur, Orissa

One set of Tender documents consisting of
1) TECHNOCOMMERCIAL BID - 2 copies
2) PRICE BID - 2 copies

Book Sl no …….

Issued to
M/s

Refer NIT for Last date of submission

Please note this tender document is not transferable

For and on behalf of
BHARAT HEAVY ELECTRICALS LIMITED

ADDL GENERAL MANAGER / CONTRACTS

Place: Chennai -35
Date:

Rev 00
6th July
2010

NOTICE INVITING TENDER

Bharat Heavy Electricals Limited

Ref: BHEL PSSR SCT 1447 **Date: 23/12/2010**

NOTICE INVITING TENDER (NIT)

NOTE: BIDDER MAY DOWNLOAD FROM WEB SITES OR PURCHASE TENDERS FROM THIS OFFICE ALSO

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To

Dear Sir/Madam

Sub : NOTICE INVITING TENDER

Sealed offers in two part bid system are invited from reputed & experienced bidders (meeting PRE QUALIFICATION CRITERIA as mentioned in Annexure-I) for the subject job by the undersigned on the behalf of BHARAT HEAVY ELECTRICALS LIMITED as per the tender document. Following points relevant to the tender may please be noted and complied with.

1.0 **Salient Features of NIT**

Sl. No	ISSUE	DESCRIPTION	
i	**TENDER NUMBER**	**BHEL PSSR SCT 1447**	
ii	**Broad Scope of job**	Handling at site stores / storage yard, transportation to site of work, Erection, Testing and Commissioning of Boiler Structures, Pressure Parts, Non Pressure Parts, Rotating Machines including Supply & Application of Final Painting for 6 X 150 MW sets at Aditya Aluminium Project, Lapanga, District Sambalpur, Orissa.	
iii	**DETAILS OF TENDER DOCUMENT**		
a	Volume-IA	*Technical Conditions of Contract (TCC) consisting of Scope of work, Technical Specification, Drawings, Procedures, Bill of Quantities, Terms of payment, etc*	*Applicable*
b	Volume-IB	*Special Conditions of Contract (SCC)*	*Applicable*
c	Volume-IC	*General Conditions of Contract (GCC)*	*Applicable*
d	Volume-ID	*Forms and Procedures*	*Applicable*
e	Volume-II	*Price Schedule (Absolute value).*	*Applicable*

iv	**Issue of Tender Documents**	***1.Sale from BHEL PSSR Regional office at :Chennai*** ***Start : 27-12-2010*** ***Closes: 18-01-2011 , Time :15.00 Hrs*** **2.From BHEL website (www.bhel.com)** Tender documents can however be downloaded from website till due date of submission	*Applicable*
v	**DUE DATE & TIME OF OFFER SUBMISSION**	***Date : 19 /01/ 2011 , Time :15.00Hrs*** ***Place : BHEL PSSR :Chennai*** Tenders can be submitted through representative / in person at SCT Dept, BHEL PSSR, Chennai.	*Applicable*
vi	**OPENING OF TENDER**	***Date : 19 /01/ 2011 , Time :15.30Hrs*** *Notes:* *(1) In case the due date of opening of tender becomes a non-working day, tenders shall be opened on next working day at the same time.* *(2) Bidder may depute representative to witness the opening of tender*	*Applicable*
vii	**EMD AMOUNT**	*Rs 2,00,000/- (Rupees Two Lakhs Only)*	*Applicable*
viii	**COST OF TENDER**	*Rs 2000/-.*	*Applicable*
ix	**LAST DATE FOR SEEKING CLARIFICATION**	*At least 7 days before the due date of offer submission or two days before the scheduled date of pre-bid meeting whichever is earlier* *Along with soft version also, addressing to undersigned & to others as per contact address given below*	*Applicable*
x	**SCHEDULE OF Pre Bid Discussion (PBD)**	*Date:* ***11/01/2011.*** *Time* ***10.00AM*** *at BHEL:PSSR:Chennai-35*	*Applicable .*
xi	**INTEGRITY PACT & DETAILS OF INDEPENDENT EXTERNAL MONITOR (IEM)**	Bidders shall enter into an **Integrity Pact (IP)** with BHEL as per format given at Volume 1D Formats of this tender. The bidders are required to return this Integrity Pact (IP) along with Techno Commercial Bid duly signed and stamped by the authorized signatory who signs the bid. It may be noted that only those bidders who have entered into such an IP with BHEL would be competent to participate against this tender .i.e. entering into this pact is a preliminary qualifications for the bidders. The	***Not Applicable***

		Independent External Monitor against this NIT shall be Shri ...	
xii	**Latest updates**	Latest updates on the important dates, Amendments, Correspondences, Corrigenda, Clarifications, Changes, Errata, Modifications, Revisions, etc to Tender Specifications will be hosted in BHEL webpage (www.bhel.com --> Tender Notifications →View Corrigendums) **and not in the newspapers**. Bidders to keep themselves updated with all such information	

2.0 The offer shall be submitted as per the instructions of tender document and as detailed in this NIT. Bidders to note specifically that all pages of tender document, including these NIT pages of this particular tender together with subsequent correspondences shall be submitted by them, duly signed & stamped on each page, as part of offer. **Rates/Price including discounts/rebates, if any, mentioned anywhere/in any form in the techno-commercial offer other than the Price Bid, shall not be entertained.**

3.0 Unless specifically stated otherwise, bidder shall remit cost of tender and courier charges if applicable, in the form of Demand Draft drawn in favour of Bharat Heavy Electricals Ltd, payable at Power Sector Regional HQ at Chennai issuing the Tender, along with techno-commercial offer. Bidder may also choose to deposit the Tender document cost by cash at the Cash Office as stated above against sl no iv of 1, on any working day; and in such case copy of Cash receipt is to be enclosed with the Techno Commercial offer. Sale of tender Documents shall not take place on National Holidays, holidays declared by Central or State Governments and BHEL PS HQ at Chennai, Sundays and second/ last Saturdays

4.0 Unless specifically stated otherwise, bidder shall deposit EMD through Demand Draft/Pay Order in favour of Bharat Heavy Electricals Ltd, payable at Chennai. For other details and for 'One Time EMD' please refer General Conditions of Contract.

5.0 **Procedure for Submission of Tenders**: The Tenderers must submit their Tenders to Officer inviting Tender, as detailed below:

- PART-I consisting of 'PART-I A (Techno Commercial Bid)' & 'PART-I B (EMD/COST of TENDER)' in two separate sealed and superscribed envelopes (ENVELOPE-I & ENVELOPE-II)
- PART-II(Price Bid) – in sealed and superscribed envelope (ENVELOPE-III)
- One set of each document shall be retained by the bidder for their reference.

6.0 The contents for ENVELOPES and the superscription for each sealed cover / Envelope are as given below. **(All pages to be signed and stamped)**

Sl no	Description	Remarks
	Part-I A	
	ENVELOPE – I superscribed as : PART-I (TECHNO COMMERCIAL BID) TENDER NO : NAME OF WORK : PROJECT: DUE DATE OF SUBMISSION: **CONTAINING THE FOLLOWING**:-	
i.	Covering letter/Offer forwarding letter of Tenderer.	
ii.	Duly filled-in `No Deviation Certificate' as per prescribed format to be placed after document under sl no (i) above. **Note:** a. In case of any deviation, the same should be submitted separately for technical & commercial parts, indicating respective clauses of tender against which deviation is taken by bidder. The list of such deviation shall be placed after document under sl no (i) above. It shall be specifically noted that deviation recorded elsewhere shall not be entertained. b. BHEL reserves the right to accept/reject the deviations without assigning any reasons, and BHEL decision is final and binding. (i) In case of acceptance of the deviations, appropriate loading shall be done by BHEL (ii) In case of unacceptable deviations, BHEL reserves the right to reject the tender.	
iii.	Supporting documents/ annexure/ schedules/ drawing etc as required in line with Pre-Qualification criteria. It shall be specifically noted that all documents as per above shall be indexed properly and credential certificates issued by clients shall distinctly bear the name of organization, contact ph no, FAX no, etc.	
iv.	All Amendments / Correspondences / Corrigenda / Clarifications / Changes / Errata etc pertinent to this NIT.	
v.	Integrity Pact Agreement (Duly signed by the authorized signatory)	If applicable
vi.	Duly filled-in annexures, formats etc as required under this Tender Specification/NIT	
vii.	Notice inviting Tender (NIT)	
viii.	Volume – I A : Technical Conditions of Contract (TCC) consisting of Scope of work, Technical Specification, Drawings, Procedures, Bill of Quantities, Terms of payment, etc	
ix.	Volume – I B : Special Conditions of Contract (SCC)	

x.	Volume – I C : General Conditions of Contract (GCC)	
xi.	Volume – I D : Forms & Procedures	
xii.	Volume – II (UNPRICED – without disclosing rates/price, but mentioning only 'QUOTED' or 'UNQUOTED' against each item	
xiii.	Any other details preferred by bidder with proper indexing.	

	PART-I B	
	ENVELOPE – II superscribed as: PART-I (EMD/COST of TENDER) TENDER NO : NAME OF WORK : PROJECT: DUE DATE OF SUBMISSION: **CONTAINING THE FOLLOWING**:-	
i.	1. Earnest Money Deposit (EMD) in the form as indicated in this Tender **OR** Documentary evidence for 'One Time EMD' with BHEL PSSR Chennai 2. Cost of Tender (Demand Draft or copy of Cash Receipt as the case may be)	

	PART-II	
	PRICE BID consisting of the following shall be enclosed	
	ENVELOPE-III superscribed as: PART-II (PRICE BID) TENDER NO : NAME OF WORK : PROJECT: DUE DATE OF SUBMISSION: **CONTAINING THE FOLLOWING**	
i	Covering letter/Offer forwarding letter of Tenderer enclosed in Part-I	
ii	Volume II – PRICE BID (Duly Filled in Schedule of Rates – rate/price to be entered in words as well as figures)	

	OUTER COVER	
	ENVELOPE-IV (MAIN ENVELOPE / OUTER ENVELOPE) superscribed as: TECHNO-COMMERCIAL BID, PRICE BID & EMD	

	TENDER NO: NAME OF WORK: PROJECT: DUE DATE OF SUBMISSION: **CONTAINING THE FOLLOWING:**	
i	○ Envelopes I ○ Envelopes II ○ Envelopes III	

SPECIAL NOTE: All documents/ annexures submitted with the offer shall be properly annexed and placed in respective places of the offer as per enclosure list mentioned in the covering letter. BHEL shall not be responsible for any missing documents.

7.0 No Deviation with respect to tender clauses and no additional clauses/ suggestions/ in Techno-commercial bid/ Price bid shall normally be considered by BHEL. Bidders are requested to positively comply with the same.

8.0 BHEL reserves the right to accept or reject any or all Offers without assigning any reasons thereof. BHEL also reserves the right to cancel the Tender wholly or partly without assigning any reason thereof. Also BHEL shall not entertain any correspondence from bidders in this matter (except for the refund of EMD).

9.0 **Assessment of Capacity of Bidders: (Shall be applicable for all Bid Evaluation from 1st Jan 2011)**

Bidders capacity for executing the job under tender shall be assessed as per the following:

I. **Assigning Weightages (A) for Similar Jobs Under-Execution**: Weightages shall be worked out and assigned based on the average number of Similar Works under execution including works yet to be commenced by the agency, in the following manner:

i). Number of Similar Jobs

a) No. of jobs in BHEL, PSER : Say 'J'
b) No. of jobs in BHEL, PSSR : Say 'K'
c) No. of jobs in BHEL, PSWR : Say 'L'
d) No. of jobs in BHEL, PSNR : Say 'M'
e) No. of jobs with other customers* : Say 'N' (*: Other than BHEL PSER, PSSR, PSWR & PSNR)
f) Average No. of Jobs is 'P'= (J+K+L+M+N) divided by 5

ii) Weightage "A" assigned to bidders based on Average Number of jobs "P";

a) If 'P' = 0-1, "A" will be equal to '3'
b) If 'P' = 2-3, "A" will be equal to '2'

c)If 'P' = 4-5, "A" will be equal to '1'
d)If 'P' is Above 5, "A" will be equal to '0'

II. **Weightage "B" for Quarterly Performance Reports of Vendors**: This shall be based on the averages of the net weighted score obtained by the bidder for the jobs under execution (excluding works not commenced) for the quarter previous to the last quarter reckoned from the date of latest due date of submission, in all four Regions i.e BHEL PSER, PSSR, PSWR & PSNR, in the following manner.

i). Ratings by Power Sector Region:

a)PS ER's Rating 'R**e**r' = ($X_1 + X_2 + .. + X_n$)
b)PS WR's Rating 'R**w**r' = ($X_1 + X_2 + .. + X_n$)
c)PS SR's Rating 'R**s**r' = ($X_1 + X_2 + .. + X_n$)
d)PS NR's Rating 'R**n**r' = ($X_1 + X_2 + .. + X_n$)
e)**Over all Power Sector Region Rating** 'R_{BHEL}'= (R**e**r+ R**w**r+ R**s**r+ R**n**r) divided by (N**e**r+ N**w**r+ N**s**r+ N**n**r)

(where "$X_1, X_2, X_3,…X_n$" is the net weighted score obtained by the bidder as per the "Evaluation of Contractor Performance (Quarterly)" against the various contracts 'n' under execution in the respective Region).

ii) Weightage "B" assigned to bidders based on Overall Power Sector Rating **(R_{BHEL}):**

a)If R_{BHEL} is 80% and above, "B" will be equal to '6'
b)If R_{BHEL} is > 70% < 80%, "B" will be equal to '5'
c) If R_{BHEL} is > 60% < 70%, "B" will be equal to '4'
d) If R_{BHEL} is = < 60%, "B" will be equal to '0'

III. Evaluation of Bidders capacity to execute the job under tender:

shall be based on the sum of scores obtained in 'A' and 'B', as below:

a) 6 or above : Considered 'Qualified' for the job under tender
b) Less than 6: Considered 'NOT Qualified' for the job under tender

IV. **Explanatory note**:

a) Similar work means Boiler or Turbine or Civil or Electrical or CI, etc as detailed in the scope irrespective of rating of Plant.

b) Quarter shall be as per the quarter defined in the "Evaluation of Contractor performance (Quarterly)". For contracts where annexed Quarterly Evaluation performance was not part of the contract, 'Quarterly Performance Reports' previous to the last quarter reckoned from the date of latest due date of

submission, given by the respective project site against the contract will be the basis for evaluation.

c) Vendors who are not executing any jobs presently in the Region and first timers to the Region, may be considered subject to satisfying all other tender conditions

d) 'Under execution' shall mean works in progress upto Boiler Steam Blowing (for Boiler and Auxilliaries) or Synchronisation (for all other jobs including Civil) shall be considered.

10.0 Since the job shall be executed at site**,** bidders must visit site/ work area and study the job content, facilities available, availability of materials, prevailing site conditions including law & order situation etc before quoting for this tender. They may also consult this office before submitting their offers, for any clarifications regarding scope of work, facilities available at sites or on terms and conditions. No additional claim shall be entertained by BHEL in future, on account of non-acquaintance of above.

11.0 For any clarification on the tender document, the bidder may seek the same in writing or through e-mail, as per specified format, within the scheduled date for seeking clarification, from the office of the undersigned. BHEL shall not be responsible for receipt of queries after due date of seeking clarification due to postal delay or any other delays. Any clarification / query received after last date for seeking clarification may not be normally entertained by BHEL and no time extension will be given.

12.0 BHEL may decide holding pre-bid discussion [PBD] with all intending bidders as per date indicated in the NIT. The bidder shall ensure participation for the same at the appointed time, date and place as may be decided by BHEL. Bidders shall plan their visit accordingly. The outcome of pre-bid discussion (PBD) shall also form part of tender.

13.0 In the event of any conflict between requirement of any clause of this specification/ documents/ drawings/data sheets etc or requirements of different codes/standards specified, the same to be brought to the knowledge of BHEL in writing for clarification before due date of seeking clarification (whichever is applicable), otherwise, interpretation by BHEL shall prevail. Any typing error/missing pages/ other clerical errors in the tender documents, noticed must be pointed out before pre-bid meeting/submission of offer, else BHEL's interpretation shall prevail.

14.0 Unless specifically mentioned otherwise, bidder's quoted price shall deemed to be in compliance with tender including PBD.

15.0 Bidders shall submit Integrity Pact Agreement (Duly signed by authorized signatory who signs in the offer), **if applicable**, along with techno-commercial bid. This pact shall be considered as a preliminary qualification for further participation. **The names and other details of Independent External Monitor (IEM) for the subject tender is as given at point (xi) of 1 above.**

16.0 The Bidder has to satisfy the Pre Qualifying Requirements stipulated for this Tender in order to be qualified. The Price Bids of only those bidders will be opened who will be qualified for the subject job on the basis of pre-qualification evaluation/ techno-commercial bids, approval/ acceptance of customer (as applicable), etc. and date of opening of price bids shall be intimated to only such bidders.

17.0 In case BHEL decides on a `Public Opening', the date & time of opening of the sealed PRICE BID shall be intimated to the qualified bidders and in such a case, bidder may depute one authorised representative to witness the price bid opening. BHEL reserves the right to open 'in-camera' the 'PRICE BID' of any or all Unsuccessful/Disqualified bidders under intimation to the respective bidders.

18.0 Validity of the offer shall be for **six months** from the latest due date of offer submission (including extension, if any) or specified otherwise in SCC of tender.

19.0 BHEL reserves the right to decide the successful bidder on the basis of Reverse Auction process. In such case all qualified bidders will be intimated regarding procedure/ modality for Reverse Auction process prior to Reverse Auction and price will be decided as per the rules for Reverse Auction. .

However, if reverse auction process is unsuccessful as defined in the RA rules/procedures, or for whatsoever reason, then the sealed 'PRICE BIDs' will be opened for deciding the successful bidder. BHEL's decision in this regard will be final and binding on bidder.

20.0 On submission of offer, further consideration will be subject to compliance to tender & qualifying requirement and customer's acceptance, as applicable.

21.0 In case the bidder is an "Indian Agent of Foreign Principals", 'Agency agreement has to be submitted along with Bid, detailing the role of the agent along with the terms of payment for agency commission in INR, along with supporting documents.

22.0 The bidders shall not enter into any undisclosed M.O.U. or any understanding amongst themselves with respect to tender.

23.0 In case Consortium Bidding is allowed as per Pre Qualifying Requirement, then Prime Bidder and Consortium Partner shall enter into Consortium Agreement. Validity period of Consortium Agreement shall be 6 months after which the same can be re validated.

'Stand alone' bidder cannot become a '**prime bidder' or a 'consortium bidder' in a consortium bidding**. Prime bidder shall neither be a consortium partner to other prime bidder nor take any other consortium partners. However, consortium partner may enter into consortium agreement with other prime bidders. In case of non compliance, consortium bids of such Prime bidders will be rejected. .

24.0 The bidder shall submit documents in support of possession of 'Qualifying Requirements" duly self certified and stamped by the authorized signatory, indexed and properly linked in the format for PQR. In case BHEL requires any other documents/proofs, these shall be submitted immediately.

25.0 The bidder may have to produce original document for verification if so decided by BHEL.

26.0 **Mode of award of work:**

(i) There are six units of 150 MW each at Aditya Aluminium Project, Lapanga. The quantity indicated in the price bid is for one Unit only. The quantity for each of the Units 1 to 6 is also same.

(ii) The L1 bidder against this quote will be awarded the contract for any one unit of Aditya Aluminium Project, Lapanga.

(iii) BHEL reserves the right to award the contract for each of the balance five Units of Aditya Aluminium Project, Lapanga on the same terms and conditions of SCT 1447 to the next five lowest bidders in the order of competitiveness who should match his quoted rates / price with awarded price / rate of the awarded Unit. If number of technically qualified bidders is less than six, then the right of awarding shall remain with BHEL to award more than one unit to one or more bidders among those who had matched the price as said herein.

(iv) In case the other bidders in their order of competitiveness do not accept to match their rates /price with awarded price / rate of awarded Unit, then BHEL reserves the option to consider the L1 bidder, for award of works of one or more of balance Units also at the same rate / Price and at the same Terms & Conditions of the awarded Unit. This will be solely at the discretion of BHEL and the L1 bidder, who is awarded the work of one Unit, shall not have any claim as a matter of right for award of any or all of balance Units work to him, on conditions whatsoever.

(v) Incase BHEL, at its discretion opts to go for re-tendering for award of work for balance Units, then the L1 bidder who is awarded with one Unit work shall not be considered for the balance Units.

(vi) Each unit will be treated as a separate contract.

27.0 **Order of Precedence**

In the event of any ambiguity or conflict between the Tender Documents, the order of precedence shall be in the order below:

a. Amendments/Clarifications/Corrigenda/Errata etc issued in respect of the tender documents by BHEL
b. Notice Inviting Tender (NIT)
c. Price Bid
d. Technical Conditions of Contract (TCC)—Volume-1A
e. Special Conditions of Contract (SCC) —Volume-1B
f. General Conditions of Contract (GCC) —Volume-1C
g. Forms and Procedures —Volume-1D

For BHARAT HEAVY ELECTRICALS LTD

AGM /SCT

Enclosure

01. Annexure-1: Pre Qualifying criteria.
02. Annexure-2: Check List.
03 Other Tender documents as per this NIT.

ANNEXURE - 1

PRE QUALIFYING CRITERIA

JOB	Handling at site stores / storage yard, transportation to site of work, Erection, Testing and Commissioning of Boiler Structures, Pressure Parts, Non Pressure Parts, Rotating Machines including Supply & Application of Final Painting of 6 X 150 MW sets at Aditya Aluminium Project, Lapanga, District Sambalpur, Orissa.
TENDER NO	**BHEL PSSR SCT 1447**

Sl. No	**PRE QUALIFICATION CRITERIA**	**Bidders claim in respect of fulfilling the PQR Criteria**	
		Name and Description of qualifying criteria	Page no of supporting document
A	Submission of Integrity Pact duly signed (if applicable)	**Not applicable**	
B	Assessment of Capacity of Bidder to execute the work as per sl no 9 of NIT (if applicable)	**Shall be applicable for Bid Evaluation from 1st Jan 2011**	
C	**Technical** Refer Annexure -3		
D 1	**Financial** **TURNOVER** Bidders must have achieved an average annual financial turnover (audited) of **Rs 283 lakhs** or more over last three financial years i.e., 2007-08, 2008-09 & 2009-10		
D2	**NETWORTH** Net worth of the bidder based on the latest audited accounts as furnished for 'D1' above should be positive.		
D3	**PROFIT** Bidders must have earned profit in any one of the three financial years in the last three years		

	defined in 'D1' above		
D4	In case bidder submits offer with **backup guarantor** then the backup guarantor should also meet the financial criteria as furnished in D1,D2& D3 above		
E	Approval of Customer (if applicable) Note: Names of bidders who stand qualified after compliance of criteria A to D shall be forwarded to customer for their approval. Price bid of only those bidders shall be opened who are approved by customer.	**Applicable**	
F	Consortium criteria (if applicable)	**Not applicable**	
G	Notwithstanding the above, BHEL reserves the right to reject any or all the Tenders for reasons whatsoever beyond its control and the decision of BHEL is final.	**Applicable**	
	Explanatory Notes for QR 'A' 1.The word 'executed' means the bidder should have achieved the criteria specified in the QR even if the total contract has not been completed or closed 2.Bidder to submit Audited Balance Sheet and Profit and Loss Account for the respective years as given above along with all annexures (a) The word 'executing' means ----------		

BIDDER SHALL SUBMIT ABOVE PRE-QUALIFICATION CRITERIA FORMAT, DULY FILLED-IN, SPECIFYING RESPECTIVE ANNEXURE NUMBER AGAINST EACH CRITERIA AND FURNISH RELEVANT DOCUMENT (copies of Work order / LOI / LOA and work completion certificate) IN THE RESPECTIVE ANNEXURES IN THEIR OFFER.

ANNEXURE - 2

CHECK LIST

NOTE: - Tenderers are required to either fill in or submit separately the following details.

1	Name and Address of the Tenderer			
2	Details about type of the Firm / Company			
3a	Details of Contact person for this Tender: Name : Mr / Ms Designation: Telephone No: Mobile No: Fax No: E-mail ID:			
3b	Details of alternate Contact person for this Tender: Name : Mr / Ms Designation: Telephone No: Mobile No: Fax No: E-mail ID:			
4	EMD DETAILS	DD No: Date : Bank : Amount: Please tick (√) whichever applicable:- ONE TIME EMD / ONLY FOR THIS TENDER		
5	Validity of offer	To be valid for six months from due date		
			APPLICABILITY	BIDDER REPLY
6	Whether the format for compliance with **PRE QUALIFICATION CRITERIA** (ANNEXURE-I) is understood and filled with proper supporting documents referenced in the specified format		Applicable / Not applicable	YES / NO
7a	Audited profit and Loss Account for the last three years submitted		Applicable / Not applicable	YES/NO
7b	Audited profit and Loss Account of backup guarantor for the last three years submitted		Applicable / Not applicable	YES/NO

8	Copy of PAN Card submitted	Applicable / Not applicable	YES/NO
9	Whether all pages of the Tender documents including annexures, appendices etc are read understood and signed	Applicable / Not applicable	YES/NO
10	Integrity Pact	Applicable / Not applicable	YES/NO
11	Declaration by Authorised Signatory	Applicable / Not applicable	YES/NO
12	No Deviation Certificate	Applicable / Not applicable	YES/NO
13	Declaration confirming knowledge about Site Conditions	Applicable / Not applicable	YES/NO
14	Declaration for relation in BHEL	Applicable / Not applicable	YES/NO
15	Non Disclosure Certificate	Applicable / Not applicable	YES/NO
16	Bank Account Details for E-Payment	Applicable / Not applicable	YES/NO
16	Capacity Evaluation of Bidder for current Tender	Applicable / Not applicable	YES/NO
17	Tie Ups / Consortium Agreement are submitted as per format	Applicable / Not applicable	YES/NO
18	Power of Attorney for Submission of Tender / Signing Contract Agreement	Applicable / Not applicable	YES/NO
19	Analysis of Unit rates	Applicable / Not applicable	YES/NO
20	Unquoted price bid submitted or not	Applicable / Not applicable	YES/NO

NOTE: STRIKE OFF ‘YES’ OR ‘NO’, AS APPLICABLE

DATE:

AUTHORISED SIGNATORY
(With Name, Designation and Company seal)

Rev 00
6th July
2010

VOLUME – IA
Part I & II
TECHNICAL CONDITIONS OF CONTRACT (TCC)

(Document No PS:MSX:TCC)

BHARAT HEAVY ELECTRICALS LIMITED

CONTENTS

VOLUME-IA PART-I CHAPTER-I
PROJECT INFORMATION

1	Name of the Project	Aditya Aluminium Project,Lapanga,Orissa
2	Station Capacity	6 x 150 MW
3	Owner	Hindalco Industries Limited, Mumbai.
4	Consultant	M/s DCPL
5	Site Location	Aditya Aluminium Project, Lapanga, Sambalpur ,Dist, Orissa
6	Latitude	-20 54" N
7	Longitude	-84 59"E
8	MSL	173 M Above MSL
9	Nearest Highway	SH- 10
10	Nearest Town / City	Angul 15 KM. South East
11	Nearest Railway Station	1. Angul Railway station on SE & 25 Kms from site 2. Kerjang Railway station of SE 7 Kms from Site
12	Nearest Air port	Bhubaneswar – 128 KM
13	Metrological Data	
	A) Temperature	
	i. Average Max Temperature	34.5 Deg C
	ii. Average Min Temperature	22.3 Deg C
	iii. Highest Max Temperature	47.2 Deg C
	iv. Lowest Minimum Temperature	9.0 Deg C
	v. Temperature to be considered for design of Electrical Equipments / Devices	50 Deg C
	B) Relative Humidity average	63%
	C) Rainfall (Average Annual)	1329 mm
	D) Wind Data / Basic Speed	50 M / Sec
	E) Seismic Data	Zone III
14	Languages spoken in the region	English, Oriya
15	Language for communication with Sub- Contractor / Vendors	English
16	Tropicalisation	All Equipments supplied against this specification shall be given tropical and fungicidal treatment in view of climatic conditions prevailing at site
17	Supply Voltage	3 Phase 415 Volts

VOLUME-IA PART – I CHAPTER – II
SCOPE OF WORKS

1.2.1 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, touch up painting , erection, leveling, alignment, and other adjustments, cutting, edge/surface preparation, welding, grinding, RT/LPI/MPI testing wherever needed, heat treatment, carrying out air tightness test by soap solution / kerosene (with air blower arrangement), pre-commissioning, commissioning, testing and trial run of Boiler Structures, Pressure Parts, Non Pressure Parts, Rotating Equipments (**including acoustic insulation**) and connected auxiliaries, supply and application of final painting covered under the tender specifications and providing assistance during commissioning and unit trial operations of 6 X 150 MW sets at Aditya Aluminium Project, Lapanga, District Sambalpur, Orissa.

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

1.2.2.1 Receipt of materials / component to be erected by the contractor, loading and transportation from the storage yard to the project site, stacking, storage and preservation.

1.2.2.2 Preassembly, Erection, Testing, Commissioning, Trial operation and reliability operation of equipment.

1.2.2.3 Final painting including supply of paints.

1.2.2.4 Arranging temporary piping, equipment for Hydro Test, chemical cleaning, steam blowing etc. Supply of chemicals during commissioning will be by BHEL.

1.2.3 **WELDING SCHEDULES**

1.2.3.1 The number of joints indicated in the welding schedules (site weld data) is approximate only and liable for variation, as per site conditions and also design consideration of manufacturing unit.

1.2.3.2 The welding process, weld joint and material specification may change to suit site requirement.

1.2.3.3 The list is furnished only for estimation purpose. The contractor is not entitled for any additional payment even if there is any increase in quantum of welding.

1.2.3.4 The contractor shall weld the joints of site routing piping as per site requirement, no extra payment shall be made for such additional joints.

Note:

FOR FURTHER DETAILED SCOPE OF WORKS REFER RELEVANT CHAPTERS IN THIS BOOK

VOLUME-IA PART – I CHAPTER – III

FACILITIES IN THE SCOPE OF CONTRACTOR / BHEL (SCOPE MATRIX)

Sl.No	Description	Scope to be taken care by		Remarks
1.3.1	PART I	BHEL	Bidder	
1.3.1.1	ESTABLISHMENT			
1.3.1.1.1	FOR CONSTRUCTION PURPOSE:			
1.3.1.1.1.1	Open space for office	Yes		
1.3.1.1.1.2	Open space for storage	Yes		
1.3.1.1.1.3	Construction of bidder's office, canteen and storage building including supply of materials and other services		Yes	
1.3.1.1.1.4	Bidder's all office equipments, office / store / canteen consumables		Yes	
1.3.1.1.1.5	Canteen facilities for the bidder's staff, supervisors and engineers etc		Yes	
1.3.1.1.1.6	Fire fighting equipments like buckets, extinguishers etc		Yes	
1.3.1.1.1.7	Fencing of storage area, office, canteen etc of the bidder		Yes	
1.3.1.1.2	FOR LIVING PURPOSES OF THE BIDDER			
1.3.1.1.2.1	Open space		Yes	
1.3.1.1.2.2	Living accommodation		Yes	
1.3.1.2	ELECTRICITY			
1.3.1.2.1	Electricity For construction purposes (to be specified whether chargeable or free)			
1.3.1.2.1.1	Single point source	Yes		
1.3.1.2.1.2	Further distribution for the work to be done which include supply of materials and execution		Yes	
1.3.1.2.2	Electricity for the office, stores, canteen etc of the bidder which include:		Yes	
1.3.1.2.2.1	Distribution from single point including supply of materials and service		Yes	
1.3.1.2.2.2	Supply, installation and connection of material of energy meter including operation and maintenance		Yes	
1.3.1.2.2.3	Duties and deposits including statutory clearances for the above		Yes	
1.3.1.2.2.4	Living facilities for office use including charges		Yes	
1.3.1.2.2.5	Demobilization of the facilities after completion of works		Yes	

Sl.No	Description	Scope to be taken care by		Remarks
1.3.1	PART I	BHEL	Bidder	
1.3.1.2.3	Electricity for living accommodation of the bidder's staff, engineers, supervisors etc on the above lines.(in case BHEL provides this facility, the scope should be given without ambiguity)		Yes	
1.3.1.3	WATER SUPPLY			
1.3.1.3.1	For construction purposes:			
1.3.1.3.1.1	Making the water available at single point	Yes		
1.3.1.3.1.2	Further distribution as per the requirement of work including supply of materials and execution		Yes	
1.3.1.3.2	Water supply for bidder's office, stores, canteen etc			
1.3.1.3.2.1	Making the water available at single point		Yes	
1.3.1.3.2.2	Further distribution as per the requirement of work including supply of materials and execution		Yes	
1.3.1.4	LIGHTING			
1.3.1.4.1	For construction work (supply of all the necessary materials) At office storage area At the preassembly area At the construction site /area		Yes	
1.3.1.4.2	For construction work (Execution of the lighting work / arrangements) At office storage area At the preassembly area At the construction site /area		Yes	
1.3.1.5	COMMUNICATION FACILITIES for site operations of the bidder	-		
1.3.1.5.1	Telephone, Fax, internet, intranet, email etc		Yes	
1.3.1.6	COMPRESSED AIR SUPPLY			
1.3.1.6.1	Supply of Compressor and all other equipments required for compressor & compressed air system including pipes, valves, storage systems etc	-	YES	
1.3.1.6.2	Installation of above system and operation & maintenance of the same	-	YES	
1.3.1.6.3	Supply of the all the consumables for the above system during the contract period		YES	

Sl.No	Description	Scope to be taken care by		Remarks
1.3.2	PART II	BHEL	Bidder	
1.3.2.1	ERECTION FACILITIES			
1.3.2.1.0	Engineering works for construction			
1.3.2.1.1	Providing the erection drawings for all the equipments covered under this scope	Yes		
1.3.2.1.2	Drawings for construction methods		Yes	In consul tation with BHEL
1.3.2.1.3	As-built drawings – wherever deviations observed and executed and also based on the decisions taken at site- example – routing of small bore pipes	Yes	Yes	,,
1.3.2.1.4	Shipping lists etc for reference and planning the activities	Yes	Yes	”
1.3.2.1.5	Preparation of site erection schedules and other input requirements		Yes	”
1.3.2.1.6	Review of performance and revision of site erection schedules in order to achieve the end dates and other commitments		Yes	
1.3.2.1.7	Weekly erection schedules based on Sl No 1.3.2.1.5		Yes	
1.3.2.1.8	Daily erection / work plan based on Sl No 1.3.2.1.7		Yes	For daily monitoring meeting at site
1.3.2.1.9	Periodic visit of the senior official of the bidder to site to review the progress so that works are completed as per schedule. It is suggested this review by the senior official of the bidder should be done once in every two months.		Yes	
1.3.2.1.10	Preparation of preassembly bay		Yes	
1.3.2.1.11	Laying of racks for gantry crane if provided by BHEL or brought by the contractor/bidder himself		Yes	

1.3.3 **OPEN SPACE:**

Minimum Open space will be provided at free of charges to the contractor for construction of temporary office shed, contractor’s stores shed(s). Contractor has to make his own arrangements for labour colony.

1.3.4 **ELECTRICITY:**

1.3.4.1 Electricity will be provided at one point on free of charge for construction purpose only. Further distribution shall be arranged by the contractor at his cost.

1.3.4.2 Any duty, deposit involved in getting the Electricity shall be borne by the bidder. As regards contractor's office shed also all such expenditure shall be borne by the contractor.

1.3.4.3 Provision of distribution of electrical power from the given single central common point to the required places with proper distribution boards, approved cables 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.

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

1.3.4.5 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. 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 to get urgent and important work to go on without interruptions. No separate payment shall be made for this contingency.

1.3.4.6 If required, 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.

1.3.5 **WATER:**

Electricity will be provided at one point on free of charge for construction purpose only. Further distribution shall be arranged by the contractor at his cost.

VOLUME-IA PART – I CHAPTER – IV

T&PS and MMEs TO BE DEPLOYED BY CONTRACTOR

The following minimum major Tools & Plants shall be deployed by the contractor for execution of this contract with in the quoted rate:

S no	Description	Capacity	Minimum quantity	Remarks
1	Pick & Carry crane	8 T	01	
2	Crawler crane	18 T	01	
3	Crawler crane	75 T	01	
4	Trailer	40 T	01	
5	Winches with ropes, sheaves pulleys etc –for drum lifting		As required.	

NOTE:

1. For loading and transportation, all necessary T&P such as Trailers, Cranes, Winches, welding generators, slings, jacks, sleepers, rails etc., are to be arranged by the contractor. All the tools & plants required for this scope of work, except the tools & plants provided by BHEL are to be arranged by the contractor within the quoted rates.

2. All heavy items like boiler drum etc., unloaded at stores nearby to foundation have to be transported to erection site. For loading and transportation, all necessary T&P such as Trailors, Cranes, Winches, welding generators, slings, jacks, sleepers, rails etc., are to be arranged by the contractor.

3. As there are bound to be interruptions in regular power supply, power cut/ load shedding in any construction site due to inherent power shortage in the state. It shall be the responsibility of the contractor to have minimum numbers of diesel operated welding generator sets to get urgent and important work to go on without interruptions. The consumables required to operate the generators are to be provided by the bidders at their cost.

4. Depending upon the nature of work and availability of facilities locally, contractor may have to arrange for a temporary workshop for facilitating uninterrupted progress of work.

5. The availability of crane is likely to be hampered from time to time due to routine preventive maintenance or breakdown maintenance. Contractor has to make alternative arrangement or plan / modify / alter his activities to suit the above conditions and the contractor will not be liable for any compensation or extension of time due to this non availability, for maintaining the erection schedule.

VOLUME-IA PART – I CHAPTER - V

T&Ps AND MMEs TO BE DEPLOYED BY BHEL ON SHARING BASIS

List of T&Ps to be made available by BHEL to contractor free of hire charges on sharable basis.

S. No	Description	Quantity
01	Crane- above 75 T capacity	As required
02	Hydraulic pressure testing pump	2 Nos
03	Chemical cleaning Pump	1 Set
04	Sky climber	1 Set
05	Air Blower	1 No

Note:

1. **BHEL Cranes will be available to contractor only after the contractor deploys the minimum T& Ps mentioned in Sl no 1 to 3 of the table in Part I Chapter IV.**
2. BHEL may provide either BHEL owned cranes or hired cranes at the discretion of BHEL.

   In the event of providing BHEL Cranes**:**

   (i) Operator will be provided by BHEL

   (ii) Fuel has to be arranged by the bidder at their cost

   In the event of providing hired cranes**:**

   The fuel charges shall be recovered as given below:

   For 75 T crane: Rs. 120/hr
   For 150 T/ 135 T/100T crane: Rs 200 /hr
   For Heavy duty crane: Rs 250 /hr

3. Besides the T & P mentioned above, which is being made available to the contractor on free of hire charges, any additional crane and other T & P which may be required for successful and timely execution of the work covered within the scope of this tender shall be arranged and provided at site by the contractor at his cost. In case if the contractor fails to provide such equipments, BHEL will arrange for the same and the cost will be recovered from the contractor's bill with BHEL overheads, as applicable from time to time which may vary even during contract period.
4. All the distribution boards, connecting cables, hoses etc., and temporary connection work including electrical connections shall have to be arranged by the contractor at his cost.

5. Cranes are only for erection purpose and shall not be available for material handling or transportation purpose. Contractor shall make their own arrangements for material transportation to erection site.
6. The contractor at his cost shall arrange for grouting of anchor points of T & Ps issued to him. Necessary grout materials are to be arranged by the contractor at his cost.
7. For higher capacity crane, the required consolidation and preparation of ground and placing the same (including civil work with material) is covered in the scope of contract. The scope includes raising the ground level by 1 M.
8. Filling pump for hydro Test is to be arranged by the contractor.

VOLUME-IA PART – I CHAPTER-VI
TIME SCHEDULE

1.6.1 TIME SCHEDULE

1.6.1.1 The entire work of erection testing and commissioning of Boiler Structures, Pressure Parts, Non Pressure Parts, Rotating Machines including Supply & Application of Final Painting, as detailed in the Tender Specification shall be completed within **14 (fourteen) months** from the date of commencement of work at site.

1.6.1.2 During the total period of contract, the contractor has to carryout the activities in a phased manner as required by BHEL and the program of milestone events.

1.6.1.3 The erection work shall be commenced on the mutually agreed date between the bidder and BHEL engineer and shall be deemed as completed in all respect only when the unit is in operation. The decision of BHEL in this regard shall be final and binding of the contractor. The scope of work under this contract is deemed to be completed only when so certified by the site Engineer.

1.6.2 COMMENCEMENT OF CONTRACT PERIOD

The date of commencement of contract period shall be the mutually agreed date between the bidder and BHEL engineer to start the work. In case of discrepancy the decision of BHEL engineer is final.

1.6.3 MOBILISATION FOR ERECTION, TESTING, ASSISTANCE FOR COMMISSIOING ETC.,

The activities for erection, testing etc shall be started as per directions of Construction manager of BHEL.

The contractor has to augment his resources in such a manner that following major milestones of erection & commission are achieved on specified schedules:

Major milestones for the unit which starts first	
DESCRIPTION	**MILESTONE MONTH**
Boiler Erection Start **(Expected)**	Jan-2011
Drum Lifting	3rd month
Boiler Hydro Test	6th month
Boiler Light Up	8th month
Steam Blowing	10th month
Synchronisation	10th month
Trial Operation / Handing Over	

The phase shift between each Unit will be two months.

1.6.4 In order to meet above schedule in general, and any other intermediate targets set, to meet customer / project schedule requirements, contractor shall arrange & augment all necessary resources from time to time on the instructions of BHEL.

1.6.5 **In case any requirement is there to compress the schedule of activities to achieve project completion, then the additional expenses if any incurred will be discussed mutually and settled. BHEL decision in this regard is final and the issue is not arbitrable.**

1.6.6 CONTRACT PERIOD

The contract period for completion of entire work under scope shall be **14 (Fourteen) months** from the "START OF CONTRACT PERIOD" as specified earlier.

1.6.7 GUARANTEE PERIOD FOR EACH UNIT

The guarantee period of twelve months shall commence from the date of handing over of the Unit to Customer or six months from the date of first synchronisation of the set, whichever is earlier (Provided all erection, testing, and commissioning works are completed in all respects).

VOLUME-IA PART – I CHAPTER-VII
TERMS OF PAYMENT

1.7.0 Terms of payment :

The progressive payment for erection, testing and commissioning on accepted rate / price of contract value will be released as mentioned below in Cl 1.7.1 & 1.7.2.

1.7.1 Progressive Payment against monthly running bills will be made upto 85 % of the value of the erected tonnage Pro rata as per Cl no 1.7.1.1 to 1.7.1.20 of the following table.

1.7.2 Further 15 % payment on pro-rata basis common to all PG shall be released on achievement of the following stage / milestones events (as per Cl no 1.7. 2.1 to1.7.2.19 of the following table) for the tonnage erected.

SL NO	**Contract (Main Package) Identitification ----->**	**Boiler**				**Rotating Machine**
	Rate schedule Identification ------->	**Structure**	**Pressure Parts**	**Non Pressure Parts (upto ESP inlet Funnel)**	**Air Pre Heaters**	**1) RM 2) Handling Eqpts**
	PRO RATA PAYMENTS (85%)					
I.7.1.1	ON PRE-ASSEMBLY WHEREVER APPLICABLE (If not applicable, then this portion shall be clubbed with placement in position)	20	20	25	--	15
I.7.1.2	PLACEMENT IN POSITION	15	10	10	--	20
I.7.1.3	ALIGNMENT	15	15	10	--	20
I.7.1.4	WELDING/BOLTING/FIXING	15	20	15	--	20
I.7.1.5	COMPLETION OF NON DESTRUCTIVE EXAMINATION & STRESS RELIEVING / HEAT TREATMENT (if not applicable, then this portion to be paid along with welding)	5	10	--	--	--
	On Drum Lifting	--	--	--	--	--
I.7.1.6	COMPLETION OF ATTACHMENT WELDING, FIN WELDING, SUPPORTS	--	5	--	--	--

I.7.1.7	COMPLETION OF ROOF SKIN CASING	--	5	--	--	--
I.7.1.8	HANGERS & SUPPORTS ETC WHEREVER NECESSARY AS PER DRG	--	--	25	--	--
I.7.1.9	COMPLETION OF FURNACE ALIGNMENT AND FIRE BALL CHECKING	5	--	--	--	--
1.7.1.10	COMPLETION OF BACK PASS ALIGNMENT	5	--	--	--	--
I.7.1.11	COMPLETION OF VIBRATION SNUBBERS, MECHANICAL SPACERS, CASSETTE BAFFLES, STEAM COOLED SPACERS	5	--	--	--	--
I.7.1.12	EQUIPMENT TRIAL OPERATION	--	--	--	--	10
	AIR PRE HEATERS (PG 52) **From the total amount payable for the PGMA weight at tonnage rates, payment will be regulated as under:**	--	--	--	--	--
1.7.1.13	Completion of Support steel squareness and leveling, Expansion arrangement, Housing panel erection and alignment, Erection, alignment and welding of pedestals	--	--	--	11	--
I.7.1.14	Completion of Erection, alignment and welding of Support Bearing, Guide Bearing, Rotor post, Bottom and Top centre sections, Hot & cold end connecting plates	--	--	--	14	--
I.7.1.15	Completion of erection and alignment of modules	--	--	--	15	--
1.7.1.16	Completion of erection, alignment and welding of Pin Rack assembly and Drive assembly	--	--	--	12	--
I.7.1.17	Completion of seals setting	--	--	--	17	--

I.7.1.18	Erection, alignment and welding of Lube oil systems, Cleaning Device, Fire sensing device, Deluge and water wash lines, Observation port and lighting assemblies and other accessories	--	--	--	13	--
1.7.1.19	Completion of PGMA	--	--	--	1	--
I.7.1.20	Air preheater Trial Run	--	--	--	2	--
	TOTAL FOR PRO RATA PAYMENTS (TOTAL 85%)	**85**	**85**	**85**	**85**	**85**
	STAGE/MILESTONE PAYMENTS (15%)					
1.7.2.1	AIR & GAS TIGHTNESS TEST	--	--	5	--	--
1.7.2.2	COMPLETION OF AIR & GAS TIGHTNESS TEST FOR FURNACE	--	2	--	--	--
1.7.2.3	BOILER HYDRAULIC TEST (DRAINABLE)	--	2	--	--	--
1.7.2.4	BOILER HYDRAULIC TEST (NON DRAINABLE)	--	1	--	--	--
1.7.2.5	Reheater Coils Hydraulic Test	--	2	--	--	--
1.7.2.6	Clean Air Flow test	--	--	--	--	1
1.7.2.7	Boiler Light Up	--	1	--	2	1
1.7.2.8	ABO	--	1	1	2	1
1.7.2.9	Steam Blowing	--	--	2	1	1
1.7.2.10	Safety Valve Floating	--	2	--	2	--
1.7.2.11	Coal Firing	--	--	2	2	2
1.7.2.12	Full Load	--	--	--	--	1
1.7.2.13	Trial Operation of Unit	--	--	--	--	2
1.7.2.14	Completion of sheet covering for Boiler roof, burner roof, lift shaft cladding, completion of gutters	3	--	--	--	--
1.7.2.15	Painting	6	0	1	1	2
1.7.2.16	Area cleaning, temporary structures cutting/removal and return of scrap	1	1	1	1	1

1.7.2.17	Punch List points/pending points liquidation	2	1	1	2	1
1.7.2.18	Material Reconciliation	2	1	1	1	1
1.7.2.19	Completion of Contractual Obligation	1	1	1	1	1
	TOTAL FOR STAGE / MILESTONE PAYMENTS (15%)	**15**	**15**	**15**	**15**	**15**
	TOTAL I + II	**100**	**100**	**100**	**100**	**100**

1.7.3 In case any requirement is there to compress the schedule of activities to achieve project completion, then the additional expenses if any incurred will be discussed mutually and settled. BHEL decision in this regard is final and the issue is not arbitrable.

Note:

1. Recovery of Retention amount as per Cl. 2.22 of GCC (Volume IC).
2. RA bill payments as per Chapter-X of SCC (Volume IB)
3. Payment for 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. Unqualified Acceptance for Detailed L.O.I.
   - v. Security Deposit as per GCC
   - vi. Rs 100 /- Stamp Paper for Preparation of Contract agreement.

VOLUME-IA PART – I CHAPTER VIII
TAXES AND OTHER DUTIES

1.8.0 TAXES

1.8.1 Value Added Tax (VAT) for the works

1.8.1.1 **Price quoted shall be inclusive of VAT except service tax.**

1.8.1.2 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., inter alia indicating the name of the supplier, address and VAT Registration No. and VAT paid for the purchases, etc

1.8.1.3 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.

1.8.1.4 The monthly/quarterly VAT return, duly incorporating the erection income from BHEL as turnover, should be submitted to BHEL at regular intervals with all annexure and details of payment of VAT (WCT).

1.8.1.5 You have to obtain VAT Clearance Certificate from the on concerned authorities as per the provisions of local VAT act, on completion of the project and submit along with the final bill.

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

1.8.2.0 **Service Tax**

1.8.2.1. 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.

1.8.3.0 **Other Taxes & Levies**

1.8.3.1 Any other taxes and duties (except VAT & Service Tax) if any, as applicable, viz. Entry Tax, Octroi, 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.

1.8.4.0 **New Levies / Taxes**

1.8.4.1 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 actual on submission of documentary proof of payment subject to the satisfaction of BHEL that such new levy / tax is applicable to this contract..

1.8.5.0 **Statutory variations**

1.8.5.1 Statutory variations are applicable only in the cases of Value Added Tax and Service Tax. The changes implemented by the Central / State Government in the VAT Act / Service Tax during the tenure of the contract viz. increase / decrease in the rate of taxes, applicability, etc. and its impact on upward revision / downward revision are to be suitably 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.

1.8.6.0 **Direct Tax**

1.8.6.1 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.

VOLUME-IA PART – I CHAPTER - IX
WEIGHT SCHEDULE

1.9.1 WEIGHT SCHEDULE - SUMMARY

SL.NO	DESCRIPTION	WEIGHT IN MT per Unit	Rate schedule Id
01	STRUCTURES	2062	STR
02	PRESSURE PARTS	1549	PP
03	NON – PRESSURE PARTS	1590	NPP
04	ROTATING MACHINES	673	RM

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 tonnage actually erected at the quoted rate only.

2. Besides PG/PGMA indicated in the weight schedule, there is likelihood of addition product groups integral to Boiler and its Aux. The quoted rate shall be applicable for such product group 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 etc. are covered in this contract and shall be carried out within the quoted rate.

5. Imported electrodes/ TIG welding wires released under PGMA XX 992 will be given by BHEL. All other electrodes / TIG welding wires are to be supplied by contractor under his scope.

1.9.2 WEIGHT SCHEDULE-PGMA WISE

PGMA WISE WEIGHT SCHEDULE A)STRUCTURES				
PGMA	PGMA DESCRIPTION	WEIGHT IN KGS	PG WISE TOTAL IN MTs	Rate schedule Id
35-010	Foundation Materials	10191		STR
35-110	Main Columns Left	94527		STR
35-120	Main Columns Right	94527		STR
35-130	Main Columns Middle	55965		STR

35-140	Auxiliary Columns-Le	36712		STR
35-150	Auxiliary Columns-Ri	36712		STR
35-160	Airheater Columns	29255		STR
35-190	Girder Pin Connectio	3208		STR
35-210	Boiler Ceiling Struc	154704		STR
35-220	Boiler Ceiling Struc	49078		STR
35-230	Boiler Ceiling Struc	7053		STR
35-310	Horizontal Bracing I	12135		STR
35-320	Horizontal Bracing I	13577		STR
35-330	Horizontal Bracing I	11322		STR
35-340	Horizontal Bracing I	12739		STR
35-350	Horizontal Bracing V	11478		STR
35-380	Landing Platforms	44968		STR
35-390	Platform At Drum Flo	23843		STR
35-441	Horizontal Beams-Low	38581		STR
35-443	Horizontal Beams-Upp	70198		STR
35-511	Front Bracing-Lower	15299		STR
35-513	Front Bracing-Upper	11626		STR
35-521	Side Bracing-Lower	41632		STR
35-523	Side Bracing-Upper	33659		STR
35-531	Rear Bracing-Lower	27909		STR
35-533	Rear Bracing-Upper	21080		STR
35-610	Boiler Roof Structur	71111		STR
35-611	Boiler Roof Sheeting	20000		STR
35-700	Hsfg Fasteners For P	3475		STR
35-811	Floor Grills And Gua	48033		STR
35-820	Stairs	14756		STR
35-851	Hand Rails And Posts	12611		STR
35-993	Consumables and erecti	12983		STR
	TOTAL WEIGHT FOR PG 35	**1144947**	**1144.947**	STR
36-310	Main Mbl Floor 11th	55000		STR
36-311	Main Floor I Mbl 1st	52000		STR
36-320	Main Floor 12th Leve	31000		STR
36-321	Main Floor Ii Mbl Is	38000		STR
36-330	Main Floor 13th Leve	23081		STR
36-331	Main Floor Iii Mbl 1	18769		STR
36-332	Main Floor Iii Mbl 2	28114		STR
36-340	Main Floor 14th Leve	19742		STR
36-341	Main Floor Iv Mbl 1s	27417		STR
36-350	Main Floor 15th Leve	6583		STR
36-351	Main Floor V Mbl Ist	15074		STR
36-391	Miscellaneous Platfo	55000		STR

36-392	Miscellaneous Platfo	52000		STR
36-610	Boiler Roof Structur	32000		STR
36-611	Boiler Roof Sheeting	13000		STR
36-620	Boiler Side Cladding	5000		STR
36-740	Posts And Hangers	18000		STR
36-813	Floor grills and guard p	90000		STR
36-820	Stairs And Ladders	9258		STR
36-853	Handrails And Posts	58540		STR
36-993	Consumables and erecit	18000		STR
	TOTAL WEIGHT FOR PG 36	**665578**	**665.578**	STR
38-210	Inter Conn Platforms	45000		STR
38-299	Mill Handling Monora	62000		STR
38-310	Conn Platforms To Mi	45000		STR
38-410	Mill Maintenance Pla	60000		STR
38-810	Floor grills And Guar	24000		STR
38-850	Hand Rails And Hand	15000		STR
	TOTAL WEIGHT FOR PG 38	**251000**	**251**	
Total weight for STRUCTURES for one UNIT			**2061.525**	

PGMA WISE WEIGHT SCHEDULE B)PRESSURE PARTS				
PGMA	**PGMA DESCRIPTION**	**WEIGHT IN KGS**	**PG WISE Total in MTs**	**Rate schedule Id**
04-124	Upper Drum Without I	86540		PP
04-144	Upper Drum Sspn Id 4	6760		PP
	TOTAL WEIGHT FOR PG 04	**93300**	**93.3**	
05-137	Inlet Front Lower Ww	6900		PP
05-147	Inlet Rear Lower Ww	6790		PP
05-155	Inlet Side Lower Ww	13290		PP
05-175	Inlet Extended Side	1470		PP
05-227	Water wall Rear Hange	2190		PP
05-229	Water wall Rear Scree	3950		PP
05-231	Outlet Front Upper W	2760		PP
05-251	Outlet Side Upper Ww	5550		PP
	TOTAL WEIGHT FOR PG 05	**42900**	**42.9**	
06-400	Unclassified Burner	14420		PP
06-631	Front Upper Ww Pnl	36785		PP
06-637	Water wall Lower Fron	13945		PP
06-641	Rear Upper Ww Pnl	20240		PP
06-647	Rear Lower Ww Pnl	13945		PP
06-651	Side Upper Ww Pnl	43435		PP

06-655	Side Lower Ww Pnl	23820		PP
06-670	Extended Side Ww Pnl	8210		PP
	TOTAL WEIGHT FOR PG 06	**174800**	**174.8**	
07-108	Down Comer Piping Up	33170		PP
07-109	Down Comer Piping Lo	31816		PP
07-215	Relief Tubes From Si	13260		PP
07-216	Relief Tubes From Re	13005		PP
07-218	Relief Tubes From Fr	5165		PP
07-223	Furnace Screen Tubes	16950		PP
07-225	Furnace Rear Hanger	6070		PP
07-226	Furnace Rear Arch Tu	13770		PP
07-231	Lower Corner Transit	1720		PP
07-232	Upper Corner Transit	620		PP
07-401	Water wall Suspension	12730		PP
07-410	Down comer Suspension	1810		PP
07-420	Down comer Guides	2570		PP
07-431	Riser Tube Support	2110		PP
07-500	Misc Components - Pr	220		PP
07-501	Furnace Insert Tubes	2900		PP
07-601	Pressure Seals	690		PP
07-700	Bulked Bps Items For	785		PP
07-991	Indigenous Electrode	30		PP
07-992	Imported Electrodes	45		PP
07-993	Consumables & Erecti	555		PP
	TOTAL WEIGHT FOR PG 07	**159991**	**159.991**	
08-101	Furnace Upper Buckst	90311		PP
08-104	Furnace Intermediate	5398		PP
08-107	Furnace Lower Buckst	27000		PP
08-111	Furnace Rear Arch Bu	2500		PP
08-400	Furnace Guide	18000		PP
08-700	Ex.Movement Measurem	340		PP
08-900	Furnace Key Buckstay	2451		PP
08-904	Wind box Connecting D	4850		PP
	TOTAL WEIGHT FOR PG 08	**150850**	**150.85**	
09-001	Seal Boxes For Furna	4775		PP
09-002	Seal Boxes For Instr	1730		PP
09-003	Material For Instrum	195		PP
	TOTAL WEIGHT FOR PG 09	**6700**	**6.7**	
10-135	Horizontal Spaced Sh	5470		PP
10-174	Vertical Spaced Sh C	6125		PP
10-178	Vertical Platen Sh 1	4450		PP
10-182	Sh Rear Wall Inlet H	2350		PP

10-183	Sh Front wall Inlet	3300		PP
10-184	Sh Extended Side Wal	680		PP
10-185	Sh Rear Roof Inlet H	2139		PP
10-191	Sh Radiant Wall Roof	2160		PP
10-235	Horizntl Spaced Sh O	7410		PP
10-274	Vertical Spaced Sh C	13705		PP
10-278	Vertical Platen Sh O	4940		PP
10-283	Sh Front wall Outlet	3930		PP
10-284	Sh Extended Side Wal	1060		PP
0-291	Sh Radiant Wall Roof	2630		PP
10-687	Sh Radiant Wall Junc	2100		PP
	TOTAL WEIGHT FOR PG 10	**62449**	**62.449**	
11-236	Sh Hor Spaced Upper	76945		PP
11-237	Sh Hor Spaced Inter	64420		PP
11-274	Sh Vertical Spaced C	36675		PP
11-278	Vert Platen Centre S	46900		PP
11-682	Sh Rear Wall Panels	17515		PP
11-683	Sh Side Wall Panels	27470		PP
11-684	Sh Extended Side Wal	3440		PP
11-685	Sh Front Wall Panels	12435		PP
11-687	Sh Rear Roof Panels	6790		PP
11-691	Sh Radiant Wall Roof	14670		PP
11-694	S.H. Extended Bottom	2440		PP
	TOTAL WEIGHT FOR PG 11	**309700**	**309.7**	
12-174	Vertical Spaced Sh I	4080		PP
12-184	Roof Inlet Sh Pipes	2550		PP
12-187	Sh Inlet Rear Roof P	1630		PP
12-535	Sh Hor Spaced Hanger	21340		PP
12-803	Sh Steam Cooled Spac	790		PP
12-805	Super Heater Hanger	3110		PP
12-850	Sh Conn Pipes-Satura	3590		PP
12-852	Sh Desh Links	3800		PP
12-900	Sh Desh	1355		PP
12-903	5h Miscl Components	29485		PP
12-906	Sh Suprts For Lines	3775		PP
12-914	Suspension Of Sh Rad	410		PP
12-917	Suspension Of Radian	2000		PP
12-924	Suspension Of Sh Bac	6835		PP
12-928	Suspension Of Sh Rea	4810		PP
12-944	Suspension Of Sh Pla	1860		PP
12-948	Suspension Of Vertic	8200		PP
12-954	Suspension Of Vertic	3940		PP

12-968	Suspension Of Platen	4535		PP
12-991	Indigenous Electrode	40		PP
12-992	Imported Electrodes	68		PP
12-993	Consumables & Erecti	405		PP
	TOTAL WEIGHT FOR PG 12	**108608**	**108.608**	
15-174	Reheater Vert Spaced	4200		PP
15-274	Reheater Vert Spaced	6900		PP
	TOTAL WEIGHT FOR PG 15	**11100**	**11.1**	
16-275	Rh Vertical Spaced F	31280		PP
16-277	Vert Rear Platen Rhc	42020		PP
	TOTAL WEIGHT FOR PG 16	**73300**	**73.3**	
17-904	Rh Hdr Suprts & Susp	3550		PP
17-919	Rh Front Suspension	5410		PP
17-929	Rh Rear Suspension	7960		PP
17-991	Indegenous Electrode	20		PP
17-992	Rh Site Electrodes I	35		PP
	TOTAL WEIGHT FOR PG 17	**16975**	**16.975**	
18-001	Furnace Roof Skin Ca	7135		PP
18-010	Pr Pts Attachmnts In	1805		PP
18-020	Vibration Snubbers	60		PP
	TOTAL WEIGHT FOR PG 18	**9000**	**9**	
19-114	Coils And Supports O	89880		PP
19-124	Coils And Supports O	89570		PP
19-701	Inlet Eco Headers	3095		PP
19-702	Outlet Eco Headers	3415		PP
19-753	Headers Of Rear In	2635		PP
19-763	Headers Of Front In	2695		PP
19-802	Eco Hanger Tubes	4160		PP
19-850	Eco Feed Pipe	2070		PP
19-851	Eco Links To Drum	4860		PP
19-904	Eco Suprts & Suspens	9795		PP
19-905	Eco Suprts & Suspens	3605		PP
19-906	Eco Suprts For Lines	680		PP
19-907	Eco Supports/Feed Pi	535		PP
19-992	Imported Electrodes	35		PP
	TOTAL WEIGHT FOR PG 19	**217030**	**217.03**	
21-600	Soot Blower Piping A	6965		PP
21-601	Soot blower Piping Su	4000		PP
21-700	Bulked Bps Component	750		PP
21-800	Sb Valves (Bhel)	470		PP
21-825	Sb Valves (Sub Deliv	250		PP
21-850	Soot Blower Safety V	30		PP

21-992	Imported Electrodes	50		PP
	TOTAL WEIGHT FOR PG 21	**12515**	**12.515**	
24-200	Boiler Trim Piping A	24345		PP
24-201	Supports For Trim Pi	5935		PP
24-215	Spray Water System	2170		PP
24-220	Safety Valve Esc Pip	8535		PP
24-225	Silencer Support-Saf	6710		PP
24-235	Slncr & Suprt-Starting	1800		PP
24-240	Sample Cooler And Su	660		PP
24-260	Valves (Bhel) Rh U	7820		PP
24-265	Valves & Fittings (S	2645		PP
24-273	Direct Water Level G	300		PP
24-275	Headers For Trim Pip	745		PP
24-280	Erv And Safety Valve	2015		PP
24-285	Safety Valve/Erv Sil	18262		PP
24-316	Rh Desh	1525		PP
24-350	Boiler Filling Pipin	1000		PP
24-351	Hangers And Supports	450		PP
24-700	Bulked Bps Component	290		PP
24-950	Special Tools	20		PP
24-955	Lapping Tools For Sv	85		PP
24-960	Lapping Tools For Co	50		PP
24-992	Imported Electrodes	25		PP
24-993	Consumables & Erecti	6		PP
24-994	Name Plates	225		PP
	TOTAL WEIGHT FOR PG 24	**85618**	**85.618**	
31-010	Skin Casing Comps We	2400		PP
31-102	Furnace Bottom Skin	750		PP
31-104	Furnace Rear Arch Sk	4150		PP
	TOTAL WEIGHT FOR PG 31	**7300**	**7.30**	
32-010	Fixing Comp For Blr	7000		PP
	TOTAL WEIGHT FOR PG 32	**7000**	**7**	
97-297	Mtm Clamps And Pads	200		PP
	TOTAL WEIGHT FOR PG 97	**200**	**0.2**	
Total weight of PRESSURE PARTS for one UNIT			**1549.34**	

PGMA WISE WEIGHT SCHEDULE C)NON-PRESSURE PARTS				
PGMA	**PGMA DESCRIPTION**	**WEIGHT IN KGS**	**PG WISE Total in MTs**	**Rate schedule Id**
20-001	Long Retractable Soo	17000		NPP
20-004	Wall Box Non-Pressur	630		NPP
20-201	Wall Deslagger Rw5e	7920		NPP
20-204	Wall Box Non Pressur	960		NPP
20-511	Da Head Valve Assy	113		NPP
20-794	Wall Box Non 7ressur	64		NPP
20-972	Temp Probe Duplex Po	1470		NPP
20-998	Special Tools For So	8		NPP
	Total weight FOR PG 20	**28165**	**28.165**	
28-220	Doors	4200		NPP
	Total weight FOR PG 28	**4200**	**4.2**	
30-103	Seal Plate Assy	1500		NPP
30-105	Furnace Bottom Enclo	3100		NPP
30-211	Furnace Rear Arch En	1700		NPP
30-212	Furnace Extd Side Bo	6000		NPP
30-215	Main Boiler	2600		NPP
30-219	Vertical Roof Enclos	35000		NPP
30-220	Deck Support And Sea	14700		NPP
	Total weight FOR PG 30	**64600**	**64.6**	
31-105	Second Pass Skin Cas	250		NPP
	Total weight FOR PG 31	**250**	**0.25**	
41-350	Air Cooled Oil Gun A	900		NPP
41-390	Oil Gun Vice Assy An	800		NPP
41-500	High Energy Arc Igni	400		NPP
	Total weight FOR PG 41	**2100**	**2.1**	
42-001	Pneumatic Fittings	300		NPP
42-002	Steam Blow Materials	800		NPP(Common for 6 Units)
42-005	Instrument Fittings	150		NPP
42-010	LFO Pump Set	8000		NPP(Common for 6 Units)
42-020	HFO Pump Set	11000		NPP(Common for 6 Units)
42-030	HFO Heater Set	25000		NPP(Common for 6 Units)
42-046	Drain Oil Pump-Motor	150		NPP
42-065	Drain Oil Tank	4500		NPP

42-120	Piping, Pump House-F	7000		NPP(Common for 6 Units)
42-128	Piping, Pump House St	800		NPP(Common for 6 Units)
42-070	Burner Station Skid	1500		NPP
42-150	Piping, Operating Fl	3500		NPP
42-152	Piping, Opr'G Floor L	1200		NPP
42-154	Piping, Opr'G Floor D	1500		NPP
42-157	Piping, Opr'G Floor A	800		NPP
42-158	Piping, Opr'G Floor S	3000		NPP
42-200	Subdelivery Fuel Oil	1500		NPP
42-300	Bhel Valve F.O. Syst	1000		NPP
42-358	Bhel Valve, Opr'G Flo	800		NPP
42-700	Bps Fasteners	1200		NPP
42-992	Imported Electrodes	10		NPP
	Total weight FOR PG 42	**73710**	**73.71**	
43-004	Assy Comp Scanner &	1600		NPP
43-005	Assy Comp Mill Seal	2500		NPP
43-104	M/C Comp Scanner & G	8500		NPP
43-105	M/C Comp Mill Seal A	12000		NPP
43-200	Subdel, Ignitor & Scann	2500		NPP
	Total weight FOR PG 43	**27100**	**27.1**	
45-220	Wind Box Assembly 22	44000		NPP
45-221	Wind Box Support 22-	5000		NPP
	Total weight FOR PG 45	**49000**	**49**	
47-201	Fuel Piping Supports	12000		NPP
47-203	Pipe Couplings Orifi	18000		NPP
47-209	St Pipes Shop Bends	150000		NPP
	Total weight FOR PG 47	**180000**	**180**	
48-012	Rect Duct Bet F.D F	36530		NPP
48-014	Expn Pieces bet F.D F	1740		NPP
48-015	Supports etc bet F.D F	4515		NPP
48-019	Foundation Materials	3265		NPP
48-112	Rect Ducts Pri Fan T	29964		NPP
48-114	Expn Pieces pri Fan T	1475		NPP
48-115	Supports etc pri Fan T	3355		NPP
48-132	Rect Duct Pri Air F	13230		NPP
48-141	Seal Air Hag And Id	6145		NPP
48-142	Rect Duct Cold air bu	16875		NPP
48-144	Expn Pieces cold air bu	1555		NPP
48-145	Supports etc cold air bu	700		NPP
48-200	Instrument Tappings	2035		NPP

48-202	Rect Ducts airheater	35380		NPP
48-204	Expn Pieces airheater	7090		NPP
48-205	Supports etc air heater	5075		NPP
48-207	Flow meters For Secon	3945		NPP
48-212	Wind Box Connecting	16000		NPP
48-214	Expn Pieces wind box C	2680		NPP
48-222	Rect Duct-Airheater	31970		NPP
48-224	Expn Pieces air heater	2920		NPP
48-225	Supports For Hot P.A	4560		NPP
48-232	Rect Ducts Hot Air B	16175		NPP
48-234	Expn Pieces hot Air B	815		NPP
48-382	Rect Duct Economise	41180		NPP
48-384	Expn Pieces economise	7310		NPP
48-385	Supports etc economise	14110		NPP
48-432	Rect Duct Airheater	24025		NPP
48-434	Expn Pieces air heater	2335		NPP
48-435	Supports etc airheater	2730		NPP
48-462	Rect Duct Boiler Ou	98775		NPP
48-464	Expn Pieces boiler Ou	8210		NPP
48-465	Bof To Ep Ducting Su	8240		NPP
48-482	Rect Ducts-Elec Prpt	60380		NPP
48-484	Expn Pieces elec Prpt	7500		NPP
48-485	Supports etc elec Prpt	5310		NPP
48-492	Rect Duct Ind Draft	70900		NPP
48-494	Expn Pieces in d Draft	4770		NPP
48-495	I.D.System Duct Supp	6025		NPP
48-499	Chimney Wall Frame	360		NPP
48-662	Rect Duct Hot Air B	32030		NPP
48-664	Expn Pieces hot Air B	3845		NPP
48-665	Supports For Hot Pa	2875		NPP
48-667	Venturi-Primary Air	5065		NPP
48-700	Bulked Bps Component	1790		NPP
48-993	Erection Materials	4730		NPP
	Total weight FOR PG 48	**660489**	**660.489**	
	AIR PRE HEATER			
52000	SPECIAL TOOLS/CONTRA	600		NPP
52010	LARG AH-ROTOR ASSY	59600		NPP
52013	LARG AH-ROTORSEALS	2150		NPP
52024	COLD BASKET&ELEMENT	43000		NPP
52025	HOT BASKET & ELEMENT	178000		NPP
52030	LARG AH-ROTORHOUSING	31350		NPP
52041	HOT END CONN PLATE	35250		NPP

52042	COLD END CONN PLATE	42165.73		NPP
52054	LARG AH-AXIAL SEAL	200		NPP
52055	LARG AH-BY PASS SEAL	780		NPP
52100	LARGE AH ROTOR DRIVE	3200		NPP
52211	LARG AH-AIRSEAL PIPE	680		NPP
52220	LARG AH-GENS DETAILS	2710		NPP
52261	LARG AH-GUIDE BEARNG	2950		NPP
52262	LARG AH-SUPRT BEARNG	3850		NPP
52271	OIL PIPING GUIDE BRG	520		NPP
52272	OIL PIPING SUPRT BRG	550		NPP
52274	LUB OIL CIRCULATION UN	1100		NPP
52301	WASH MANIFLD GAS INL	450		NPP
52302	WASH MANIFLD GAS OUT	400		NPP
52326	CLEANG EQPT GAS OUT	150		NPP
52329	CLE EQPT DRIVE UNIT	1320		NPP
52600	LARGE AH E,C&I COMPONE	150		NPP
52988	LARG AH COMMISSIONING	120		NPP
	Total weight FOR PG 52	**411245.73**	**411.24573**	
	DAMPERS			
57013	DAMPERS BET FD FAN & A	5400		NPP
57033	SA SCAPH INLET DAMPER	8600		NPP
57110	GUILLOTENE GATE PA FAN	8000		NPP
57113	DAMPERS BETWEEN PAFAN	2900		NPP
57143	DAMPER COLD AIR BUS(TE	1400		NPP
57160	COLD AIRGATE, AIRBUS T	6000		NPP
57203	DAMP APH TO WINDBOX DU	3100		NPP
57209	LINKAGES FOR DAMPERS	3500		NPP
57223	DAMP APH PRIMARY SIDE	2800		NPP
57270	GUILLOTENE GATE DUCT T	13800		NPP
57273	DAMPER BOILER OUTLET	4500		NPP
57383	FLUE GAS SAH INLET DAM	9000		NPP
57433	DAMPER APH BOILER OUTL	10000		NPP
	Total weight FOR PG 57	**79000**	**79**	
99-100	Fan Handling Equipme	8000		NPP
99-400	Airheater, Steam coil	600		NPP
99-512	Furnace Cradle 2 Wal	1500		NPP
	Total weight FOR PG 99	**10100**	**10.1**	NPP
Total weight of NONPRESSURE PARTS for one UNIT			**1589.95973**	

PGMA WISE WEIGHT SCHEDULE D) ROTATING MACHINES- PGMA WISE				
PGMA	**PGMA DESCRIPTION**	**WEIGHT IN KGS**	**PG WISE TOTAL IN MTs**	**Rate schedule Id**
55011	FD FAN FOUNDATION MATL	960		**RM**
55017	FD FAN C&I ITEMS	25		**RM**
55031	PA FAN FOUNDATION MATL	807.296		**RM**
55037	PA FAN C&I ITEMS	25		**RM**
55214	1REAC FDFAN1600-2000	13150		**RM**
55334	2 REACT PA FAN	23420		**RM**
55810	AXIAL FDFAN COUPLING	650		**RM**
55830	AXL PAFAN COUPLING	860		**RM**
55910	AXL FDFAN ACCESSORY	4400		**RM**
55911	AXIAL FDFAN SILENCER	18050		**RM**
55930	AXL PAFAN ACCESSORY	4400		**RM**
55931	PA FAN SILENCER	23800		**RM**
	TOTAL WEIGHT FOR PG 55	**90547.296**	**90.547296**	**RM**
56000	TOOLS & FIXTURE/CONT	500		**RM**
56021	ID FAN FOUNDATION MATL	2000		**RM**
56027	ID FAN C&I ITEMS	25		**RM**
56077	SEAL AIR FAN C&I ITEMS	25		**RM**
56091	RAD FAN-FIRST FILL LUB	7000		**RM**
56161	BAC 1 SUC SA FAN	500		**RM**
56171	SEALAIRFAN BCSS<1000	5300		**RM**
56226	IDFAN BCDS2500-3150	54000		**RM**
56670	IGNITR FAN MOTOR	1000		**RM**
56820	RADL IDFAN COUPLING	100		**RM**
56870	SEAL AIR FAN COUPLING(	50		**RM**
56988	RADIAL FAN COMMG SPA	10		**RM**
	TOTAL WEIGHT FOR PG 56	**70510**	**70.51**	**RM**
65-736	36 Inch Gravimetric	32000		**RM**
	TOTAL WEIGHT FOR PG 65	**32000**	**32**	**RM**
67-272	Coal Valve-36 Inch M	4800		**RM**
67-277	Coal valve Motor Oper	6500		**RM**
67-283	Feeder Outlet Isolat	7000		**RM**
67-801	Down Spout	13000		**RM**
67-803	Feed Pipe To Mill	5000		**RM**
	TOTAL WEIGHT FOR PG 67	**36300**	**36.3**	
Total weight of all PG's in MTs for one UNIT- 229.357296				

DESCRIPTION	QTY PER UNIT	WT (KG)	WT IN MT (Corrected to Decimal)	Rate schedule Id
61xxx	ID Fan Motors(2 Nos)	17200	**17.2**	**RM**
…..	PA Fan Motors(2 Nos)	15600	**15.6**	**RM**
…..	FD Fan Motors(2 Nos)	9000	**9.0**	**RM**
….	Mill motors (5 Nos)	40000	**40.0**	**RM**
…..	Mills(5 Nos)	351900	**351.9**	**RM**
….	VFD Coupling-ID Fan	5000	**5.0**	**RM**
…	Miscellaneous items	5000	**5.0**	**RM**
Total Weight			**443.7**	
Overall weight of ROTATING MACHINES in MT for one UNIT			**673.057296**	

VOLUME-IA PART –I CHAPTER -X
GENERAL

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

1.10.1 All the works such as cleaning, leveling, aligning, trial assembly, dismantling of certain components for checking and cleaning, surface preparation, fabrication of sheets, tubes and pipes as per general engineering practice and as per BHEL Engineer's instructions at site, cutting, weld depositing, grinding, straightening, chamfering, filing, chipping, drilling, reaming, scrapping, lapping, fitting-up etc., as may be applicable in such erection works and are necessary to complete the work satisfactorily, shall be carried out by the contractor as part of the work with in the quoted rate. Major machining work, which is only to be carried out in workshops, will be arranged by BHEL.

1.10.2 Contractor shall execute the work as per sequence and procedure prescribed by BHEL at site. The applicable erection manuals which are available with BHEL site office are to be referred for compliance and guidance before taking up the work. Any rework on this failure to comply with will be to account contractor only. 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.

1.10.3 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 milestones are achieved as per schedule/ plans. Contractor shall arrange & augment the resources accordingly.

1.10.4 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.

1.10.5 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 drawls at the rate prescribed by manufacturing units.

1.10.6 No member of the already erected structure/ platform, pipes, grills, platform, other component and auxiliaries should be cut without specific approval of BHEL engineer.

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

1.10.8 For other agencies, such as piping, cabling, instrumentation, insulaton 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.

1.10.9 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.

1.10.10 Crane operators deployed by the contractor shall be tested by BHEL before he is allowed to operate the cranes.

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

1.10.12 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.

1.10.13 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.

1.10.14 **UTILITY POINTS**

1.10.14.1 Number of utility points (Service / plant air, service / plant water, service / washing steam, inert gas (N2) etc., shall be indicated in the P & I diagram. Contractor to locate the utility points as advised by site engineer and shall route the piping to these points as per site conditions, and shall submit as built layout with B O M to BHEL for approval.

1.10.14.2 The utility points shall be located at convenient point to handle and to be terminated with brass / bronze valve with suitable connection for hose pipe.

1.10.15 **AS BUILT DRAWINGS**

Contractor shall be supplied with two extra copies of the layout & isometrics drawings. Contractor to incorporate in one of the copy with Red ink all the changes / deviations / alterations etc carried out at site due to various reasons, with site engineer's endorsement. Marked up drawings shall be submitted to BHEL for approval.

1.10.16 **SITE INSPECTION**

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. No cost whatsoever such duplication of inspection of work be entertained.

VOLUME-IA PART –I CHAPTER -XI

FOUNDATIONS AND GROUTING

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

1.11.1 Foundation for the equipments to be erected shall be provided by BHEL/ clients of BHEL. The dimension of the foundation and anchor bolt pits shall be checked by the contractor for their correctness as per drawings. Further, top elevation of foundations shall be checked with respect to bench mark etc. All adjustments of foundations surfaces, enlarging the pockets in foundations etc. as may be required for the erection of equipments plants shall be carried out by the contractor.

1.11.2 Cleaning of foundation surfaces, pocket holes and anchor bolt pits etc., de-watering, making them free of oil, grease, sand and other foreign materials by soda wash, water wash, compressed air or any other approved methods etc., form/shuttering work are within the scope this work.

1.11.3 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 30 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.

1.11.4 The surface of foundations shall be dressed to bring the surface of the foundations to the required level and smoothness prior to placement of equipments

1.11.5 Foundation pockets are to be cleaned thoroughly before placing the columns/equipments. Verticality of foundation bolts to be checked along with correctness of the threads and freeness of the nuts movement. If required cleaning of the threads to be done with proper dies.

1.11.6 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. Packer plates should not only be blue matched with foundation but also inter-packer contact surfaces between the packers and foundation frame etc., shall also be blue matched by Prussian Blue match checks and required percentage contact shall be achieved by chipping and scrapping as per BHEL Engineers instructions.

1.11.7 The certificates of the grout is to be submitted BHEL. If necessary test cubes are to be made and tested at site to ensure the quality of the grout as per relevant IS standards. In case grouting with Portland cement is approved, necessary cement, sand etc to be arranged by the contractor including the fine aggregates.

1.11.8 All the materials required for grouting including special cements like Conbextra GPI,GP2, ACC- Shrinkkomb-N20, Sika Anckor, NSG/ NSG -1, CICO Excem GP, or its equivalent as approved by BHEL and other materials like Portland cement, sand etc., are to be arranged by the contractor at his cost. It shall be the responsibility of the contractor to obtain prior approval of BHEL, regarding suppliers, type of grouting cements before procurement of grouting cements.

1.11.9 Certain packer plates and shims over and above the quantity received as part of supplies from manufacturing units of BHEL will have to be cut out from steel plates / sheets at site by the contractor to meet site requirement. However machining of the packers, wherever necessary, will be arranged by BHEL at free of cost.

1.11.10 Works 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.

1.11.11 PROCEDURE FOR GROUTING **:**

Contractor has to carryout the grouting as per the work instructions for grouting available at site.

VOLUME-IA PART –I CHAPTER -XII

MATERIAL HANDLING AND SITE STORAGE

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

1.12.1 Loading at BHEL/Customer stores and storage yard, transport to site, unloading at site/working area of equipment placement on respective foundation/location, fabrication yard, pre-assembly bay or at working area are in the scope of work. The scope includes taking materials / Equipments from customer stores / storage yard also. Contractors Quoted / Accepted rate shall be inclusive of the same. Required cranes, tractors, trailer or trucks/ slings/ tools and tackles/labour including operators Fuel lubricants etc for loading & unloading of materials will be in the scope of contractor.

1.12.2 The equipments / materials from the storage yard shall be moved in sequence 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.

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

1.12.4 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.

1.12.5 All pipe and tube ends shall be covered with plastic caps or will be closed with wooden plugs as the case may be.

1.12.6 The contractor shall provide any fixtures, concrete blocks & wooden sleepers, which are required for temporary supporting / storage of the components at site.

1.12.7 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.

VOLUME-IA PART – I CHAPTER- XIII
ERECTION

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

1.13.1 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 , Rotating Machines & auxiliaries and supply and application of final painting covered under the tender specifications and providing adequate assistance during entire commissioning and unit trial operations.

1.13.2 Pressure Vessels for Electronic Level Indicators, Flow Meters, Condensing Pots, MTM Clamps & Pads, etc. approx. 300 Kg per unit, released under PG 97 is also covered in the scope of work.

1.13.3 Normally the 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.

1.13.4 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.

1.13.5 Ducts / expansion pieces are dispatched to site in loose walls / plates and these are to be assembled at site before erection.

1.13.6 Tubes or pipes wherever deemed to be convenient will be sent in running lengths with sufficient bends length and will be cut to suit the site conditions and the layouts. Bends up to NB 65 mm will have to be fabricated at site adopting specified heat treatment procedures, Wherever required at no extra cost. All the attachments like lugs, stoppers, cleats etc., will be supplied as loose items and to be cut and welded to the pipes at site as per erection drawing necessary drilling of holes on main pipe for welding stubs shall also be

done at site by the contractor. Fittings like bends, tees, elbow, mitre bends, reducers, flanges etc., will be supplied as loose items.

1.13.7 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.

1.13.8 All welded joints should be painted with anti corrosive paint, once radiography and stress relieving works are over.

1.13.9 Incase of any class of work for which there is no such specifications as laid down in the contract such us 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.

1.13.10 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.

1.13.11 Normally, the machine profile will be cut for the structural members but the contractor will have to carry out suitable alterations / adjustments at site, without any extra payment, in case it becomes necessary. Also, it may sometimes be necessary to remove some of the erected members to facilitate erection of bigger pre-assembled equipments. In such case, the removal and re-erection of such members which are essential and if so agreed by the BHEL Engineer will have to be done by the contractor without any extra payment.

1.13.12 Attachment, welding of necessary instrumentation tapping points, thermocouple pads, root valves, condensing vessels, flow nozzles and control valves etc., to be provided on boiler & its auxiliaries, Rotating machines, pipelines covered with in 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, the Items are supplied by an agency other than BHEL if they are integral to the scope envisaged under this package.

1.13.13 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.,

1.13.14 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 / pipes below 2" before erecting the same. Bigger size pipes should be cleaned with flexible wire brush and subsequently flushed with air before lifting them into position. 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.

1.13.15 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.

1.13.16 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.

1.13.17 In the case of structural members / ducts or piping, in certain cases, or in small bore piping for integral cooling water or lubrication system, etc., the raw material will be supplied in random lengths and the contractor will have to make up the length/prepared the edges to suit the matching profile weld/bolt connect the joints at no extra cost.

1.13.18 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 of structures. 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.

1.13.19 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.

1.13.20 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 final layout. For any mismatch while matching the joints in tubes, the cutting, preparing edges afresh, re-welding, addition of spool pieces, adopting specified heat treatment procedure should be done by the contractor to match site conditions without any extra payment.

1.13.21 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 retightened wherever necessary. The tightened bolts shall be identified by color paints. Facility for random checking with calibrated Torque Wrench shall also be provided by contractor.

1.13.22 All Rotating machineries and equipment 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 of work or during commissioning period, all such works are to be carried out by contractor at his cost.

1.13.23 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 are 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 BHEL free of cost.

1.13.24 The temporary structures / items welded to permanent members / pipes are to be cut and removed without any damage. Any damage so to be made good by the contractor at his cost.

1.13.25 Before lifting the heavy components, soft materials like gunny bags to be used while lashing the rope to avoid dents, rubbing marks etc. The capacity, number of sheave pulleys, size of the rope, guide pulley locations are to be decided at site with respect to the capacity and positioning of the winch. The end caps provided at shop for various stubs are to be removed during final fit up only.

1.13.26 Before erecting the valves and other mountings, check for the tag for correct rating with valve schedule. Ensure correct flow direction. Ensure easy accessibility for operation and maintenance of valves.

1.13.27 All the tapping points meant for monitoring the level should be erected and protocol is to be made. Maximum use of the pads and lugs welded on the drum to be used for giving supports.

1.13.28 All the drain lines should have sufficient slope towards drain. Provide expansion loops in all the vents and drains as the drawings. All the valve packing with asbestos base to be lubricated once in 6 months till handing over. Necessary gland packing will be supplied by BHEL.

1.13.29 Prior to erection of any components inspection to be done for any foreign materials and damages and they are to be attended as per directions of BHEL engineer.

1.13.30 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. All fittings like

elbows, tees, reducers, flanges, inserts etc., shall be matched with pipes for welding which may required re-edge preparation, grinding etc.,

1.13.31 The valves will have to be checked, cleaned, lapped or overhauled in full or in parts before erection, after chemical cleaning and during commissioning. All the valves ,after chemical cleaning , have to be checked, cleaned or over hauled in full or part before erection if called for as part of scope

1.13.32 For skid mounted equipment, the checking and re-alignment required at site is in the scope of wok.

1.13.33 All the shafts of rotating equipment shall have to be properly aligned to those of matching equipment to perfection, accuracy as required and the equipment shall be free from excessive vibration so as to avoid overheating of bearings or other conditions which may tend to shorten the life of the equipment.

1.13.34 All the equipments /material to be taken inside the plant building shall be cleaned thoroughly before taking them inside and erect. The contractor shall clean, wherever necessary and paint inside surfaces of the equipments like coolers, oil tanks, Rubber expansion joints assemble and other components as per instruction of BHEL Engineer during erection at the quoted rate.

1.13.35 Wherever equipments are supplied in pre-fabricated assembled packages, there may be necessity to make minor changes, including strengthening by additional welds. This shall be treated as part of the contractor's scope.

1.13.36 All the bearings, Gearboxes etc., of the equipment 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 bearing / gear boxes 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 recommended lubricants and assembling back.

1.13.37 Certain instruments like pressure switches, gauges, air sets, regulators, filters, junction boxes, power cylinders, dial gauges, thermometers, flow meters, valve actuators, flow indicators etc., are received in assembled conditions as integral part of equipments. Contractor shall dismantle such instruments and re-erect whenever required prior to commissioning. Some time this may have to be handed over to store or instrumentation contractor.

1.13.38 All the motors / pumps shall be stripped opened, thoroughly serviced with proper care and re-assembled properly before erection by the contractor. During servicing, pre-commissioning & commissioning, if any deficiency is observed the same should be taken up with BHEL Engineer at site and rectified at site without any delay.

1.13.39 All the oil & gas piping flanges, wherever provided are to be blue matched using surface plates for at least 80% contact area to attain leak proof of joints.

1.13.40 The contractor shall also carry out erection, testing, and commissioning of the oil centrifuge with in their quoted rate.

1.13.41 Erection of all the piping systems supplied along with equipments, pumps and other auxiliaries covered in this contract is to be erected by the contractor with in the quoted rate.

1.13.42 Adjustment like removal of ovalities in pipes and opening or closing of the fabricated bends, piping by process of heat correction or any other method approved by BHEL Engineer to suit the layout, with specified heat treatment procedure with in the quoted rate.

1.13.43 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 subject 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.

1.13.44 Flame cutting of piping and other equipment shall be strictly done as per BHEL Engineer's instructions and in his presence only.

1.13.45 Incase of piping connected to equipment, matching of flanges for achieving the parallelism and alignment at equipment end by suitably resorting to heat correction or other method as instructed by BHEL Engineer is within scope of work.

1.13.46 The surface of the pipes to be joined shall be suitably prepared as per instructions of BHEL Engineers. Edge preparation shall be done by chamfering machine, whenever required and all welding surfaces must be cleaned thoroughly. Instrumentation drains, stubs which are sent in loose from manufacturing units are to be welded at site as per BHEL Engineer's instructions.

1.13.47 Impulse piping wherever required for BHEL equipment is to be fabricated by the contractor including erection and welding of root valves as per the instructions of BHEL Engineer. The required piping and root valves will be supplied by BHEL free of cost.

1.13.48 All instrumentation impulse lines up to root valves shall also be erected and welded by TIG welding only by the contractor within their quoted value.

1.13.49 All the weld joints on equipments and piping shall be ground or filed after completion of welding and before radiography as per instructions of BHEL Engineer so as to achieve smooth surface to avoid of ripples, undulations etc.,

1.13.50 All piping items including pipes, valves, flanges, fittings etc. shall be supplied as commercially available. Hence Fit-ups, edge preparation including welding of stubs, shall be included in the contractor's scope.

1.13.51 All piping will be supplied in running metres, contractor has to cut and edge prepare as per the standards / drawings and as per the instruction of BHEL Engineer within the quoted rate.

1.13.52 Wherever elbows of 45 deg or any other angle are required, the same shall be cut from 90 deg. elbow supplied and used. No extra cost shall be paid.

1.13.53 The work on piping systems (air, water, oil, steam, gas etc.,) will include laying, edge preparation, fixing and welding of the elbows / fittings / valves etc., welded on the lines, fixing and adjustment of supports / hangers / shock absorbers and carrying out all other activities/works to complete the erection and also carrying out all pre-commissioning / commissioning operations mentioned in the specification as per BHEL Engineer's instructions and/or as per approved drawings/documents.

1.13.54 Flow nozzles, orifice, spray nozzles etc., shall be mounted / erected after chemical cleaning / flushing / or steam blowing at site.

1.13.55 Erection of flow switches, steam traps, filters, flow meters, other metering elements, flow orifices, flow indicators, control valves supplied either by BHEL or customer forming part of the system is in the scope of work. This will include collecting from BHEL / Customer stores, transport to site, suitably cutting the erected piping, cleaning, erection, welding, radiography and stress relieving and commissioning.

1.13.56 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.

1.13.57 All drains / vents / relief / escape / safety valve piping to various tanks / sewage / drain canal / flash box / flash tank / condenser / sump / atmosphere etc. from the stubs on the piping and equipments erected by the contractor is completely covered in the scope of work.

1.13.58 The contractor has to fabricate stainless steel orifice plate within the quoted rate. No extra payment will be made for fabrication of above orifice plates. The required stainless steel plate will be supplied by BHEL.

1.13.59 Fixing / fitting / welding of thermo wells, stubs, hoses, tapping points, root valves and instruments etc., on different lines / equipments (which will be supplied by BHEL) is within the scope of work. Fixing of Pick-Ups, Probes & Accessories for vibration monitoring system is the scope of this specification.

1.13.60 Welding of all thermo wells, draft, pressure and temperature instrumentation points and all other instrumentation points on piping and auxiliaries and welding of thermocouple are in the scope of work.

1.13.61 The contractor shall also weld all thermo wells, small length of pipes to all pressure, flow and level tapping points, isolating valves and root valves on all equipment under scope of erection of this contract. All embedded temperature measuring elements provided in the bearings will have to be terminated at the junction box by the contractor. Thermo wells tapping point connections incorporated shall be plugged during the pressure testing and steam blow out of piping systems. Upon completion of blow out operation all thermo wells and flow elements with branch pipes be installed and welded.

1.13.62 Contractor has to fabricate and erect temporary spool pieces wherever required due to non receipt of valves in time and after receipt of valves the spool pieces are to be replaced with regular valves at free of cost. For spool pieces materials will be supplied free of cost by BHEL.

1.13.63 Wherever hanger and support materials of piping are not received from manufacturing unit in time to suit the erection schedule, contractor shall erect the piping system on temporary supports to ensure the progress of work. The required structural steel materials will be issued on free of charges by BHEL, either from scrap/spare materials. The same shall be removed and returned to BHEL store after erection of permanent supports.

1.13.64 The contractor shall conduct non destructive tests like radiography ultrasonic test for weld defects etc., ultrasonic test for finding thickness, dye penetrant tests, magnetic particle test etc., on weld joints, castings, valve bodies and other equipments etc., as per BHEL Engineer's instructions.

1.13.65 Suspension for pressure parts ,piping etc., will be supplied in running lengths and shall be cut to suitable sizes and adjusted as required. Hangers' components which are being supplied in loose shall be assembled at site and erected as part of the work.

1.13.66 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.

1.13.67 All hangers, supports and anchors (including concreting or welding) shall be installed as per drawing to obtain are reliable and complete 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).

1.13.68 Plate / Pipe shoes for piping supports shall be fabricated at site by the contractor at no extra cost. Other supports namely Hangers, U-clamps etc., shall be supplied by BHEL duly bent and threaded. Assembly and necessary cutting work etc., shall be carried out at site by contractor within the quoted rate.

1.13.69 No separate payment will be made for the edge preparation of pipes, Standard fittings such as bends, Tees etc.,

1.13.70 Contractors has to carryout fabrication works such as welding of stubs / nipples, attachments etc., preparation of surface for rust preventive coating and application of rust preventive is within the quoted / accepted rate.

1.13.71 The PG wise break up of Boiler and Auxiliaries are indicated in the weight schedule, 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.

1.13.72 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.

1.13.73 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.

1.13.74 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 completed only when jointly certified so, by the BHEL Engineer & Customer. Also the contractor should ensure that the alignment is not disturbed afterwards.

1.13.75 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, fettling, 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

1.13.76 Burner tilt mechanism will be checked for freeness, serviced and adjusted, if necessary to obtain optimum tilt before and after installation.

1.13.77 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.

1.13.78 No temporary supports shall be welded on the pressure parts of 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 alternation of member of the structure of platform or other equipment shall not be done without specific prior approval of BHEL Engineer.

1.13.79 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.

1.13.80 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.

1.13.81 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.

1.13.82 For all the site routed piping, as built drawings are to be submitted by the contractor immediately after erection.

1.13.83 Fixing, welding of necessary instrumentation tapping points, to be provided on auxiliaries covered within the scope of this specification will also be the responsibility of the contractor and will be done as per the instructions of BHEL Engineer. The fixing / welding of all the above items will be contractor's responsibility even if the

i) Product groups under which these items are not specifically indicated in the Tender Specification.

ii) Items are supplied by an agency other than BHEL

1.13.84 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.,

1.13.85 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**.**

1.13.86 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.

1.13.87 For all the site routed piping, as built drawings are to be submitted by the contractor immediately after erection.

1.13.88 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.

1.13.89 **CEILING GIRDERS IF SUPPLIED IN PIECES ARE TO BE PRE-ASSEMBLED AT SITE AND WELDING & NDT TESTS ARE TO BE CARRIED OUT, INCLUDING 100% RADIOGRAPHY AND THE REQUIRED UT FOR THE WELDED JOINTS IN CEILING GIRDERS.**

1.13.90 **DRUM LIFTING**

1.13.90.1 BHEL shall arrange to unload boiler drum in a convenient location nearer to Boiler Foundation. Transportation of the same to erection site for erection shall be within the scope of work of the contractor.

1.13.90.2 All the required T & Ps and arrangements required for Drum lifting is in the contractor scope. The entire activities of drum lifting are to be carried out as per instructions of BHEL / Customer Engineers.

1.13.90.3 Drum lifting structures shall be fabricated by the contractor at site according of BHEL drawing. Necessary steel for the same shall be arranged by BHEL. Fabrication, erection and complete installation of drum lifting arrangements, including supply of consumables and anchoring for diversion pulleys shall be carried out by the contractor at no extra cost. After completion of drum lifting, erection and alignment, the drum lifting arrangements shall be dismantled by the contractor and returned to BHEL stores in good condition and to the satisfaction of BHEL Engineer.

1.13.91 Any fixtures, concrete block supports, steel structures required for temporary supporting for pre-assembly or checking and welding for lifting and handling during pre-assembly and erection shall be arranged by the contractor.

1.13.92 Details regarding boiler components, sub-assemblies, and auxiliaries etc. to be erected, tested and commissioned under the scope of this tender are given in this tender. The schedule of weights given in the appendices are only approximate and meant for giving a general idea to the tenderer, about the magnitude of the work involved. This should not be taken for billing or any other claims. All weights for such purposes will have to be taken from design documents only (Shipping list).

1.13.93 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 day rates.

1.13.94 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 / add extra lengths to suit the final layout after preparing edges afresh and adopting specified heat treatment procedures at no extra cost, wherever indicated.

1.13.95 Burner tilt mechanism will be checked for freeness, serviced and adjusted, to obtain optimum tilt before and after installation.

1.13.96 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.

1.13.97 The materials for boiler burner roofing, side cladding etc. will be supplied by BHEL and contractor has to erect the same at the quoted / accepted tonnage rate.

1.13.98 Skin casing sheet for covering the boiler roof panels, rear arch tubes 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.

1.13.99 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.

1.13.100 Assistance for calibrating / testing the power cylinders / valves etc., and setting to actuators coming under various groups shall be provided by contractor within the quoted rates.

1.13.101 Regarding tubes erection, wherever tubes expansion is involved to be expanded using contractors' experienced operators, with special tools provided by BHEL, as per the erection procedure / BHEL engineer's instruction.

1.13.102 Air leak test is to be conducted for the cold & hot secondary air ducts, primary 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.

1.13.103 The scope of work shall also include application of final painting of Fans, ACCOUSTIC INSULATION for Fans as required and specified for the components of rotating machines its auxiliaries.

VOLUME-IA PART – I CHAPTER - XIV

PROGRESS OF WORK

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

1.14.1 Refer forms F -14 to F-18 of volume I D of volume -I book-II. Plan and review will be done as per the formats.

1.14.2 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.

1.14.3 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.

1.14.4 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.

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

1.14.6 The monthly report ending on 24th of every month shall be submitted as a booklet and shall contain the following details :-

a) Colour Progress photographs to accompany the report should be submitted.

b) Erection progress in terms of tonnage, welding joints, radiography, stress relieving, etc., 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 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.

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

1.14.8 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.

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

VOLUME-IA **PART – I CHAPTER - XV**
WELDING, HEAT TREATMENT & RADIOGRAPHY AND NON-DESTRUCTIVE TESTING

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

1.15.1 Welding of pressure parts, high tensile structural steel, Piping shall be done by certified high pressure welders who posses valid certificate and who are approved by BHEL Engineer.

1.15.2 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.

1.15.3 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.

1.15.4 All butt / fillet welds shall be subject to Non –Destructive testing as per the Drawing / Procedures / Welding Schedules / Documents at no additional cost.

1.15.5 All welded joints shall be subjected to acceptance by BHEL Engineer.

1.15.6 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.

1.15.7 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.

1.15.8 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.

1.15.9 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.

1.15.10 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.

1.15.11 Pre-heating, radiography and other NDT tests, post heating and stress relieving after welding, are parts of erection work and shall be carried out by the contractor in accordance with the instructions of the Engineer.

1.15.12 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.

1.15.13 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.

1.15.14 All welds shall be painted with anticorrosive red oxide paint once radiography and stress reliving works are over.

1.15.15 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.

1.15.16 Pre-heating, radiography and other NDT tests, post heating and stress relieving after welding of tubes, pipes, Non Pressure Parts like Crown Plate support assly, 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.

1.15.17 Contractor shall arrange all necessary stress relieving equipment with automatic recording devices. 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 for heat treatment works 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 Engineer or his representative on the strip chart of the recorder prior to the starting of SR operations.

1.15.18 The contractor shall also be equipped for carrying out other NDT like LPI / MPI / Hardness test etc. as required as per welding schedules / drawings within the finally accepted price / rates. Ultrasonic testing, wherever required, will be arranged by contractor within the quoted rate.

1.15.19 The technical particulars, specification and other general details for radiography work shall be in accordance with ASME, IBR or ISO as specified by BHEL.

1.15.20 The contractor for radiography work shall use iridium-192/ Cobalt 60; the geometric un-sharpness shall not exceed 1.5mm. 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).

1.15.21 Low speed high contrasts, fine grain films (D-7 or equivalent) in 10cm width only are used for weld joint radiography. Film density shall be between 1.5 and 2.0.

1.15.22 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.

1.15.23 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.

1.15.24 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.

1.15.25 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.

1.15.26 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.

1.15.27 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.

1.15.28 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 radio graphed 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.

1.15.29 All the Radiographs shall be properly preserved and shall become the property of BHEL. They are to be reconciled with the work done, joints radio graphed and submitted to BHEL / customer.

1.15.30 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.

1.15.31 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.

1.15.32 Wherever radiographs are not accepted, on account of bad shot, joints shall be re-radio graphed and re- submitted for evaluation.

1.15.33 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-radio graphed at contractor's cost.

1.15.34 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.

1.15.35 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.

1.15.36 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.

1.15.37 All welded joints shall be subjected to acceptance by BHEL Engineer.

1.15.38 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.

1.15.39 Contractor shall carryout Radiography as per welding Manual booklet applicable as per IBR, enclosed. However percentage radiography shown in the respective drawings shall be final and binding on the contractors.

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

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

1.15.42 All radiographs shall be free from mechanical, chemical or process marks to the extent they shall not confuse the radiographic image and noticed.

1.15.43 Penetrometor as per ASME/ISO shall be used for all exposures.

1.15.44 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.

1.15.45 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.

1.15.46 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.

1.15.47 All the radiographs shall be properly preserved in air-conditioned rooms and shall become the property of BHEL.

1.15.48 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.

1.15.49 The defects as pointed out by the Engineer shall be rectified immediately to the satisfaction of Engineer and Re-radio graphed. The decision of Engineer

regarding acceptance or otherwise of the joint shall be final and binding on the contractor.

1.15.50 Wherever radiographs are not accepted on account of poor exposure, joints shall be re-radio graphed 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-radio graphed at contractor's cost.

1.15.51 The contractor shall also be equipped for carrying out other NDT like liquid penetrant inspection, magnetic particle inspection, Ultrasonic testing, etc as per welding schedules / drawings as and when required within the quoted rates.

1.15.52 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.

1.15.53 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.

1.15.54 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.

1.15.55 Erection of equipment involves good quality welding, dye penetration test and heat treatment/ Radiography work. Wherever required, 100% dye penetration test shall be carried out as per instructions of BHEL Engineer. Contractor's personnel Technicians along with labourers engaged should have adequate knowledge on the above works.

1.15.56 Welding of high pressure parts shall be done by certified High Pressure Welders who possess valid certificate of CIB of the State in which the equipment is erected as per provision of IBR.

1.15.57 Oxy-acetylene flame heating or exothermic chemical heating for stress relieving is not permitted. Heating shall be by means of Electric Induction coil or Electric resistance coil.

1.15.58 Radiography work of welds connected with this contract shall be arranged by the contractor including provisions of services of technicians and necessary equipment and consumables like Isotope camera, X-Ray films, chemicals and other dark room facilities etc. Also contractor has to provide necessary labour required such as Riggers, Helpers etc., to assist the technicians for carrying the above radiography work and making other arrangements, such as providing scaffolding, approaches, platform lighting arrangements etc., at his cost as per the instructions of BHEL. It may please be noted that invariably the radiography will be carried out after the normal working hours only.

1.15.59 Radiography inspection of welds shall be performed in accordance with the requirements and recommendations of BHEL Engineer. The minimum extent of radiographic inspection shall be as per provision of IBR Regulations. They may however be increased depending upon the performance of the individual welder at the discretion of BHEL Engineer/Boiler inspection authority. It is the responsibility of the contractor to get the IBR clearance, wherever required including arranging for IBR Inspection.

Also refer "Guidelines for Welding, NDE & Heat treatment" published under Chapter-5 of volume 1A part II of this booklet.

VOLUME-IA PART - I CHAPTER- XVI
TESTING AND COMMISSIONING

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

1.16 TESTING , PRE – COMMISSIONING & COMMISSIONING AND POST COMMISSIONING

1.16.1 The Contactor 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.

1.16.2 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.

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

1.16.4 All the tests shall be repeated till all the equipment satisfy the requirement / obligation of BHEL to their customer at various stages. 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.

1.16.5 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.

1.16.6 It shall be specifically noted that the contractor and employees of the contractor may have to work round the clock during the pre-commissioning, commissioning and post-commissioning period along with BHEL Engineers / customer officials. Hence contractor's quoted rate shall take into consideration of all expenses that will be incurred for such arrangement of personnel including engineers/supervisors.

1.16.7 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.

1.16.8 During commissioning, opening / closing of valves, changing of gaskets, packings, re-erection, Re-alignment of rotating and other equipment, attending to leakage , filling of oil to the meters / equipment and adjustments of erected equipment may arise. The finally accepted price / rates shall also include all such work.

1.16.9 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.

1.16.10 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.

1.16.11 Replacing / Cleaning and servicing of all the filters of the erected equipments during pre-commissioning / commissioning stage shall be done by the contractor within the accepted price.

1.16.12 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.

1.16.13 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.

1.16.14 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.

1.16.15 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.

1.16.16 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.

1.16.17 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 per site requirement and to meet the various pre-commissioning and commissioning programmes made to achieve the schedule agreed with customer.

1.16.18 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 till handing over of sets to customer.

1.16.19 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.

1.16.20 Replacing / changing mechanical / other seals, removal and cleaning / replacing of filters etc. during pre-commissioning / commissioning stage is within the scope of work.

1.16.21 Contractor shall lay all necessary electric cables and switches etc. required for the hydraulic tests and other tests, flushing etc., and maintain the system till the tests are completed satisfactorily.

1.16.22 All the tests shall be repeated till all the equipment satisfy the requirement of BHEL /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.

1.16.23 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, commissioning activities and related processes and returning of remaining and/or the empty containers of the chemicals to customer/BHEL stores is the responsibility of the contractor.

1.16.24 Cleaning of oil tank as per the instructions of BHEL Engineer before and after oil flushing is responsibility of the contractor.

1.16.25 Pre commissioning of oil lines includes oil flushing of the pipelines till the entire system and the pipelines are accepted as satisfactorily cleaned after inspection of sediments in the centrifuge bowl and laboratory tests of the oil samples taken from the system. After declaration of complete oil flushing of system including oil tank and coolers shall be completely drained thoroughly cleaned and refilled with fresh oil for putting the set on operation. Before commissioning of oil system the pipelines should be hydraulically tested using the hydraulic test pump to the required pressure.

1.16.26 All shaft journals and bearings shall be periodically inspected and preservation shall be done as per BHEL Engineer's instructions.

1.16.27 All bearings, shafts and other rotating parts shall be thoroughly cleaned and lubricated as per the recommendations of BHEL Engineers before commissioning / starting.

1.16.28 The contractor shall carryout the required tests on the equipments and the pipelines such as gas tightness test / air tightness test, kerosene test, hydrostatic testing of the equipment / piping etc., and rectify all the defects caused due to contractor's fault at his own cost. Contractor may have to replace old/ damaged

gaskets / packing etc. for equipments and the same shall be carried out by contractor as per requirement.

1.16.29 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.

1.16.30 The contractor shall carry out the trial run of motors including checking the direction of rotation in the uncoupled condition checking aligning and coupling the motor to the respective driven equipment. Before starting the motor, IR values of insulation shall be recorded and if found necessary the contractor shall dry out to improve the IR value at no extra cost.

1.16.31 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.

1.16.32 The contractor shall carryout any other test not listed in the tender 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.

1.16.33 Contractor to provide necessary commissioning assistance from pre-commissioning stage onwards and up to continuous operation of Gas turbine, GTG / STG and Auxiliaries. The category of personnel to be as per site requirement and to meet the various pre-commissioning and commissioning programmes made to achieve the schedule agreed with customer.

1.16.34 It is the responsibility of the contractor to provide necessary manpower, tools, tackles and consumable till the completion of work under these specifications including for trial operation, even if commissioning of equipments is delayed due to reasons not attributable to the contractor.

1.16.35 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.

1.16.36 The commissioning activities will continue up to handing over of the units. It shall be the responsibility of the contractor to provide following category of workers in sufficient numbers along with supervisors including necessary

equipment, consumables, hand tools, etc. during this period. The rate quoted shall include all these contingencies also.

a) Fitters, Millwright Fitters & Pipe fitters
b) HP & Structural Welders
c) Riggers
d) Unskilled workers
e) Electricians
f) Any other category of workers as may be required.
g) Supervisors

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. This manpower will be directly controlled by BHEL commissioning engineers only.

i. One Engineer per shift for three shifts.
ii. One supervisor per shift for three shifts
iii. One fitter per shift for three shifts
iv. Two helpers per shift for three shifts
v. One Electrician per shift for three shifts

1.16.37 All items / material required for conducting hydraulic test, alkali boil out, acid cleaning / EDTA cleaning steam blowing etc., will be supplied by BHEL / its customer. 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).

1.16.38 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.

1.16.39 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.

1.16.40 Contractor at his cost shall lay all necessary temporary piping, install the pumps, blanks ,valves pressure gauges etc required for the test,. Contractor shall also lay the temporary pipelines with fittings, accessories and erection / commission pumps, tanks 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. Necessary, materials for this will be provided by BHEL. Temporary piping, fittings, accessories, 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.

1.16.41 Chemical cleaning (Acid cleaning of piping / alkali flushing) will involve the installation of temporary piping, valves, cutting of some of the existing valves, placing the rubber 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. Required materials will be provided by BHEL free of cost.

1.16.42 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.

1.16.43 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 by the contractor at his cost.

1.16.44 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.

1.16.45 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.

1.16.46 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.

1.16.47 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.

1.16.48 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.

1.16.49 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.

1.16.50 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.

1.16.51 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.

1.16.52 Lying 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 welded by HP welders only. Required NDT tests are to carried out for the above joints within quoted as per customer / BHEL requirement.

1.16.53 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.

1.16.54 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.

1.16.55 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.

1.16.56 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.

1.16.57 It shall be the responsibility of the contractor to preserve the boiler as per BHEL's requirement.

1.16.58 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.

1.16.59 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.

1.16.60 **AIR LEAK TEST**

Air leak test is to be conducted for the cold & hot 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.

Air leak test on pressure parts preliminary to hydraulic test by compressed air shall also be carried out to check and rectify the various leakages / defects.

1.16.61 Hydraulic test may be carried out in different stages, necessary blanks / valves will be supplied by BHEL free of charges. However the welding and removing it after hydrotest, repreparing the edges if required, it is to be done by the contractor within the quoted rates.

1.16.62 The contractor has to provide manpower with requisite T & P and carry out the chemical cleaning, Alkali Boilout, Steam blowing etc. as per BHEL instructions. Contractor shall lay out all necessary temporary piping, install the pumps, valves, pressure gauges, cables, switches, cutting of some of existing valves, placing of rubber wedges in the valves, installation of temporary tanks for chemical storage

and for mixing, temporary access platforms to mixing tanks etc., all arrangements for nitrogen capping etc. required for hydro-test, chemical cleaning and steam blow off or for any other tests as the case may be. After the test is over all the temporary piping, pumps etc. will be removed. All these form part of the scope of work. All chemicals and alkalis shall be arranged by BHEL free of cost.

1.16.63 All temporary piping materials necessary for conducting hydraulic test, steam blowing etc. will be supplied by BHEL. However, servicing, erection and dismantling of the same is the responsibility of the contractor. Those items that are issued along with boiler components specified under despatchable unit for temporary piping including tanks, pumps, valves fittings, hangers and supports etc. supplied by BHEL or by other agencies alone will be paid at the quoted rates for erection. Charges for dismantling of temporary lines etc should be included in the quoted rates. The boiler drum internals shall be removed during chemical cleaning and will be refitted after completion of acid cleaning within the quoted rates.

1.16.64 The pumps, pipes, tanks required for chemical cleaning shall be spared at BHEL stores on “as is where is basis” condition. All necessary repairs / overhauls alone are in he scope of the contractor at no extra cost. All the materials shall be returned to stores after use in good condition. Necessary spares will be given by BHEL.

1.16.65 All temporary pipe work and alterations carried out in the normal circulation system shall be tested, prior to commencement of chemical cleaning to a pressure of 1 ½ times the pressure at which cleaning / flushing processes will be carried out. On completion of chemical cleaning, an inspection shall be carried out in the presence of the Engineer to ascertain the effectiveness of the cleaning process. Satisfactory completion of acid cleaning is subject to the Engineer’s approval.

1.16.66 The contractor has carry out the required pre commissioning activities like, alkali boil out, steam blowing etc as per BHEL instructions. Contractor shall lay all the necessary temporary piping, erection of valves, pressure gauges, cables, switches etc., required for these operations. After the test is over all the temporary piping, pumps etc will be removed and returned to BHEL. All these form part of the scope of work.

1.16.67 Commissioning of the set involves trial runs of all the equipment erected, blowing of steam lines, floating of safety valves, flushing of all the lines by air, oil or steam as the case may be, trail run of the boiler, servicing of all equipment 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 materials for all these works which shall form part of the work to be done.

VOLUME-IA PART- I CHAPTER-XVII
PAINTING

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

1.17.1 FINAL PAINTING

1.17.1.1 The scope of work shall also include supply and application of final painting of all the erected equipments as required and specified for the components of boiler and its auxiliaries.

1.17.1.2 In the case of steel fabricated items, raw steel after fabrication has to be cleaned and subsequent painting to be carried out.

1.17.1.3 All the exposed metal parts of the equipments including piping, structures, hangers etc., wherever applicable after installation unless otherwise specified the surface protected, are to be first painted with at least one coat of suitable primer and required number of finish coats as indicated in the Painting Specification in TCC which matches the shop primer paint used, after thoroughly cleaning the dust, rust, scales, grease oil, and other foreign materials by wire brushing scrapping and chemical cleaning and the same being inspected and approved by BHEL engineers for painting. Afterwards the above parts shall be finished with as per the instructions of BHEL/Customer official.

1.17.1.4 Paint shall be applied by brushing or by spray painting as per the instruction of BHEL Engineer. Spray painting gun and compressed air arrangement has to be made by the contractor himself. It shall be ensured that brush marks are minimum.

1.17.1.5 Before applying the subsequent coats the thickness of each coat shall be measured and recorded with BHEL / Customer.

1.17.1.6 Paint used shall be stirred frequently to keep the pigment in suspension. Paint shall be of the ready mix type in original sealed containers as packed by the paint manufacturer. No thinners shall be permitted. Paint manufacturers instructions shall be followed in method of application, handling, drying time etc.,

1.17.1.7 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 data required by BHEL within the quoted rate.

1.17.1.8 All surfaces shall be thoroughly cleaned, free from scales, dirt and other foreign matter. Each coat shall be applied in an even & uniform film free from lumps, streaks, runs, sags and uncoated spots. Each coat (Primer, intermediate, finish) shall have a minimum thickness of dry film thickness (DFT) in microns and the DFT of finish paint shall not be less than the

specified. Necessary instrument for measuring the thickness of paint applied is to be arranged by the contractor.

1.17.1.9 Finish coat paint, No of coat and DFT shall be as indicated in the painting specification enclosed in this tender / relevant BHEL document/ customer's specifications. The painting specification which is forming part of this tender as in TCC shall be used as guidelines to be followed.

1.17.1.10 The actual colour to be applied shall be approved by the customer before starting of actual painting work.

1.17.1.11 Primer & finish paint shall be of reputed paint supplier approved by BHEL / Customer. Contractor has to procure paints from the **BHEL / Customer approved agencies** only, and the paints should be as per the customer painting specification. The quality of the finish paint shall be as per the standards of IS or equivalent as approved by BHEL / Customer. Before procurement of paint the contractor has to obtain the clearance from BHEL authorities.

1.17.1.12 No paint shall be applied when the surface temp is above 55 deg. Centigrade or below 10 deg. Centigrade, and when the humidity is greater than 90% to cause condensation on the surface or frost / foggy weather.

1.17.1.13 If needed and insisted either by BHEL / Customer in certain cases, spray painting has to be carried out within the Quoted rates.

1.17.1.14 Before commencement of final painting, contractor has to obtain written clearance from BHEL / Customer for effective completion of surface preparation.

1.17.1.15 Before applying the subsequent coats, the thickness of each coat shall be measured and recorded with BHEL/ Customer.

1.17.2 PRESERVATION / TOUCH UP PAINTING

1.17.2.1 Contractor shall carryout cleaning and preservation / touch up painting for the materials / equipments under this tender specification right from pre- assembly stage to till the equipment is cleared for final painting.

1.17.2.2 Any equipment which has been given the shop coat of primer shall be carefully examined after its erection in the field and shall be treated with touch up coat of red oxide primer wherever the shop coat has been abraded, removed or damaged during transit / erection, or defaced during welding.

1.17.2.3 Mostly the equipment / items/ components will be supplied as finish painted. However during storage and handling, the same may get peeled off / deteriorate. All such surfaces are to be thoroughly cleaned and to be touch up painted with suitable approved primer and finish paint matching with shop paint / approved final colour.

VOLUME-IA PART – II CHAPTER - 1
REVERSE AUCTION PROCEDURE

GENERAL TERMS AND CONDITIONS OF REVERSE AUCTION

Against this NIT for the subject work, tender shall be processed through "REVERSE AUCTION PROCEDURE" i.e. ON LINE BIDDING on INTERNET.

1. For the proposed reverse auction, technically and commercially acceptable bidders only shall be eligible to participate.
2. BHEL will engage the services of a service provider who will provide all necessary training and assistance before commencement of on line bidding on Internet.
3. BHEL will inform the vendor in writing in case reverse auction, the details of service provider to enable them to contact and get trained.
4. Business rules like event date, time, start price, bid decrement, extensions, etc. also will be communicated through service provider for compliance.
5. Vendors have to fax the compliance form in the prescribed (provided by service provider) before start of Reverse auction. Without this the vendor will not be eligible to participate in the event.
6. BHEL will provide the calculation sheet (e.g.: EXCEL sheet) which will help to arrive at "Total Cost to BHEL".
7. Reverse auction will be conducted on schedule date & time.
8. At the end of reverse auction event, the lowest bidder value will be known on the network.
9. The lowest bidder has to fax the duly signed filled-in prescribed format as provided on case-to-case basis to BHEL through service provider within 24 hours of action without fail.
10. During Reverse Auction, the process of reverse auction is unsuccessful then BHEL at its discretion may decide to call the L1 bidder of reverse auction for further negotiation.
11. Sealed bid reverse auction: The opening bid (in the initial auction) of the bidders shall be same as that quoted in their final sealed price submitted to BHEL. The bidder shall confirm in writing to BHEL that their opening bid in both cases shall be same as that quoted in their final sealed price bids submitted to BHEL against this NIT along with Technical bid.

12. BHEL reserves the right to cancel Reverse Auction (RA) without assigning any reasons and resort to considering the sealed bids submitted by vendor for processing and finalizing the tender.

13. Any variation between the on-line bid value and signed document will be considered as sabotaging the tender process and will invite disqualification of vender to conduct business with BHEL as per prevailing procedure.

14. In case BHEL decides not to go for Reverse auction procedure for this tender enquiry, the price bids and price impacts, if any already submitted and available with BHEL shall be opened as per BHEL standard practice.

15. Bids given by the bidders during the reverse auction process will be taken as an offer to execute the work. Bids once made by the bidder, cannot be cancelled/withdrawn and bidders shall be bound to execute the work as mentioned above at the final bid price. BHEL shall take appropriate action as the lowest bidder do not execute the contract as per the rates quoted by him.

VOLUME-IA **PART- II CHAPTER -2**
VERTICALITY OF BOILER COLUMNS

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, pull lifts 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.

9 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

VOLUME-IA PART – II
CHAPTER 3 & 4

In next 52 pages as below

Erection welding schedule & Summary list of site electrodes	36 pages
Painting scheme	11+2
Guidelines for Welding, NDE & Heat treatment	64 pages

TIRUCHY

SUMMARY LIST OF SITE ELECTRODES

PROJECT: HINDALCO INDUSTRIES LTD.
UNIT: MAHAN & ADITYA
ALUMINIUM 2X(6X150MW)

CUSTOMER NO: 0164 TO 0169
0172 TO 0177

P: G: NO: 04 TO 07

P.G. NAME: DRUM&WATERWALLS

SL. NO	TYPE OF ELECTRODE / WIRE	SIZE & QTY				TIG WIRE WT (IN gms)	REMARKS
		ø2.5	ø3.15	ø4.0	ø5.0		
01	RT 1/2 MO					53643	
02	E 7018-1	31793	5850				
03	E 7018-A1	1125	1875	3955			

NOTES: -

1. RESERVE 25% ADDED.
2. QUANTITY GIVEN IS PER BOILER

ENCL : ERECTION WELDING SCHEDULE SHEET DRG NO 4-07-992-05046

CC: 1. SDGM / CONTRACTS (Subramanian N.)
2. Sr.Manager / WTC

PREPARED	CHD (DGN)	APPD (WTC)	DATE	DRAWING NO.
V.K.	S.A.K.	G.SUBARAMANIAN	06.07.10	4-07-992-05045

CAUTION: THE INFMN ON THIS DOCUMENT IS THE PROPERTY OF BHEL. IT MUST NOT BE USED DIRECTLY OR INDIRECTLY IN ANY WAY DETRIMENTAL TO THE INTEREST OF BHEL

ERECTION WELDING SCHEDULE

PRESSURE PARTS / ~~NON PRESSURE PARTS~~

PROJECT: HINDALCO INDUSTRIES LTD.
UNIT: MAHAN & ADITYA ALUMINIUM
2X(6X150MW)

CUSTOMER NO: 0164 TO 0169
0172 TO 0177

PG(S): 04 TO 07

PG NAME: PRESSURE PARTS

SL. NO.	DRAWING NO.	DESCRIPTION	MATERIAL	SIZE	THICKNESS	WELD Specn.	NO. OFF	TIG		ARC SPECN.			PREHEAT °C	PWHT °C	MIN RECOMMENDED NDE
								SPECN.	QTY	ø2.5	ø3.15	ø4.0			
1	0-00-027-45332	PANEL ARRGT.	SA210 GRC SA210 GRC	ø63.5	4.8	4.8 V	1900	RT 1/2 MO	26030	E 7018 – 1 17100	– –	– –	–	–	10% RT MIN 1 WELD PER WELDER
2	0-00-027-45334	REAR ARCH, HANGER & SCREEN TUBES	SA210 GRC SA210 GRC	ø76.1	7.1	7.1 V	270	RT 1/2 MO	4266	E 7018 – 1 4590	– –	– –	–		10% RT MIN 1 WELD PER WELDER
3	0-00-027-45329	RISER PIPES	SA106 GRC SA106 GRC	ø127	11.5	10.5V	312	RT 1/2 MO	8736	E 7018 – 1 3744	– 4680	– –	–	–	10% RT MIN 2 WELD PER WELDER
4	0-00-027-45323	DOWNCOMER PIPES	SA106 GRC SA106 GRC	ø406.4	32.0	29.2VV	26	RT 1/2 MO	3406	E 7018 – A1 780	1300	2392	100	635 ±15	100% RT
5	0-00-027-45323	RING HEADERS	SA106 GRC SA106 GRC	ø406.4	50.0	48 VV	4	RT 1/2 MO	476	E 7018 – A1 120	200	772	100		100% RT

PREPARED	CHECKED (DESIGN)	APPROVED (WTC)	DATE	DRAWING NO:
V.K.	S.A.K.	G.SUBARAMANIAN	06.07.10	4-07-992-05046

TIRUCHY

SUMMARY LIST OF SITE ELECTRODES

PROJECT: HINDALCO INDUSTRIES LTD.
UNIT: MAHAN & ADITYA
ALUMINIUM 2X(6X150MW)

CUSTOMER NO: 0164 TO 0169
0172 TO 0177

NON PRESSURE PARTS

P.G. NO: 12

P.G. NAME: SUPERHEATER SYSTEM

SL. NO	TYPE OF ELECTRODE / WIRE	SIZE & QTY				TIG WIRE WT (IN KG)	REMARKS
		ø2.5	ø3.15	ø4.0	ø5.0		
01	E-7018	40	330	–			
02	E 8018 B2	60	13	–			
03	E 9018 B3	5550	1639	–			
04	E 309	582	–	–			

NOTES: –

1. RESERVE 25% ADDED.
2. QUANTITY GIVEN IS PER BOILER

ENCL: ERECTION WELDING SCHEDULE SHEETS
FROM 4-12-992-11063
TO 4-12-992-11065

CC: 1. SDGM / CONTRACTS (SUBRAMANIAN N.)
2. Sr.MANAGER/WTC

PREPARED	CHKD(DGN)	APPD(WTC)	DATE	DRAWING NO.
V.K	S.A.K	G.SUBARAMANIAN	07.07.10	4-12-992-11062

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ERECTION WELDING SCHEDULE

NON– PRESSURE PARTS

PROJECT : HINDALCO INDUSTRIES LTD. UNIT: MAHAN & ADITYA ALUMINIUM 2X(6X150MW)

CUSTOMER NO: 0164 TO 0169 0172 TO 0177

PG : 12

PG NAME : SUPERHEATERS

SL. NO.	DRAWING NO. WPS NO.	DESCRIPTION	MATERIAL	SIZE	THICK	WELD SPECN.	RECOMMENED ELECTRODE/WIRE SPECN.	PROCESS	SIZE	TOTAL LENGTH NO.OFF WELD	ACTUAL QTY (NOS)	PREHEAT °C	PWHT °C	MIN RECOMMENDED NDE
01	1–12–917–01345	PLATE + PLATE	SA387Gr22CL2 + SA387Gr12CL2	–	–	6 ◺	E 8018B2	ARC	ø2.5	1.6	24	150	–	10% LPI OR MPI
		PLATE + PLATE	SA387Gr22CL2 + SA387Gr22CL2	–	–	6V̂	E 9018B3	ARC	ø2.5	0.80	20	150	–	10% LPI OR MPI
		PIPE + PLATE	SA106GrB + IS2062FE410WA	–	–	10V̂	E 7018	ARC	ø2.5 ø3.15	3.192	32 96	–	–	–
		PLATE + PLATE	SA387Gr22CL2 + SA387Gr22CL2	–	–	6 ◺	E 9018B3	ARC	ø2.5	4.0	60	150	–	10% LPI OR MPI
02	1–12–928–01355	LUG PLATE + PLATE	SA 515Gr70	–	–	10◺	E 7018	ARC	ø3.15	8.8	168	–	–	–
03	0–12–948–01457	SEAL + HEAT PLATE + SHIELD	SA387Gr22CL2 + SA240TYTP430	–	–	3 ◺	E 309	ARC	ø2.5	105.23	421	150 on Gr22 side	–	100%LPI
		CROWN+ SEAL PLATE PLATE	SA387Gr22CL2 + SA387Gr22CL2	–	–	4 ◺	E 9018B3	ARC	ø2.5	143.32	1004	150	–	10%LPI OR MPI

PREPARED	CHECKED (DESIGN)	CHECKED (W.T.C)	APPROVED	DATE	DRAWING NO:
V.K	S.A.K			07.07.2010	4–12–992–11063

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ERECTION WELDING SCHEDULE

NON–PRESSURE PARTS

PROJECT : HINDALCO INDUSTRIES LTD.
UNIT: MAHAN & ADITYA ALUMINIUM 2X(6X150MW)

CUSTOMER NO: 0164 TO 0169, 0172 TO 0177

PG : 12

PG NAME : SUPERHEATERS

SL. NO.	DRAWING NO. WPS NO.	DESCRIPTION	MATERIAL	SIZE	THICK	WELD SPECN.	RECOMMENED ELECTRODE/WIRE SPECN.	PROCESS	SIZE	TOTAL LENGTH NO.OFF WELD	ACTUAL QTY (NOS)	PREHEAT °C	PWHT °C	MIN RECOMMENDED NDE
04	0–12–948–01457	RSB PLATE + CR. PLATE	SA387Gr22CL2 + SA387Gr22CL2	–	–	5 ◺	E 9018B3	ARC	ø2.5	160.0	1760	150	–	10% LPI OR MPI
		RSB PLATE + END BAR PLATE	SA387Gr22CL2 + SA387Gr22CL2	–	–	8 ◺	E 9018B3	ARC	ø2.5 ø3.15	72.52	726 581	150	–	10% LPI OR MPI
		PLATE + END BAR PLATE	SA387Gr22CL2 + SA387Gr22CL2	–	–	3 ◺	E 9018B3	ARC	ø2.5	1.20	5	150	–	10% LPI OR MPI
05	0–12–968–01465	SEAL PLATE + HS PLATE	SA387Gr22CL2 + SA240TYTP304	–	–	3 ◺	E 309	ARC	ø2.5	10.752	44	150 on Gr22 side	–	100% LPI
		RSB PLATE + CR. PLATE	SA387Gr22CL2 + SA387Gr22CL2	–	–	5 ◺	E 9018B3	ARC	ø2.5	57.6	634	150	–	10%LPI OR MPI
		SEAL PLATE + CR. PLATE	SA387Gr22CL2 + SA387Gr22CL2	–	–	5 ◺	E 9018B3	ARC	ø2.5	22.464	248	150	–	10%LPI OR MPI

PREPARED	CHECKED (DESIGN)	CHECKED (W.T.C)	APPROVED	DATE	DRAWING NO:
V.K	S.A.K	G.SUBARAMANIAN	S.A.K	07.07.10	4–12–992–11064

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ERECTION WELDING SCHEDULE

NON– PRESSURE PARTS

PROJECT : HINDALCO INDUSTRIES LTD. UNIT: MAHAN & ADITYA ALUMINIUM 2X(6X150MW)

CUSTOMER NO: 0164 TO 0169 0172 TO 0177

PG : 12 PG NAME : SUPERHEATERS

SL. NO.	DRAWING NO. WPS NO.	DESCRIPTION	MATERIAL	SIZE	THICK	WELD SPECN.	RECOMMENED ELECTRODE/WIRE SPECN.	PROCESS	SIZE	TOTAL LENGTH NO.OFF WELD	ACTUAL QTY (NOS)	PREHEAT °C	PWHT °C	MIN RECOMMENDED NDE
06	0–12–968–01465	CR. PLATE + END BAR PLATE	SA387Gr22CL2 + SA387Gr22CL2	–	–	10◺	E 9018B3	ARC	ø3.15	38.4	730	150	–	10% LPI OR MPI
		PLATE + END BAR PLATE	SA387Gr12CL2 + SA387Gr22CL2	–	–	8 ◺	E 8018B2	ARC	ø2.5 ø3.15	1.2	12 10	150	–	10% LPI OR MPI

PREPARED	CHECKED (DESIGN)	CHECKED (W.T.C)	APPROVED	DATE	DRAWING NO:
V.K	S.A.K			07.07.10	4–12–992–11065

TIRUCHY

SUMMARY LIST OF SITE ELECTRODES

PROJECT: HINDALCO INDUSTRIES LTD.
UNIT: MAHAN & ADITYA ALUMINIUM 2X(6X150MW)

CUSTOMER NO: 0164 TO 0169
0172 TO 0177

P.G. NO: 12

P.G. NAME: SUPERHEATERS

PRESSURE PARTS

SL. NO	TYPE OF ELECTRODE / WIRE	SIZE & QTY				TIG WIRE WT (in gm)	REMARKS
		ø2.5	ø3.15	ø4.0	ø5.0		
01	E-7018-1	16464	1580				
02	E- 7018-A1	180	293	488			
03	E-8018-B2	15528	357	1497			
04	E-9018-B3	9712					
05	RT 1/2 MO					27837	
06	RT 1 1/4 Cr 1/2 MO					15965	
07	RT 2 1/4 Cr 1 MO					7404	

NOTES: -

1. RESERVE 25% ADDED.
2. QUANTITY GIVEN IS PER BOILER

ENCL: ERECTION WELDING SCHEDULE SHEETS
FROM 4-12-992-11067
TO 4-12-992-11069

CC: 1. SDGM / CONTRACTS (SUBRAMANIAN N.)
2. Sr.MANAGER/WTC

PREPARED	CHECKED(DESIGNS)	APPROVED(WTC)	DRAWING NO.
V.K	S.A.K	G.S	4-12-992-11066

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ERECTION WELDING SCHEDULE

PRESSURE PARTS

PROJECT : HINDALCO INDUSTRIES LTD. UNIT: MAHAN & ADITYA ALUMINIUM 2X(6X150MW)

CUSTOMER NO: 0164 TO 0169 0172 TO 0177

PG : 12

PG NAME : SUPERHEATERS

SL. NO.	DRAWING NO. WPS NO.	DESCRIPTION	MATERIAL	SIZE	THICK	WELD Specn.	NO OFF	TIG SPECN.	QTY gm	ACTUAL SPECN.(NOS) ø2.5	ø3.15	ø4.0	PREHEAT °C	PWHT °C	MIN RECOMMENDED NDE
01	1-12-850-01350	SH.CONN.PIPES PIPE + PIPE	SA106GrC + SA106GrC	ø 127	11.5	10.5 VV	48	RT 1/2 MO	1277	E7018-1 576	816		–	–	10% RT MIN 2WELD/ WELDER
02	0-00-027-45330	SH.RAD.ROOF TUBE + TUBE	SA213T11 + SA213T11	ø 51	5	5 V	300	RT 1 1/4Cr 1/2 MO	3180	E8018-B2 2400			150	–	10% RT MIN 1WELD/ WELDER
03	0-00-027-45328	SH.SW.HDR HDR+PIPE +ELBOWPIPE	SA106GrC + SA234WPC	ø 273	32	28 VV	2	RT 1/2 MO	164	E7018-A1 40	66	144	100	635 ± 15	100% RT
04	0-00-027-45333	SH.BP.PANELS TUBE + TUBE	SA210GrC + SA210GrC	ø 44.5	5.0	5.0 V	1200	RT 1/2 MO	10800	E7018-1 8400			–	–	10% RT MIN 1WELD/ WELDER
05	0-00-027-45335	SH.SW.OUT.HDR HDR+ELBOW PIPE + PIPE	SA106GrC + SA234WPC	ø 273	32	28 VV	4	RT 1/2 MO	328	E7018-A1 80	132	228	100	635 ± 15	100% RT
06	0-10-135-01019 0-00-027-45333	LTSH ASY+HDR HH PIPE+HSE	SA210GrC + SA234WPC	ø 127	20.5	18.15 VV	2	RT 1/2 MO	68	E7018-A1 24	36	18		635 ± 15	10% RT MIN1WELD/ WELDER
07	0-00-027-45326	LTSH ASY+HDR TUBE+TUBE	SA210GrC + SA210GrC	ø 44.5	4.5	4.5 V	360	RT 1/2 MO	3312	E7018-1 2520			–	–	10% RT MIN1WELD/ WELDER
08	0-00-027-45326	LTSH ASY+HDR TUBE+TUBE	SA210GrC + SA210GrC	ø 44.5	5	5 V	180	RT 1/2 MO	1620	E7018-1 1260			–	–	10% RT MIN1WELD/ WELDER
09	0-00-027-45326	LTSH ASY+HDR TUBE+TUBE	SA210GrC + SA210GrC	ø 44.5	4	4 V	90	RT 1/2 MO	3969	E7018-1			–	–	10% RT MIN1WELD/ WELDER

PREPARED	CHECKED (DESIGN)	CHECKED (W.T.C)	APPROVED	DATE	DRAWING NO:
V.K	S.A.K	G.S	S.A.K	12.07.10	4-12-992-11067

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ERECTION WELDING SCHEDULE

PRESSURE PARTS

PROJECT : HINDALCO INDUSTRIES LTD. UNIT: MAHAN & ADITYA ALUMINIUM 2X(6X150MW)

CUSTOMER NO: 0164 TO 0169 0172 TO 0177

PG : 12 PG NAME : SUPERHEATERS

SL. NO.	DRAWING NO. WPS NO.	DESCRIPTION	MATERIAL	SIZE	THICK	WELD Specn.	NO OFF	TIG SPECN.	TIG QTY	ACTUAL SPECN.(NOS) ø2.5	ø3.15	ø4.0	PREHEAT °C	PWHT °C	MIN RECOMMENDED NDE
10	0-00-027-45326	LTSH UPR+LWR TUBE+TUBE	SA213T11 + SA213T11	ø 44.5	5	5 V	360	RT 1 1/4Cr 1/2MO	3240	E8018-B2 2520			150	–	10% RT MIN1WELD/ WELDER
11	0-00-027-45327	LTSH UPR+TER TUBE+TUBE	SA213T11 + SA213T11	ø 44.5	7.1	6.15 V	360	RT 1 1/4Cr 1/2MO	2736	E8018-B2 3600			150	–	10% RT MIN1WELD/ WELDER
12	0-00-027-45327	LTSH TER +HDR TUBE+TUBE	SA213T11 + SA213T11	ø 44.5	7.1	6.15 V	360	RT 1 1/4Cr 1/2MO	2736	E8018-B2 3600			150	–	10% RT MIN1WELD/ WELDER
13	1-12-852-01206	SH.LINK TEE PIPE +PIPE	SA234WP12CL1 + SA234WP12CL1	ø 406.4	45	43.2 VV	1	RT 11/4Cr 1/2MO	123	E8018-B2 30	50	164	150	655 ± 15	100% RT
14	1-12-852-01364	LINK+DESH-1 PIPE + PIPE	SA 335P12 + SA 335P12	ø 368	36	34 VV	2	RT 11/4Cr 1/2MO	228	E8018-B2 56	90	202	150	655 ± 15	100% RT
15	1-12-852-01206	SH.LINK TEE PIPE + PIPE	SA234WP12CL1 + SA 335P12	ø 368	36	34 VV	1	RT 11/4Cr 1/2MO	114	E8018-B2 28	45	101	150	655 ± 15	100% RT
16	1-12-852-01364	RG PLUG +PIPE	SA182F22CL3 + SA335P12	–	–	7 △	4	–	–	E8018-B2 9			150	–	100% LPI
17	0-00-027-45322	SH.PLATEN TUBE + TUBE	SA213T22 + SA213T22	ø 47.63	6.6	6.6 V	144	RT 21/4 Cr 1MO	1296	E9018-B3 1440			150	–	10% RT MIN 1WELD/ WELDER
18	0-00-027-45322	SH.PLATEN TUBE + TUBE	SA213T22 + SA213T22	ø 47.63	6.6	6.6 V	144	RT 21/4 Cr 1MO	1296	E9018-B3 1440			150	–	10% RT MIN 1WELD/ WELDER

PREPARED	CHECKED (DESIGN)	CHECKED (W.T.C)	APPROVED	DATE	DRAWING NO:
V.K	S.A.K	G.S	S.A.K	12.07.10	4-12-992-11068

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ERECTION WELDING SCHEDULE

PRESSURE PARTS

PROJECT : HINDALCO INDUSTRIES LTD.
UNIT: MAHAN & ADITYA
ALUMINIUM 2X(6X150MW)

CUSTOMER NO: 0164 TO 0169 0172 TO 0177 PG : 12

PG NAME : SUPERHEATERS

SL. NO.	DRAWING NO. WPS NO.	DESCRIPTION	MATERIAL	SIZE	THICK	WELD Specn.	NO OFF	TIG SPECN.	TIG QTY gm	ACTUAL SPECN.(NOS) ø2.5	ø3.15	ø4.0	PREHEAT °C	PWHT °C	MIN RECOMMENDED NDE
19	1-12-174-01360	SH.LINK+ TEE PIPE + ELBOW	SA234WP12CL1 + SA234WP12CL1	ø 406.4	68.57	52.5V	2	RT 11/4 Cr 1MO	194	E8018-B2 60	100	730	150	655 ± 15	100% RT
20	0-00-027-44359	RG PLUG +PIPE	SA182F22CL3 + SA234WP22CL1	–	–	7	2	–	–	E9018-B3 5			150	–	100% LPI
21	0-00-027-45328	SH.FINAL OUTLET NIPPLE TUBE + TUBE	SA213T22 + SA213T22	ø 44.5	8.0	8.0V	222	RT 2 1/4Cr 1MO	1643	E9018-B3 2664			150	–	10% RT MIN1WELD/ WELDER
22	0-00-027-45328	SH.FINAL INLET NIPPLE TUBE + TUBE	SA213T22 + SA213T22	ø 44.5	7.1	7.1V	222	RT 2 1/4Cr 1MO	1688	E9018-B3 2220			150	–	10% RT MIN 1 WELD/ WELDER
23	0-12-184-01489	SH.EXTD.CONN PIPES PIPE+PIPE	SA106GrC + SA106GrC	ø 108	12.5	11.5V	16	RT 1/2 MO	359	E7018-1 176	224		–	–	10% RT MIN 1 WELD/ WELDER
24	1-12-187-01365	SH.CONN.PIPES PIPE+PIPE	SA106GrC + SA106GrC	ø 108	12.5	11.5V	16	RT 1/2 MO	359	E7018-1 176	224		–	–	10% RT MIN 1 WELD/ WELDER
25	0-12-803-01554 0-12-803-01555	SH SC.SPACER TUBE + TUBE	SA 210GrC + SA 210GrC	ø 44.5	5	5V	7	RT 1/2 MO	63	E7018-1 49			–	–	10% RT MIN 1 WELD/ WELDER
26	0-12-803-01554 0-12-803-01555	SH SC.SPACER TUBE + TUBE	SA 210GrC + SA 213T11	ø 44.5	5	5V	2	RT 1/2 MO	18	E7018-1 14			150	–	10% RT MIN 1 WELD/ WELDER
27	0-12-803-01554 0-12-803-01555	SH SC.SPACER TUBE + TUBE	SA 213T11 + SA 213T11	ø 44.5	5	5V	17	RT 1 1/4 Cr 1/2MO	153	E8018-B2 119			150	–	10% RT MIN 1 WELD/ WELDER

PREPARED	CHECKED (DESIGN)	CHECKED (W.T.C)	APPROVED	DATE	DRAWING NO:
V.K	S.A.K	G.S	S.A.K	12.07.10	4-12-992-11069

TIRUCHY

SUMMARY LIST OF SITE ELECTRODES

PROJECT: HINDALCO INDUSTRIE LTD.
UNIT: MAHAN & ADITYA.
ALUMINIUM 2X(6X150MW)

CUSTOMER NO: 0164 to 0169
0172 to 0179

P:G: NO: 17

P.G. NAME: REHEATERS

NON PRESSURE PARTS

SL. NO	TYPE OF ELECTRODE / WIRE	SIZE & QTY				TIG WIRE WT gm	REMARKS
		ø2.5	ø3.15	ø4.0	ø5.0		
01	E 8018–B2	3042					
02	E 9018–B3	5340					
03	E 309	235					

NOTES:–

1. RESERVE 25% ADDED.
2. QUANTITY GIVEN IS PER BOILER

ENCL : ERECTION WELDING SCHEDULE SHEET : 4–17–992–02688

CC: 1. SDGM /CONTRACTS: SHRI. SUBRAMANIAN N.
2. Sr. Manager/WTC

PREPARED	CHECKED(DESIGNS)	APPROVED(WTC)	DATE	DRAWING NO.
B.S	R.B	G. SUBRAMANIUM	07.07.10	4–17–992–02687

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ERECTION WELDING SCHEDULE

NON PRESSURE PARTS

PROJECT: HINDALCO INDUSTRIES LTD
MAHAN & ADITYA

CUSTOMER NO: 0164 to 169, 172 to 177 PG(S): 17 PG NAME: REHEATERS

SL. NO.	DRAWING NO.	DESCRIPTION	MATERIAL	SIZE	THICK	WELD Specn.	RECOMMENDED ELECTRODE/WIRE SPECN.	PROCESS	SIZE	TOTAL LENGTH NO.OFF WELD	ACTUAL QTY (NOS)	PREHEAT °C	PWHT °C	MIN RECOMMENDED NDE
01	0-17-919-00206	ROOF SEAL BAND + CROWN PLATE	SA387Gr12CL2 + SA387Gr12CL2	–	6 + 10	6 ◺ (LC)	E 8018-B2	ARC	ø2.5	93.59	1404	125	–	10 % MPI OR LPI
		SEAL PLATE + CROWN PLATE	SA387Gr22CL2 + SA387Gr12CL2	–	6 + 10	4 ◺ (NLC)	E 8018-B2	ARC	ø2.5	50.27	352	150	–	10 % MPI OR LPI
		SEAL PLATE + HEAT SHIELD	SA387Gr22CL2 + SA240TYP430	–	6 + 3.15	3 ◺ (NLC)	E 309	ARC	ø2.5	21.85	88	150	–	10 % LPI
		CROWN PLATE + END BAR	SA387Gr12CL2 + SA387Gr12CL2	–	10 + 16	6 ◺ (LC)	E 8018-B2	ARC	ø2.5	45.08	677	150	–	10 % MPI OR LPI
02	0-17-929-00205	ROOF SEAL BAND + CROWN PLATE	SA387Gr22CL2 + SA387Gr22CL2	–	6 + 10	6 ◺ (LC)	E 9018-B3	ARC	ø2.5	205.80	3087	150	680 TO 720	10 % MPI OR LPI
		SEAL PLATE + CROWN PLATE	SA387Gr22CL2 + SA387Gr22CL2	–	6 + 10	4 ◺ (NLC)	E 9018-B3	ARC	ø2.5	55.42	388	150	–	10 % MPI OR LPI
		ROOF TUBE CLIP + END BAR	SA387Gr22CL2 + SA387Gr22CL2	–	6 + 25	6 ◺ (LC)	E 9018-B3	ARC	ø2.5	8.0	120	150	680 TO 720	10 % MPI OR LPI
		CROWN PLATE + END BAR	SA387Gr22CL2 + SA387Gr22CL2	–	10 + 25	6 ◺ (LC)	E 9018-B3	ARC	ø2.5	45.08	677	150	680 TO 720	10 % MPI OR LPI
		SEAL PLATE + HEAT SHIELD	SA387Gr22CL2 + SA240TYP430	–	6 + 3.15	3 ◺ (NLC)	E 309	ARC	ø2.5	25.0	100	150	–	10 % MPI OR LPI

PREPARED	CHECKED (DESIGN)	CHECKED (W.T.C)	APPROVED	DATE	DRAWING NO:
B.S	R.B	G.SUBRAMANIUM	R.B	07.07.10	4-17-992-02688

(NLC-NON LOAD CARRYING)

TIRUCHY

SUMMARY LIST OF SITE ELECTRODES

PROJECT: HINDALCO INDUSTRIE LTD.
UNIT: MAHAN & ADITYA.
ALUMINIUM 2X(6X150MW)

CUSTOMER NO: 0164 to 0169
0172 to 0179

P: G: NO: 17

P.G. NAME: REHEATERS

PRESSURE PARTS

SL. NO	TYPE OF ELECTRODE / WIRE	SIZE & QTY				TIG WIRE WT gm	REMARKS
		ø2.5	ø3.15	ø4.0	ø5.0		
01	RT 1 1/4 CR 1/2 MO	–	–	–	–	29604	
02	RT 2 1/4 CR 1 MO	–	–	–	–	6580	
03	ER90SB9	–	–	–	–	13160	

NOTES: –

1. RESERVE 25% ADDED.
2. QUANTITY GIVEN IS PER BOILER

ENCL : ERECTION WELDING SCHEDULE SHEET : 4–17–992–02690

CC: 1. SDGM /CONTRACTS: SHRI. SUBRAMANIAN N.
2. Sr. Manager/WTC

PREPARED	CHECKED(DESIGNS)	APPROVED(WTC)	DATE	DRAWING NO.
B.S	S.A.K	G. SUBRAMANIUM	09.07.10	4–17–992–02689

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ERECTION WELDING SCHEDULE

PRESSURE PARTS

PROJECT: HINDALCO INDUSTRIE LTD.
UNIT: MAHAN & ADITYA
ALUMINIUM 2X(6X150MW)

CUSTOMER NO: 0164 to 0169
0172 to 0179

PG NAME: REHEATERS
PG NO: 17

SL. NO.	DRAWING NO. WPS NO.	DESCRIPTION	MATERIAL	SIZE	THICKNESS	WELD Specn.	NO. OFF	TIG SPECN.	TIG QTY gm	ARC SPECN. ø2.4	ARC SPECN. ø3.15	ARC SPECN. ø4.0	PREHEAT °C	PWHT °C	MIN RECOMMENDED NDE
01	0-00-027-45322	RH. FRONT + NIPPLE	SA 213 T11 SA 213 T11	ø54.0	4.0	4.0 V	245	RT 1 1/4CR 1/2 MO	13157	–			150	–	10 % RT MIN 1WELD/ WELDER
		RH. REAR + NIPPLE	SA 213 T91 SA 213 T91	ø54.0	4.0	4.0 V	196	ER90S-B9	10526	–			220	750 to 770	100 % RT MIN 1WELD/ WELDER
		RH. REAR + NIPPLE	SA 213 T22 SA 213 T22	ø54.0	4.0	4.0 V	49	RT 2 1/4CR 1MO	2632	–			150	–	10 % RT MIN 1WELD/ WELDER
		RH. FRONT + RH. REAR	SA 213 T22 SA 213 T22	ø54.0	4.0	4.0 V	49	RT 2 1/4CR 1 MO	2632	–			150	–	10 % RT MIN 1WELD/ WELDER
		RH. FRONT + RH. REAR	SA 213 T11 SA 213 T22	ø54.0	4.0	4.0 V	196	RT 1 1/4CR 1/2 MO	10526	–			150	–	10 % RT MIN 1WELD/ WELDER

PREPARED	CHECKED (DESIGN)	CHECKED (W.T.C)	APPROVED	DATE	DRAWING NO:
B.S	S.A.K	G. SUBRAMANIUM	S.A.K	09.07.2010	4-17-992-02690

BHEL TIRUCHY

SUMMARY LIST OF SITE ELECTRODES

PROJECT: HINDALCO INDUSTRIES LTD.
UNIT: MAHAN & ADITYA ALUMINIUM 2X(6X150MW)

CUSTOMER NO: 0164 TO 0169
0172 TO 0177

P.G. NO: 19

NON PRESSURE PARTS

P.G. NAME: ECONOMISERS SYSTEM

SL. NO	TYPE OF ELECTRODE / WIRE	SIZE & QTY				TIG WIRE WT (in gm)	REMARKS
		ø2.5	ø3.15	ø4.0	ø5.0		
01	E-7018	385	244				
02	E 8018 B2	560	305	63			

NOTES:-

1. RESERVE 25% ADDED.
2. QUANTITY GIVEN IS PER BOILER

ENCL : ERECTION WELDING SCHEDULE SHEETS

4-19-992-06174

CC : 1. SDGM / CONTRACTS (SUBRAMANIAN N.)
2. Sr.MANAGER/WTC

PREPARED	CHECKED(DESIGNS)	APPD(WTC)	DATE	DRAWING NO.
B.S	S.A.K	G.S	08.07.10	4-19-992-06173

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ERECTION WELDING SCHEDULE

NON–PRESSURE PARTS

PROJECT : HINDALCO INDUSTRIES LTD. CUSTOMER NO: 0164 TO 0169 PG : 19 PG NAME : ECONOMISERS
UNIT: MAHAN & ADITYA 0172 TO 0177
ALUMINIUM 2X(6X150MW)

SL. NO.	DRAWING NO. WPS NO.	DESCRIPTION	MATERIAL	SIZE	THICK	WELD SPECN.	RECOMMENED ELECTRODE/WIRE SPECN.	PROCESS	SIZE	TOTAL LENGTH NO.OFF WELD	ACTUAL QTY (NOS)	PREHEAT °C	PWHT °C	MIN RECOMMENDED NDE
01	0–00–027–45325	WASHER PLATE	SA387Gr12CL2 + SA182F12CL2	–	–	3◺	E 8018B2	ARC	ø2.5	10.5	42	125	–	10%LPI OR MPI
		PLATE + PLATE	SA387Gr12CL2 + SA387Gr12CL2	–	–	8◺	E 8018B2	ARC	ø2.5 ø3.15	99	989 792	125	–	10%LPI OR MPI
		PLATE + PLATE	SA387Gr12CL2 + SA387Gr12CL2	–	–	12◺	E 8018B2	ARC	ø3.15	8.00	218	125	–	10%LPI OR MPI
02	1–19–904–01946	PLATE + PLATE	SA515GR70 + SA387GR12CL2	–	–	10◺	E7018	ARC	ø3.15	13.2	250	125	–	10%LPI OR MPI
03	1–19–904–01947	PLATE + CHANNEL	IS2062FE410A + IS2062FE410A	–	–	5◺	E 7018	ARC	ø3.15	22.0	242	–	–	–
		FLAT + SLEEVE	IS2062FE410A + IS2062FE410A	–	–	3◺	E 7018	ARC	ø2.5	18.1	73	–	–	–
		TUBE PANEL + CHANNEL	SA210GrC + IS2062FE410A	–	–	5◺	E 7018	ARC	ø2.5	4.524	50	–	–	–

PREPARED	CHECKED (DESIGN)	CHECKED (W.T.C)	APPROVED	DATE	DRAWING NO:
B.S	S.A.K	G.S	S.A.K	08.07.10	4–19–992–06174

TIRUCHY

SUMMARY LIST OF SITE ELECTRODES

PROJECT: HINDALCO INDUSTRIES LTD.
UNIT: MAHAN & ADITYA ALUMINIUM 2X(6X150MW)

CUSTOMER NO: 0164 TO 0169
0172 TO 0177

P.G. NO: 19
P.G. NAME: ECONOMISERS

PRESSURE PARTS

SL. NO	TYPE OF ELECTRODE / WIRE	SIZE & QTY				TIG WIRE WT (in gm)	REMARKS
		ø2.5	ø3.15	ø4.0	ø5.0		
01	E-7018-A1	150	232	195			
02	E-7018-1	3822	313	263			
03	RT 1/2 MO					55124	

NOTES:-
1. RESERVE 25% ADDED.
2. QUANTITY GIVEN IS PER BOILER

ENCL : ERECTION WELDING SCHEDULE SHEETS

4-19-992-06176

CC: 1. SDGM / CONTRACTS (SUBRAMANIAN N.)
2. Sr.MANAGER/WTC

PREPARED	CHECKED(DESIGNS)	APPD(WTC)	DATE	DRAWING NO.
V.K	S.A.K	G.S	09.07.10	4-19-992-06175

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ERECTION WELDING SCHEDULE

PRESSURE PARTS

PROJECT: HINDALCO INDUSTRIES LTD.
UNIT: MAHAN & ADITYA.
ALUMINIUM 2X(6X150)

CUSTOMER No. : 0164 TO 0169
0172 TO 0179

PG : 19

PG NAME : ECONOMISERS

SL. NO.	DRAWING NO. WPS NO.	DESCRIPTION	MATERIAL	SIZE	THICK	WELD Specn.	NO OFF	TIG SPECN.	QTY gm	ACTUAL SPECN.(NOS) ø2.5	ø3.15	ø4.0	PREHEAT °C	PWHT °C	MIN RECOMMENDED NDE
01	0-19-850-00886	ECO.FEED PIPE PIPE + ECO. INLET HEADER	SA106GrC + SA106GrC	ø 323.9	25	22.05 VV	1	RT 1/2 MO	125	E7018-A1 24	39	44	100	635 ± 15	100% RT
		ECO.FEED PIPE PIPE + ELBOW	SA106GrC + SA234WPC	ø 323.9	25	22.05 VV	1	RT 1/2 MO	125	E7018-A1 24	39	44	100	635 ± 15	100% RT
		ECO.FEED PIPE PIPE + VALVE	SA106GrC + SA106GrC	ø 323.9	25	22.05 VV	1	RT 1/2 MO	125	E7018-A1 24	39	44	100	635 ± 15	100% RT
		R.G PLUG + PIPE	SA105 + SA106GrC	–	–	7	3	–	–	E7018-1 7			150	–	100% MPI (OR) LPI
02	0-00-027-45322	ECO.HANGER TUBE + TUBE	SA210GrC + SA210GrC	ø 44.5	5.6	5.6 V	360	RT 1/2 MO	3132	E7018-1 2880			–	–	10% RT MIN 1WELD/ WELDER
		ECO.COILS TUBE + TUBE	SA210GrC + SA210GrC	ø 38.1	4	4 V	1072	RT 1/2 MO	39772						10% RT MIN 1WELD/ WELDER
03	1-19-851-01996	ECO.LINKS TO DRUM PIPE + PIPE	SA106GrB + SA106GrB	ø 219.1	22.23	19.4 VV	8	RT 1/2 MO	544	E7018-1 136	200	168	–	610 ± 15	100% RT
		ECO.LINKS TO DRUM PIPE + PIPE	SA234WPC + SA106GrB	ø 219.1	22.85	16.05 VV	2	RT 1/2 MO	136	E7018-1 34	50	42	–	610 ± 15	100% RT
04	0-19-763-00874 0-19-753-00873	HH PIPE + END COVER PIPE + PIPE	SA106GrC + SA234WPC	ø 127	20	18.15 VV	4	RT 1/2 MO	140	E7018-A1 48	68	24	–	635 ± 15	10% RT MIN2WELD/ WELDER

PREPARED	CHECKED (DESIGN)	CHECKED (W.T.C)	APPROVED	DATE	DRAWING NO:
V.K	S.A..K	G.SUBARAMANIAN	S.A.K	09.07.10	4-19-992-06176

355-066

SUMMARY LIST OF SITE ELECTRODES

FROM

SR.PRODUCT ENGINEER/BOILER MOUNTING
PE (BOILER)

REF: PE(B) : BM: JOJO
DT. 06-05-2008

TO

MANAGER/ERECTION.

PPD

(IN DUPLICATE)

PROJECT: **JOJOBERA 1 x 120 MW**

CUSTOMER Nos.: 0162

P.G. NO: 21

P.G. NAME: SOOT BLOWER PIPING AND SUPPORTS & TEMPERATURE PROBE SUPPORT.

SL.NO.	TYPE OF ELECTRODE/WIRE	SIZE & QTY IN NOS.				TIG WIRE WT IN kgs	REMARKS.
		D 2.50	D 3.15	D 4.00	D 5.00		
01	RT 2 1/4CR 1MO	–	–	–	–	0.140	
02	RT 1/2MO	–	–	–	–	39.830	
03	E 9018-B3	54	27	–	–	–	
04	E 7018-1	874	4	–	–	–	
05	E 7018	2084	779	–	–	–	
06	E 8018-B2	3	–	–	–	–	

NOTES :

1. RESERVE 25% ADDED.
2. QUANTITY GIVEN IS PER BOILER.
3. THIS ERECTION WELDING SCHEDULE IS FOR REFERENCE PURPOSE ONLY.

ENCL: ERECTION WELDING SCHEDULE SHEET: 4-21-992-02062 TO 4-21-992-02068

C.C
1. PROJECT COORDINATOR (Sri.G.SUNDRARAMAN,Mgr./CONTRACTS)
2. SR.MANAGER/W.T.CENTRE
3. WELDING SCHEDULE FILE.

DRG NO. 4-21-992-02062 REV 00

PREPARED	CHECKED	APPROVED/WTC	DATE	SH.NO.
R.ANNADURAI	V.G.S	G.SUBRAMANIAN	06-05-2008	01 OF 01

BHEL

355-005

ERECTION WELDING SCHEDULE.

PRESSURE PARTS / ~~NON PRESSURE PARTS.~~

PROJECT	JOJOBERA 1 x 120 MW
CUST. Nos.	0162
PRODUCT GROUP	21

SL NO.	DRAWING NO.	DESCRIPTION OF PARTS	MATERIAL	SIZE OF THE ITEM	THICKNESS	WELD SPECN.	RECOMMENDED ELECTRODE / WIRE			TOTAL LENGTH/ NO.OF WELD	ACTUAL QTY. (kgs/Nos)	PREHEAT °C	PWHT °C	MIN. RECOMMENDED NDE
							SPECN.	PROCESS ARC/TIG	SIZE (mm)					
01	0-21-600-00296	BW CON RED + CONDENSING LOOP ASSY.	SA234 WP22 CL1. + SA335 P22	D21.3 (1/2")	4.78 (SCH 160)	4.78 V	RT 2 1/4CR 1MO	TIG	ø2.4	2 Nos.	0.030 Kg	200	–	10% RT SUBJECT TO A MIN.OF 1WELD/ WELDER
02	0-21-600-00296	PIPE + BW CON RED	SA335 P22+ SA234 WP22 CL1.	D33.4 (1")	6.35 (SCH 160)	6.35 V	RT 2 1/4CR 1MO + E9018-B3	TIG ARC	ø2.4 ø2.5	2 Nos.	0.008 Kg 14 Nos.	200	–	10% RT SUBJECT TO A MIN.OF 1WELD/ WELDER
03	0-21-600-00296 0-21-600-00297	BW CON RED + CONDENSING LOOP ASSY. (OR) PIPE	SA234 WPB+ SA106 Gr.B	D21.3 (1/2")	2.77 (SCH 40)	2.77 V	RT 1/2MO	TIG	ø2.4	10 Nos.	0.084 Kg	–	–	10% RT SUBJECT TO A MIN.OF 1WELD/ WELDER
04	0-21-600-00296 0-21-600-00297	PIPE + PIPE (OR) BW CON RED (OR) ORIFICE PLATE ASSEMBLY	SA106 Gr.B+ SA234 WPB (OR) SA106 Gr.B	D33.9 (1")	3.38 (SCH 40)	3.38 V	RT 1/2MO	TIG	ø2.4	20 Nos.	0.570 Kgs	–	–	10% RT SUBJECT TO A MIN.OF 1WELD/ WELDER
05	0-21-600-00296 0-21-600-00297	PIPE + PIPE (OR) BEND(MADE AT SITE) (OR)BW CON RED (OR) TEE PIECE(FOR SV)	SA106 Gr.B+ SA106 Gr.B (OR) SA234 WPB	D60.3 (2")	3.91 (SCH 40)	3.91 V	RT 1/2MO	TIG	ø2.4	510 Nos.	31.008 Kgs	–	–	10% RT SUBJECT TO A MIN.OF 1WELD/ WELDER
06	0-21-600-00296	PIPE + PIPE (OR) FLOW SWITCH (OR) BW CON RED	SA106 Gr.B+ SA106 Gr.B (OR)SA105(OR) SA234 WPB	D88.9 (3")	5.49 (SCH 160)	5.49 V	RT 1/2MO E 7018-1	TIG ARC	ø2.4 ø2.5	4 Nos.	0.080 Kgs 56 Nos.	–	–	10% RT SUBJECT TO A MIN.OF 1WELD/ WELDER
07	0-21-600-00296	TEE + SV FLANGE	SA105 + SA105	D60.3	8.3	8.3 V	RT 1/2MO E 7018-1	TIG ARC	ø2.4 ø2.5 ø3.15	1 No.	0.008 Kgs 10 Nos. 3 Nos.	–	–	10% RT SUBJECT TO A MIN.OF 1WELD/ WELDER
08	0-21-600-00296	PIPE + PRV	SA335 P22+ SA182 F22	D60.3 (2")	8.74 (SCH 160)	10 △	E 9018-B3	ARC	ø3.15	1 No.	4 Nos.	200	–	100% MPI (OR)LPI

PREPARED	CHECKED DESIGN	CHECKED WTC	APPROVED	DATE	DRG NO.	REV
R.ANNADURAI	V.GUNASEKARAN	G.SUBRAMANIAN	V.GUNASEKARAN	06-05-2008	4-21-992-02063	00

BHEL

355–005

ERECTION WELDING SCHEDULE.

PRESSURE PARTS / ~~NON PRESSURE PARTS.~~

PROJECT	JOJOBERA 1 x 120 MW
CUST. Nos.	0162
PRODUCT GROUP	21

SL NO.	DRAWING NO.	DESCRIPTION OF PARTS	MATERIAL	SIZE OF THE ITEM	THICKNESS	WELD SPECN.	RECOMMENDED ELECTRODE / WIRE			TOTAL LENGTH/ NO.OF WELD	ACTUAL QTY. (kgs/Nos)	PREHEAT °C	PWHT °C	MIN. RECOMMENDED NDE
							SPECN.	PROCESS ARC/TIG	SIZE (mm)					
09	0–21–600–00296	TUBE + PRV	SA213Gr.T11+ SA182 F22	D60.3	3.6	4 ∆	E 8018–B2	ARC	ø2.5	1 No.	2 Nos.	150	–	10% MPI (OR) LPI
10	0–21–600–00296	TUBE + PIPE	SA213Gr.T11 +SA106 Gr.B	D60.3	3.6	3.6 V̂	RT 1/2MO	TIG	ø2.4	1 No.	0.061Kgs	125	–	10 % RT SUBJECT TO A MIN. OF 1 WELD / WELDER
11	0–21–600–00296	PIPE + TEE (OR) TEE + REDUCER	SA335 P22+ SA182 F22CL3 (OR) SA182 F22CL3 +SA234WP22 CL1	D60.3 (2")	8.74 (SCH 160)	10 ∆	E 9018–B3	ARC	ø3.15	3 Nos.	11 Nos.	200		100% MPI (OR) LPI
12	0–21–600–00296	VALVE + PIPE (OR) BW CON RED CL1	SA182 F22CL3 + SA335 P22 (OR) SA234 WP22 CL1	D33.4 (1")	6.35 (SCH 160)	7 ∆	E 9018–B3	ARC	ø2.5	4 Nos.	9 Nos.	200	–	100% MPI (OR) LPI
13	0–21–600–00296 0–21–600–00297	TEE + PIPE (OR) VALVE (OR) BW CON RED	SA234 WPB+ SA106 Gr.B SA105 (OR) SA234 WPB	D33.4 (1")	3.38 (SCH 40)	4 ∆	E 7018–1	ARC	ø2.5	40 Nos.	30 Nos.	–	–	10% MPI (OR) LPI
14	0–21–600–00296 0–21–600–00297	SW ELL. + PIPE(OR) VALVE (OR) THERMO COUPLE ASSY.(OR) THEMOWELL ASSY. (OR)LRSB INLET(OR) WB INLET(OR)BLANK FLANGE(OR)SW EQ. TEE(OR)SW UE TEE	SA234 WPB+ SA106 Gr.B (OR) SA105 (OR)BM–C16	D60.3 (2")	3.91 (SCH 40)	4 ∆	E 7018–1	ARC	ø2.5	450 Nos.	600 Nos.	–	–	10% MPI (OR) LPI

PREPARED	CHECKED DESIGN	CHECKED WTC	APPROVED	DATE	DRG NO.	REV
R.ANNADURAI	V.GUNASEKARAN	G.SUBRAMANIAN	V.GUNASEKARAN	06–05–2008	4–21–992–02064	00

BHEL

355–005

ERECTION WELDING SCHEDULE.

PRESSURE PARTS / ~~NON PRESSURE PARTS.~~

PROJECT	JOJOBERA 1x 120MW
CUST. Nos.	0162
PRODUCT GROUP	21

SL NO.	DRAWING NO.	DESCRIPTION OF PARTS	MATERIAL	SIZE OF THE ITEM	THICKNESS	WELD SPECN.	RECOMMENDED ELECTRODE / WIRE			TOTAL LENGTH/ NO.OF WELD	ACTUAL QTY. (kgs/Nos)	PREHEAT °C	PWHT °C	MIN. RECOMMENDED NDE
							SPECN.	PROCESS ARC/TIG	SIZE (mm)					
15	0–21–600–00296	PIPE + PIPE	SA335 P22+ SA335 P22	D60.3 (2")	8.74 (SCH 160)	8.74 V	RT 2 1/4CR 1 MO E 9018–B3	TIG ARC	ø2.4 ø2.5 ø3.15	2 Nos.	0.022Kgs 20 Nos. 6 Nos.	–	680–750	10% RT SUBJECT TO A MIN.OF 1WELD/ WELDER
16	0–21–600–00297	AHB INLET + BW CON RED (OR) BLANK FLANGE	SA234 WPB+ SA234 WPB (OR) IS2062Fe410A	D48.3 (1 1/2")	3.68 (SCH 40)	4 △	E 7018–1	ARC	ø2.5	2 Nos.	3 Nos.	–	–	10% MPI (OR) LPI

PREPARED	CHECKED DESIGN	CHECKED WTC	APPROVED	DATE	DRG NO.	REV
R.ANNADURAI	V.GUNASEKARAN	G.SUBRAMANIAN	V.GUNASEKARAN	06–05–2008	4–21–992–02065	00

BHEL

355-005

ERECTION WELDING SCHEDULE.

~~PRESSURE PARTS~~ / NON PRESSURE PARTS.

PROJECT	JOJOBERA 1x 120MW
CUST. Nos.	0162
PRODUCT GROUP	21

SL NO	DRAWING NO	DESCRIPTION OF PARTS	MATERIAL	SIZE OF THE ITEM	THICKNESS	WELD SPECN.	RECOMMENDED ELECTRODE / WIRE			TOTAL LENGTH/ NO. OF WELD	ACTUAL QTY. (kgs/Nos)	PREHEAT °C	PWHT °C	MIN. RECOMMENDED NDE
							SPECN.	PROCESS ARC/TIG	SIZE (mm)					
17	0-21-600-00296	PIPE + PIPE	IS1239 + SA106 Gr.B	D21.3	2.77	2 ∆	E 7018	ARC	ø2.5	2 Nos.	2 Nos.	–	–	
18	0-21-600-00296	PIPE + SOC FOR SV DRAIN	SA106 Gr.B +SA105	D21.3	2.77	2 ∆	E 7018	ARC	ø2.5	1 No.	1 No.	–	–	
19	0-21-600-00296	PIPE +PIPE (OR) DRIP PAN (OR) AIRVENT THROUGH DRAIN PIPE	IS1239 + IS1239 (OR) IS2062 Fe410A	D34.2	3.25	3 ∆	E 7018	ARC	ø2.5	2 Nos.	5 Nos.	–	–	–
20	0-21-600-00296 0-21-600-00297	FLAT + ISMC (OR) SUPPORTING STRUCTURE (OR) ISA	IS2062 Fe410A + IS2062 Fe410A	–	–	5 ∆	E 7018	ARC	ø2.5	30 m	330 Nos.	–	–	–
21	0-21-600-00296 0-21-600-00297	ISMC + PIPE SADDLE (OR) SV SUPPORT	IS2062 Fe410A + IS2062 Fe410A	–	–	10 ∆	E 7018	ARC	ø3.15	25 m	475 Nos.	–	–	–
22	3-21-601-00242 3-21-601-00243 3-21-601-00244	PIPE + PIPE GUIDE	IS1239 + IS2062 Fe410A	–	–	3 ∫	E 7018	ARC	ø2.5	26.4 m	106 Nos.	–	–	–
23	3-21-601-00242 3-21-601-00243 3-21-601-00244	PIPE + PIPE (OR) SUPPORT PLATE	IS1239 + IS1239 (OR) IS2062 Fe410A	–	–	3 ∆	E 7018	ARC	ø2.5	5.94 m	24 Nos.	–	–	–
24	3-21-601-00204	ISMB + PLATE	IS2062 Fe410A + IS2062 Fe410A	–	–	5 ∆	E 7018	ARC	ø2.5	1.2 m	14 Nos.	–	–	–
25	3-21-601-00572	PIPE + FLAT	API5L Gr.B + IS2062 Fe410A	–	–	4 ∆	E 7018	ARC	ø2.5	1.6 m	12 Nos.	–	–	–

PREPARED	CHECKED DESIGN	CHECKED WTC	APPROVED	DATE	DRG NO.	REV
R.ANNADURAI	V.GUNASEKARAN	G.SUBRAMANIAN	V.GUNASEKARAN	06-05-2008	4-21-992-02066	00

BHEL

355-005

ERECTION WELDING SCHEDULE.

~~PRESSURE PARTS~~ / NON PRESSURE PARTS.

PROJECT	JOJOBERA 1 x 120MW
CUST. Nos.	0162
PRODUCT GROUP	21

SL No.	DRAWING No.	DESCRIPTION OF PARTS	MATERIAL	SIZE OF THE ITEM	THICKNESS	WELD SPECN.	RECOMMENDED ELECTRODE / WIRE			TOTAL LENGTH/ No.OF WELD	ACTUAL QTY. (kgs/Nos)	PREHEAT °C	PWHT °C	MIN. RECOMMENDED NDE
							SPECN.	PROCESS ARC/TIG	SIZE (mm)					
26	3-21-601-00572	ISMC + ISMC (OR) SUPPORTING STRUCTURE	IS2062 Fe410A + IS2062 Fe410A	–	–	5 △	E 7018	ARC	ø2.5	2.4 m	27 Nos.	–	–	–
27	3-21-601-00590	PIPE + PLATE	API5L Gr.B + IS2062 Fe410A	–	–	5 ⌒	E 7018	ARC	ø2.5	0.56 m	7 Nos.	–	–	–
28	3-21-601-00590	ISMC + ISMC (OR) PLATE	IS2062 Fe410A + IS2062 Fe410A	–	–	6 △	E 7018	ARC	ø2.5	2.4 m	36 Nos	–	–	–
29	3-21-601-00590	ISMC + SUPPORTING STRUCTURE	IS2062 Fe410A + IS2062 Fe410A	–	–	5 △	E 7018	ARC	ø2.5	0.4 m	5 Nos.	–	–	–
30	3-21-601-00254 3-21-601-00255	PIPE + PIPE GUIDE	SA106 Gr.B + IS2062 Fe410A	–	–	4 ⌒	E 7018	ARC	ø2.5	55.2 m	387 Nos.	–	–	–
31	3-21-601-00254 3-21-601-00255	ISMC + SUPPORTING STRUCTURE (OR) BUCK STAY	IS2062 Fe410A + IS2062 Fe410A	–	–	8 △	E 7018	ARC	ø2.5 ø3.15	18.4 m	184 Nos 148 Nos	–	–	–
32	3-21-601-00260	EYE HANGER + ROD	IS2062 Fe410A + IS2062 Fe410A	–	–	10 ⌒	E 7018	ARC	ø2.5	4.0 m	145 Nos	–	–	–

PREPARED	CHECKED DESIGN	CHECKED WTC	APPROVED	DATE	DRG NO.	REV
R.ANNADURAI	V.GUNASEKARAN	G.SUBRAMANIAN	V.GUNASEKARAN	06-05-2008	4-21-992-02067	00

BHEL

355-005

ERECTION WELDING SCHEDULE.

~~PRESSURE PARTS~~ / NON PRESSURE PARTS.

PROJECT	JOJOBERA 1 x 120MW
CUST. Nos.	0162
PRODUCT GROUP	21

SL No.	DRAWING No.	DESCRIPTION OF PARTS	MATERIAL	SIZE OF THE ITEM	THICKNESS	WELD SPECN.	RECOMMENDED ELECTRODE / WIRE			TOTAL LENGTH/ No. OF WELD	ACTUAL QTY. (kgs/Nos)	PREHEAT °C	PWHT °C	MIN. RECOMMENDED NDE
							SPECN.	PROCESS ARC/TIG	SIZE (mm)					
33	3-21-601-00260	SUSPENSION PLATE + ROD	IS2062 Fe410A + IS2062 Fe410A	–	–	10-1/2 K	E 7018	ARC	ø2.5	4.0 m	90 Nos	–	–	–
34	3-21-601-00260	SUPPORTING STRUCTURE + EYE HANGER	IS2062 Fe410A + IS2062 Fe410A	–	–	5 ◺	E 7018	ARC	ø2.5	6.0 m	66 Nos	–	–	–
35	3-21-601-00260	SUSUPENSION PLATE + PIPE CLAMP ROD TYPE	IS2062 Fe410A + IS2062 Fe410A	–	–	10 K	E 7018	ARC	ø2.5	4.0 m	114 Nos	–	–	–
36	2-21-601-00098	PLATE + PLATE	IS2062 Fe410A + IS2062 Fe410A	–	–	2 ⎍	E 7018	ARC	ø2.5	0.48 m	1 Nos	–	–	–
37	2-21-601-00098	SEAL PLATE + WALL SLEEVE ASSY.	IS2062 Fe410A + IS2062 Fe410A	–	–	2 ◺ TACK WELD	E 7018	ARC	ø2.5	8Nos	1 Nos	–	–	–
38	2-21-601-00098	ISMC + ISMC (OR) SUPPORTING STRUCTURE (OR) ISMB	IS2062 Fe410A + IS2062 Fe410A	–	–	6 ◺	E 7018	ARC	ø2.5	6.02 m	91 Nos	–	–	–
39	2-21-601-00098	ISMC + PLATE	IS2062 Fe410A + IS2062 Fe410A	–	–	6 ▷	E 7018	ARC	ø2.5	0.6 m	18 Nos	–	–	–

PREPARED	CHECKED DESIGN	CHECKED WTC	APPROVED	DATE	DRG No.	REV
R.ANNADURAI	V.GUNASEKARAN	G.SUBRAMANIAN	V.GUNASEKARAN	06-05-2008	4-21-992-02068	00

355–006

SUMMARY LIST OF SITE ELECTRODES

FROM

SR.PRODUCT ENGINEER/BOILER MOUNTING
PE (BOILER)

REF: PE(B) : BM: JOJO: 0162
DT. 14/06/08

TO

MANAGER/ERECTION.

PPD

(IN DUPLICATE)

PROJECT: **JOJOBERA – 1 x 120MW**

CUSTOMER Nos.: **0162**

P.G. NO: **24**

P.G. NAME: **BOILER TRIM PIPING , SUPPORT & SV ORIENTATION & EXHAUST PIPE ARRGT. WITH SILENCER SUPPORT.**

SL.No.	TYPE OF ELECTRODE/WIRE	SIZE & QTY IN Nos.				TIG WIRE WT IN KG.	REMARKS.
		D 2.50	D 3.15	D 4.00	D 5.00		
01	RT 1/2MO	–	–	–	–	10.520	
02	RT 11/4CR 1/2MO	–	–	–	–	0.070	
03	RT 21/4CR 1MO	–	–	–	–	3.640	
04	E 7018–1	8725	2721	137	–	–	
05	E 7018–A1	516	770	312	–	–	
06	E 7018	5470	439	140	–	–	
07	E 8018–B2	14	22	3	–	–	

NOTES

1. RESERVE 25% ADDED.
2. QUANTITY GIVEN IS PER BOILER.
3. THIS ERECTION WELDING SCHEDULE IS FOR REFERENCE PURPOSE ONLY.

ENCL: ERECTION WELDING SCHEDULE SHEET : 4–24–992–07502 TO 4–24–992–07512

C.C
1. PROJECT COORDINATOR (Sri.G.SUNDARARAMAN, DM)
2. Sr.MANAGER/W.T.CENTRE.
3. WELDING SCHEDULE FILE.

DRG NO. 4–24–992–07502

PREPARED	CHECKED	APPROVED/WTC	DATE	SH.NO.
A. SHANMUGARAJ	V. GUNASEKAREN	G. SUBRAMANIAN	14/06/08	01 OF 02

355–006

SUMMARY LIST OF SITE ELECTRODES

FROM

SR.PRODUCT ENGINEER/BOILER MOUNTING
PE (BOILER)

REF: PE(B) : BM: JOJO: 0162
DT. 14/06/08

TO

MANAGER/ERECTION.

PPD

(IN DUPLICATE)

PROJECT: JOJOBERA – 1 x 120MW

CUSTOMER Nos.: 0162

P.G. NO: 24

P.G. NAME: BOILER TRIM PIPING , SUPPORT & SV ORIENTATION & EXHAUST PIPE ARRGT. WITH SILENCER SUPPORT.

SL.No.	TYPE OF ELECTRODE/WIRE	SIZE & QTY IN Nos.				TIG WIRE WT IN KG.	REMARKS.
		D 2.50	D 3.15	D 4.00	D 5.00		
08	E 9018–B3	1917	1345	1177	–	–	
09	E 347	289	–	–	–	–	
10	E 309	129	–	–	–	–	

NOTES

1. RESERVE 25% ADDED.
2. QUANTITY GIVEN IS PER BOILER.
3. THIS ERECTION WELDING SCHEDULE IS FOR REFERENCE PURPOSE ONLY.

ENCL: ERECTION WELDING SCHEDULE SHEET : 4–24–992–07502 TO 4–24–992–07512

C.C
1. PROJECT COORDINATOR (Sri.G.SUNDARARAMAN, DM)
2. Sr.MANAGER/W.T.CENTRE.
3. WELDING SCHEDULE FILE.

DRG NO. 4–24–992–07503

PREPARED	CHECKED	APPROVED/WTC	DATE	SH.NO.
A. SHANMUGARAJ	V. GUNASEKAREN	G. SUBRAMANIAN	14/06/08	02 OF 02

BHEL

355-005

ERECTION WELDING SCHEDULE.

PRESSURE PARTS / ~~NON PRESSURE PARTS.~~

PROJECT	JOJOBERA 1 x 120MW
CUST. Nos.	0162
PRODUCT GROUP	24

SL NO	DRAWING No.	DESCRIPTION OF PARTS	MATERIAL	SIZE OF THE ITEM	THICKNESS	WELD SPECN.	RECOMMENDED ELECTRODE / WIRE			TOTAL LENGTH/ NO OF WELD	ACTUAL QTY. (Nos.)	PREHEAT °C	PWHT °C	MIN. RECOMMENDED NDE
							SPECN.	PROCESS ARC/TIG	SIZE (mm)					
01	0-00-047-47725	DRUM SV + STUB	SA105 + SA105	D146.1	31.7	31.7 V̂V̂	RT1/2MO E 7018-A1	TIG ARC	ø2.4 ø2.5 ø3.15 ø4.00	2 Nos.	0.078 kgs 26 Nos. 38 Nos. 58 Nos.	100	620 -650	100% RT
02	0-00-047-47725	CRH LINE SV + STUB	SA105 + SA105	D203.2	22.2	22.2 V̂V̂	RT1/2MO E 7018-A1	TIG ARC	ø2.4 ø2.5 ø3.15 ø4.00	1 No.	0.068 kgs 17 Nos. 25 Nos. 21 Nos.	–	620 -650	100% RT
03	0-00-047-47725	HRH LINE SV + STUB	SA182 F22CL3 + SA182 F22CL3	D203.2	22.2	22.2 V̂V̂	RT2 1/4CR1MO E 9018-B3	TIG ARC	ø2.4 ø2.5 ø3.15 ø4.00	2 Nos.	0.136 kgs 34 Nos. 50 Nos. 42 Nos.	200	680 -750	100% RT
04	0-00-047-47725	MSL. SV + STUB	SA182 F22CL3 + SA182 F22CL3	D146.1	31.7	31.7 V̂V̂	RT2 1/4CR1MO E 9018-B3	TIG ARC	ø2.4 ø2.5 ø3.15 ø4.00	1 No.	0.039 kgs 13 Nos. 19 Nos. 29 Nos.	200	680 -750	100% RT
05	0-00-047-47725	ERV. ISOL. VALVE + STUB (1358VX)	SA217 WC9 + SA182 F22CL3	D139.7	39.7	34.9 V̂V̂	RT2 1/4CR1MO E 9018-B3	TIG ARC	ø2.4 ø2.5 ø3.15 ø4.00	1 No.	0.030 kgs 14 Nos. 20 Nos. 25 Nos.	200	680 -750	100% RT
06	0-00-047-47725	ERV. ISOL. VALVE + ERV (1538VX)	SA217 WC9 + SA182 F22CL3	D139.7	39.7	34.9 V̂V̂	RT2 1/4CR1MO E 9018-B3	TIG ARC	ø2.4 ø2.5 ø3.15 ø4.00	1 No.	0.030 kgs 14 Nos. 20 Nos. 25 Nos.	200	680 -750	100% RT
07	0-00-047-47730 1-00-047-47532	PIPE + PIPE (OR) CONDENCING LOOP ASSY. (OR) BW CON RED	SA106 Gr.B + SA106 Gr.B(OR) SA234 WPB	D21.3 (1/2")	3.73 (SCH 80)	3.73 V̂	RT1/2MO	TIG	ø2.4	50 Nos.	0.675 kgs	–	–	10% RT MIN OF 1 WELD/ WELDER
08	0-00-047-47729	PIPE + PIPE	SA106 Gr.B + SA106 Gr.B	D33.4 (1")	3.38 (SCH 40)	3.38 V̂	RT1/2MO	TIG	ø2.4	5 Nos.	0.388 kgs	–	–	10% RT MIN OF 1 WELD/ WELDER
09	0-00-047-47729 0-00-047-47730 1-00-047-47532	PIPE + PIPE (OR) BW CON RED (OR) PIPE WITH STUB (OR) DRUM NIPPLE (OR)ECO INLET PI NIPPLE(OR)HDR NIPPLE	SA106 Gr.B + SA106 Gr.B(OR) SA234 WPB	D33.4 (1")	6.35 (SCH 160)	6.35 V̂	RT1/2MO E 7018-1	TIG ARC	ø2.4 ø2.5	135 Nos.	0.756 kgs 945 Nos.	–	–	10% RT MIN OF 1 WELD/ WELDER

PREPARED	CHECKED DESIGN	CHECKED WTC	APPROVED	DATE	DRG NO.	REV
A. SHANMUGARAJ	V. GUNASEKAREN	G. SUBRAMANIAN	V. GUNASEKAREN	14/06/08	4-24-992-07504	

355-005

ERECTION WELDING SCHEDULE.

PRESSURE PARTS / ~~NON PRESSURE PARTS.~~

PROJECT	JOJOBERA 1x 120MW
CUST. Nos.	0162
PRODUCT GROUP	24

SL NO	DRAWING No.	DESCRIPTION OF PARTS	MATERIAL	SIZE OF THE ITEM	THICKNESS	WELD SPECN.	RECOMMENDED ELECTRODE / WIRE			TOTAL LENGTH/ NO OF WELD	ACTUAL QTY. (Nos.)	PREHEAT °C	PWHT °C	MIN. RECOMMENDED NDE
							SPECN.	PROCESS ARC/TIG	SIZE (mm)					
10	0-00-047-47729 0-00-047-47730 1-00-047-47532	PIPE + PIPE (OR) BW CON RED (OR) STUB IN MANIFOLD (OR) DRUM NIPPLE (OR)HDR. NIPPLE (OR)END COVER (OR)DWLG	SA106 Gr.B + SA106 Gr.B(OR) SA234 WPB(OR) SA105	D48.3 (1 1/2")	7.14 (SCH 160)	7.14 $\hat{V}$	RT1/2MO E 7018-1	TIG ARC	ø2.4 ø2.5	175 Nos.	1.103 kgs 1575 Nos.	–	–	10% RT MIN. OF 1 WELD/ WELDER
11	0-00-047-47729 0-00-047-47730	PIPE + PIPE (OR) BEND(OR)REDUCER (OR) DRUM NIPPLE	SA106 Gr.B + SA106 Gr.B(OR) SA105	D60.3	8.74 (SCH 160)	8.74 $\hat{V}$	RT1/2MO E 7018-1	TIG ARC	ø2.4 ø2.5 ø3.15	150 Nos.	1.185 kgs 1500 Nos. 450 Nos.	–	–	10% RT MIN. OF 1 WELD/ WELDER
12	0-00-047-47729 0-00-047-47730	PIPE + PIPE (OR) BEND (OR) BW EQ TEE (OR) BW CON RED.(OR)HEADER/DRUM NIPPLE	SA106 Gr.B + SA106 Gr.B(OR) SA234 WPB	D73.0 (2 1/2")	9.53 (SCH 160)	9.53 $\hat{V}$	RT1/2MO E 7018-1	TIG ARC	ø2.4 ø2.5 ø3.15	105 Nos.	1.050 kgs 1260 Nos. 525 Nos.	–	–	10% RT MIN OF 1 WELD/ WELDER
13	0-00-047-47730	PIPE + VALVE (OR) BW.CON.RED.	SA106 Gr.B + SA216 WCB(OR) SA105	D73.0 (2 1/2")	9.53 (SCH 160)	9.53 $\hat{V}$	RT1/2MO E 7018-1	TIG ARC	ø2.4 ø2.5 ø3.15	25 Nos.	0.250 kgs 300 Nos. 125 Nos.	–	610±15	10% RT MIN. OF 1 WELD/ WELDER
14	0-00-047-47730	VALVE + VALVE	SA216 WCB + SA216 WCB	D108.0 (2")	12.5	12.5 $\hat{V}$	RT1/2MO E 7018-A1	TIG ARC	ø2.4 ø2.5 ø3.15	3 Nos.	0.048 kgs 33 Nos. 42 Nos.	–	620 -650	10% RT MIN. OF 1 WELD/ WELDER
15	0-00-047-47730	MANINFOLD+RED. (OR)VALVE (OR)MANI FOLD	SA106 Gr.B + SA105 (OR) SA216 WCC	D108.0	12.5	12.5 $\hat{V}$	RT1/2MO E 7018-1	TIG ARC	ø2.4 ø2.5 ø3.15	2 Nos.	0.032 kgs 22Nos. 28 Nos.	–	610±15	10% RT MIN. OF 1 WELD/ WELDER
16	0-00-047-47730	PIPE + VALVE (OR) PIPE WITH STUB	SA106 Gr.B + SA216 WC6 (OR) SA106 Gr.B	D108.0	16.0	16.0 $\hat{V}\hat{V}$	RT1/2MO E 7018-1	TIG ARC	ø2.4 ø2.5 ø3.15 ø4.00	4 Nos.	0.124 kgs 44 Nos. 56Nos. 8 Nos.	–	610±15	10% RT MIN. OF 1 WELD/ WELDER

PREPARED	CHECKED DESIGN	CHECKED WTC	APPROVED	DATE	DRG NO.	REV
A. SHANMUGARAJ	V. GUNASEKAREN	G. SUBRAMANIAN	V. GUNASEKAREN	14/06/08	4-24-992-07505	

355-005

ERECTION WELDING SCHEDULE.

PRESSURE PARTS / ~~NON PRESSURE PARTS.~~

PROJECT	JOJOBERA 1 x 120MW
CUST. Nos.	0162
PRODUCT GROUP	24

SL NO	DRAWING No.	DESCRIPTION OF PARTS	MATERIAL	SIZE OF THE ITEM	THICKNESS	WELD SPECN.	RECOMMENDED ELECTRODE / WIRE			TOTAL LENGTH/ NO OF WELD	ACTUAL QTY. (Nos.)	PREHEAT °C	PWHT °C	MIN. RECOMMENDED NDE
							SPECN.	PROCESS ARC/TIG	SIZE (mm)					
17	0-00-047-47729 0-00-047-47730	PIPE + PIPE (OR) BEND(OR)BW.EQ.TEE (OR)PIPE WITH STUB (OR)MANIFOLD	SA106 Gr.B + SA106 Gr.B(OR) SA234WPB	D108.0	16.0	16.0 V̂V̂	RT1/2MO E 7018-1	TIG ARC	ø2.4 ø2.5 ø3.15 ø4.00	50 Nos.	1.550 kgs 550 Nos. 700 Nos. 100 Nos.	–	–	10% RT MIN OF 1 WELD/ WELDER
18	0-00-047-47729	VALVE+PIE (OR) BEND(OR)REDUCER (OR) PIPE WITH STUB (OR)MANI FOLD(OR)FLOWTRANSMITTER.	SA216 WCC+ SA106 Gr.B(OR) SA105	D108.0	16.0	16.0 V̂V̂	RT1/2MO E 7018-A1	TIG ARC	ø2.4 ø2.5 ø3.15 ø4.00	25 Nos.	0.775 kgs 275 Nos. 350 Nos. 28 Nos.	–	620 -650	10% RT MIN OF 1 WELD/ WELDER
19	0-00-047-47730	PIPE+VALVE(E1INLET &OUTLET) (OR) VALVE (E2 INLET)	SA106 GrC + SA216 WCC(OR) SA106 GrC	D273.0	32.0	29.25 V̂V̂	RT1/2MO E 7018-A1	TIG ARC	ø2.4 ø2.5 ø3.15 ø4.00	3 Nos.	0.252 kgs 60 Nos. 99 Nos. 141 Nos.	100	620 -650	100% RT
20	0-00-047-47729	TUBE + PIPE	SA213 Gr.T11 + SA106 Gr.B	D47.3 / D48.3	8.60 / 7.14 (SCH 160)	7.14 V̂	RT1/2MO E 7018-1	TIG ARC	ø2.4 ø2.5 ø3.15	1 No.	0.006 kgs 8 Nos. 3 Nos.	125	–	10% RT MIN OF 1 WELD/ WELDER
21	0-00-047-47729	PIPE + VALVE	SA335 P22 + SA216 WC6	D108.0	16.0	16.0 V̂V̂	RT11/4CR1/2MO E 8018-B2	TIG ARC	ø2.4 ø2.5 ø3.15 ø4.00	1 No.	0.031 kgs 11 Nos. 14 Nos. 2 Nos.	150	680-720	10% RT MIN OF 1 WELD/ WELDER
22	0-00-047-47729	BW CONN.RED + CONNECTOR	SA234WPB + SA182F12CL2	D73.0 (21/2")	9.53 (SCH 160)	9.53V̂	RT1/2MO E 7018-1	TIG ARC	ø2.4 ø2.5 ø3.15	1 No.	0.010 kgs 12 Nos. 5 Nos.	125	–	10% RT MIN OF 1 WELD/ WELDER
23	0-00-047-47729	PIPE + PIPE (OR) CONDENSING LOOP ASSY. (OR) BW CON RED	SA335 P22 + SA335 P22(OR) SA234WP22CL1	D21.3 (1/2")	4.78 (SCH 160)	4.78 V̂V̂	RT2 1/4CR1MO	TIG	ø2.4	5 Nos.	0.075 kgs	150	–	10% RT MIN OF 1 WELD/ WELDER
24	0-00-047-47729	PIPE + PIPE (OR) HDR NIPPLE	SA335 P22 + SA335P22(OR) SA182F22CL3	D33.4 (1")	3.38 (SCH 40)	3.38 V̂V̂	RT2 1/4CR1MO	TIG	ø2.4	8 Nos.	0.227 kgs	150	–	10% RT MIN OF 1 WELD/ WELDER
25	0-00-047-47729 0-00-047-47730	PIPE + PIPE (OR) CONDENSING LOOP (OR) CONNECTING PIECE/ CONDENSING LOOP FOR SH ERV (OR)PIPE WITH STUB	SA335 P22 + SA335 P22 (OR) SA182F22CL3	D33.4 (1")	6.35 (SCH 160)	6.35 V̂	RT2 1/4CR1MO E 9018-B3	TIG ARC	ø2.4 ø2.5	40 Nos.	0.224 kgs 280 Nos.	150	–	10% RT MIN OF 1 WELD/ WELDER

PREPARED	CHECKED DESIGN	CHECKED WTC	APPROVED	DATE	DRG NO.	REV
A. SHANMUGARAJ	V. GUNASEKAREN	G. SUBRAMANIAN	V. GUNASEKAREN	14/06/08	4-24-992-07506	

भेल BHEL

355-005

ERECTION WELDING SCHEDULE.

PRESSURE PARTS / ~~NON PRESSURE PARTS.~~

PROJECT	JOJOBERA 1x 120MW
CUST. Nos.	0162
PRODUCT GROUP	24

SL NO	DRAWING No.	DESCRIPTION OF PARTS	MATERIAL	SIZE OF THE ITEM	THICKNESS	WELD SPECN.	RECOMMENDED ELECTRODE / WIRE			TOTAL LENGTH/ NO OF WELD	ACTUAL QTY. (Nos.)	PREHEAT °C	PWHT °C	MIN. RECOMMENDED NDE
							SPECN.	PROCESS ARC/TIG	SIZE (mm)					
26	0-00-047-47729	PIPE + PIPE (OR) BEND(OR)SH DESH STAGE-II NIPPLE	SA213 GR.T22 + SA335 P22	D47.63	8	8.0 V̂	RT2 1/4CR1MO E 9018-B3	TIG ARC	ø2.4 ø2.5	20 Nos.	0.126 kgs 180 Nos.	150	–	10% RT MIN OF 1 WELD/ WELDER
27	0-00-047-47729	PIPE + PIPE (OR) BEND	SA335 P22 + SA335 P22	D60.3 (2")	8.74 (SCH 160)	8.74 V̂	RT2 1/4CR1MO E 9018-B3	TIG ARC	ø2.4 ø2.5 ø3.15	12 Nos.	0.095 kgs 120 Nos. 36 Nos.	–	680 -750	10% RT MIN OF 1 WELD/ WELDER
28	0-00-047-47729	PIPE + PIPE (OR) BEND (OR) DESH STG-I NIPPLE	SA335 P22 + SA335 P22	D108.0	16.0	16.0 V̂V̂	RT2 1/4CR1MO E 9018-B3	TIG ARC	ø2.4 ø2.5 ø3.15 ø4.00	20 Nos.	0.620 kgs 220 Nos. 280 Nos. 40 Nos.	150	680 -750	10% RT MIN OF 1 WELD/ WELDER
29	0-00-047-47729	PIPE + PIPE (OR) BEND(OR)HDR.NIPPLE (OR) REDUCING STAGES	SA335 P22 + SA335 P22	D159.0	30.0	30.0 V̂V̂	RT2 1/4CR1MO E 9018-B3	TIG ARC	ø2.4 ø2.5 ø3.15 ø4.00	26 Nos.	1.092Kgs 338 Nos. 494 Nos. 676 Nos.	150	680 -750	10% RT MIN OF 1 WELD/ WELDER
30	0-00-047-47729	VALVE+ PIPE	SA217WC9 + SA335 P22	D159.0	30.0	30.0 V̂V̂	RT2 1/4CR1MO E 9018-B3	TIG ARC	ø2.4 ø2.5 ø3.15 ø4.00	4 Nos.	0.168kgs 52 Nos. 76 Nos. 104 Nos.	200	680 -750	10% RT MIN OF 1 WELD/ WELDER
31	0-00-047-47729 1-00-047-47532	PIPE + VALVE (OR) TEE(OR)CONDENSING LOOP ASSY.	SA106 Gr.B+ SA105 (OR) SA106 Gr.B	D21.3 (1/2")	3.73 (SCH 80)	4 ◺	E 7018-1	ARC	ø2.5	45 Nos.	22 Nos.	–	–	10% MPI (OR) LPI
32	0-00-047-47729	PIPE + VALVE	SA106 Gr.B+ SA105	D33.4 (1")	3.38 (SCH 40)	4 ◺	E 7018-1	ARC	ø2.5	4 Nos.	3 Nos.	–	–	10% MPI (OR) LPI
33	0-00-047-47729 0-00-047-47730 1-00-047-47532	PIPE + VALVE (OR) BW CON RED (OR) SW EQ TEE(OR)HDR NIPPLE	SA106 Gr.B+ SA105 (OR) SA234 WPB	D33.4 (1")	6.35 (SCH 160)	7 ◺	E 7018-1	ARC	ø2.5	150 Nos.	315 Nos.	–	–	10% MPI (OR) LPI
34	0-00-047-47729 0-00-047-47730 1-00-047-47532	PIPE + VALVE (OR) HEADER NIPPLE(OR) SW EQ TEE (OR) BW CON RED(OR)DWLG	SA106 Gr.B+ SA105 (OR) SA234 WPB	D48.3 (1 1/2")	7.14 (SCH 160)	8 ◺	E 7018-1	ARC	ø2.5 ø3.15	195	296 Nos. 237 Nos.	–	–	10% MPI (OR) LPI
35	0-00-047-47729 0-00-047-47730	PIPE + VALVE (OR) SW EQ TEE (OR) HEADER NIPPLE (OR) REDUCER	SA106 Gr.B+ SA105	D60.3 (2")	8.74 (SCH 160)	10 ◺	E 7018-1	ARC	ø3.15	35 Nos.	126 Nos.	–	–	10% MPI (OR) LPI

PREPARED	CHECKED DESIGN	CHECKED WTC	APPROVED	DATE	DRG NO.	REV
A. SHANMUGARAJ	V. GUNASEKAREN	G. SUBRAMANIAN	V. GUNASEKAREN	14/06/08	4-24-992-07507	

355-005

ERECTION WELDING SCHEDULE.

PRESSURE PARTS / ~~NON PRESSURE PARTS.~~

PROJECT	JOJOBERA 1 x 120MW
CUST. Nos.	0162
PRODUCT GROUP	24

SL NO	DRAWING No.	DESCRIPTION OF PARTS	MATERIAL	SIZE OF THE ITEM	THICKNESS	WELD SPECN.	RECOMMENDED ELECTRODE / WIRE			TOTAL LENGTH/ NO OF WELD	ACTUAL QTY. (Nos.)	PREHEAT °C	PWHT °C	MIN. RECOMMENDED NDE
							SPECN.	PROCESS ARC/TIG	SIZE (mm)					
36	1-00-047-47532	CONNECTOR + PIPE	SA182 Gr.F12 CL2+ SA106 Gr.B	D33.4 (1")	6.35 (SCH 160)	7 ∆	E 7018-1	ARC	ø2.5	1 No.	3 No.	125	–	100% MPI (OR) LPI
37	0-00-047-47729	TUBE + VALVE	SA213Gr.T11+ SA182 Gr.F22 CL3	D48.3 (1 1/2")	8.6	10 ∆	E 8018-B2	ARC	ø3.15	1 No.	3 Nos.	150	680 -720	100% MPI (OR) LPI
38	0-00-047-47729	PIPE + VALVE (OR) BW CON RED	SA335 P22 + SA182F22CL3 (OR) SA234 WP22 CL1	D21.3 (1/2")	4.78 (SCH 160)	6 ∆	E 9018-B3	ARC	ø2.5	6 Nos.	6 Nos.	150	–	100% MPI (OR) LPI
39	0-00-047-47729	PIPE + VALVE	SA335 P22 + SA182 F22	D33.4 (1")	3.38 (SCH 40)	4 ∆	E 9018-B3	ARC	ø2.5	10 Nos.	8 Nos.	150	–	100% MPI (OR) LPI
40	0-00-047-47729 0-00-047-47730	PIPE + VALVE (OR) SW EQ TEE (OR) CONDENSING LOOP(OR) ERV IMPULSE STUB	SA335 P22 + SA182F22CL3 (OR) SA234WP22CL1	D33.4 (1")	6.35 (SCH 160)	7 ∆	E 9018-B3	ARC	ø2.5	25 Nos.	53 Nos.	150	–	100% MPI (OR) LPI
41	0-00-047-47729	PIPE + SW EQ TEE (OR)CONNECTOR	SA335 P22 + SA182F22CL3	D48.3 (1 1/2")	8 (SCH 160)	8 ∆	E 9018-B3	ARC	ø2.5 ø3.15	5 Nos.	8 Nos. 6 Nos.	150	–	100% MPI (OR) LPI
42	0-00-047-47729	PIPE + VALVE	SA335 P22 + SA182F22CL3	D60.3 (2")	8.74 (SCH 160)	10∆	E 9018-B3	ARC	ø3.15	4 Nos.	15 Nos.	150	–	100% MPI (OR) LPI
43	0-00-047-47729	CONNECTOR + TUBE (OR)DRUM NIPPLE	SA182 Gr.F12 CL2 + SA213 TP347H	D14	2.9	4 ∆	E309	ARC	ø2.5	1 No.	1 No.	150° ON F12 SIDE	–	100% LPI
44	1-00-047-47532	DRUM NIPPLE + CONNECTOR	SA213 TP347H + SA182 Gr.F12 CL2	D31.8	4	4 ∆	E309	ARC	ø2.5	1 No.	1 No.		–	100% LPI
45	0-00-047-47729 0-00-047-47730 1-00-047-47531	TUBE + SOCKET (SAMPLING CONN.) (OR) BEND (OR) VALVE	SA213 TP304H + SA182 F316	D14	2.9	4 ∆	E 347	ARC	ø2.5	750 Nos.	231 Nos.	–	–	100% LPI

PREPARED	CHECKED DESIGN	CHECKED WTC	APPROVED	DATE	DRG NO.	REV
A. SHANMUGARAJ	V. GUNASEKAREN	G. SUBRAMANIAN	V. GUNASEKAREN	14/06/08	4-24-992-07508	

BHEL

355-005

ERECTION WELDING SCHEDULE.

~~PRESSURE PARTS~~ / NON PRESSURE PARTS.

PROJECT	JOJOBERA 1x 120MW
CUST. Nos.	0162
PRODUCT GROUP	24

SL NO	DRAWING No.	DESCRIPTION OF PARTS	MATERIAL	SIZE OF THE ITEM	THICKNESS	WELD SPECN.	RECOMMENDED ELECTRODE / WIRE			TOTAL LENGTH/ NO OF WELD	ACTUAL QTY. (Nos.)	PREHEAT °C	PWHT °C	MIN. RECOMMENDED NDE
							SPECN.	PROCESS ARC/TIG	SIZE (mm)					
46	0-00-047-47725	PIPE + FLANGE (OR) ELL	SA106 Gr.B + SA234 WPB	D168.3 (6")	7.11 (SCH 40)	7△	E 7018	ARC	ø2.5	6 Nos.	120 Nos.	–		–
47	0-00-047-47725	PIPE + FLANGE (OR) ELL	SA106 Gr.B + SA234 WPB	D219.1 (8")	6.35 (SCH 20)	6△	E 7018	ARC	ø2.5	3 Nos.	31 Nos.	–	–	–
48	0-00-047-47725	PIPE + FLANGE (OR) ELL	SA335 P22 + SA234 WP22 CL1	D168.3 (6")	7.11 (SCH 40)	7△	E 9018-B3	ARC	ø2.5	3 Nos.	60 Nos.	150	–	10% MPI (OR) LPI
49	0-00-047-47725	PIPE + FLANGE (OR) ELL	SA335 P22 + SA234 WP22 CL1	D219.1 (8")	8.18 (SCH 40)	8△	E 9018-B3	ARC	ø3.15	6 Nos.	60 Nos.	150	–	10% MPI (OR) LPI
50	0-00-047-47725	PIPE + FLANGE	SA335 P22 + SA387 Gr.22 CL2	D114.3 (4")	6.02 (SCH 40)	6△	E 9018-B3	ARC	ø2.5	1 No.	15 Nos.	150	–	10% MPI (OR) LPI
51	0-00-047-47725	PIPE + PIPE	API 5L Gr.B + API 5L Gr.B	D355.6	6.40	6.40 ⌒V	E 7018	ARC	ø2.5	26 Nos.	581 Nos.	–	–	–
52	0-00-047-47725	PIPE + PIPE	API 5L Gr.B + API 5L Gr.B	D273.1	6.40	6.40 ⌒V	E 7018	ARC	ø2.5	5 Nos.	144 Nos.	–	–	–
53	0-00-047-47725	PIPE +PIPE (OR) SOCKET	SA106 Gr.B + SA106 Gr.B (OR) SA105	D48.3 (1 1/2")	3.68 (SCH 40)	3.68 ⌒V	E 7018	ARC	ø2.5	10 Nos.	11 Nos.	–	–	–
54	0-00-047-47725	PIPE + ELL	SA106 Gr.B + SA105	D48.3 (1 1/2")	3.68 (SCH 40)	4△	E 7018	ARC	ø2.5	16 Nos.	17 Nos.	–	–	–

PREPARED	CHECKED DESIGN	CHECKED WTC	APPROVED	DATE	DRG No.	REV
A. SHANMUGARAJ	V. GUNASEKAREN	G. SUBRAMANIAN	V. GUNASEKAREN	14/06/08	4-24-992-07509	

355-005

ERECTION WELDING SCHEDULE.

~~PRESSURE PARTS~~ / NON PRESSURE PARTS.

PROJECT	JOJOBERA 1 x 120MW
CUST. Nos.	0162
PRODUCT GROUP	24

SL NO	DRAWING No.	DESCRIPTION OF PARTS	MATERIAL	SIZE OF THE ITEM	THICKNESS	WELD SPECN.	RECOMMENDED ELECTRODE / WIRE			TOTAL LENGTH/ NO OF WELD	ACTUAL QTY. (Nos.)	PREHEAT °C	PWHT °C	MIN. RECOMMENDED NDE
							SPECN.	PROCESS ARC/TIG	SIZE (mm)					
55	0-00-047-47725	PIPE + PIPE SOCKET (OR) ELL	SA106 Gr.B+ SA106 Gr.B (OR) SA105 (OR) SA234 WPB	D73.0 (2 1/2")	7.01 (SCH 80)	7.01 V	E 7018	ARC	ø2.5	10 Nos.	42 Nos.	–	–	–
56	0-00-047-47725	PIPE + PIPE	SA335 P22 + SA335 P22	D21.3 (1/2")	4.78 (SCH 160)	4.78 V	E 9018-B3	ARC	ø2.5	2 Nos.	1 No.	150	–	10% MPI(OR) LPI
57	0-00-047-47725	PIPE + SOCKET (OR) ELL	SA335 P22 + SA182F22CL3	D21.3 (1/2")	4.78 (SCH 160)	6 △	E 9018-B3	ARC	ø2.5	10 Nos.	7 Nos.	150	–	10% MPI(OR) LPI
58	0-00-047-47725	PIPE + ELL (OR) SOCKET	SA335 P22 + SA182F22CL3	D48.3 (1 1/2")	3.68 (SCH 40)	4 △	E 9018-B3	ARC	ø2.5	10 Nos.	11 Nos.	150	–	10% MPI (OR) LPI
59	0-00-047-47725	TUBE + ELL (OR) SOCKET	SA335 P22 + SA234WP22CL1 (OR) SA182F22CL3	D76.1	6.3	6.3 V	E 9018-B3	ARC	ø2.5	20 Nos.	95 Nos.	150	–	10% MPI (OR) LPI
60	0-00-047-47725	TUBE + SOCKET (OR) TUBE	IS 1239 + SA105	D27.3 / D34.2	2.65 / 3.25	2 △	E 7018	ARC	ø2.5	16 Nos.	5 Nos.	–	–	–
61	0-00-047-47725	TUBE + TUBE (OR) PIPE + PIPE	IS 1239 + IS 1239	D34.2 / D113.9	3.25 / 3.65	3 △	E 7018	ARC	ø2.5	15 Nos.	5 Nos.	–	–	–
62	0-00-047-47725	TUBE + SOCKET	IS 1239 + SA105	D27.3	2.65	2 △	E 7018	ARC	ø2.5	8 Nos.	2 Nos.	–	–	–
63	0-00-047-47725	TUBE + TUBE	IS 1239 + IS 1239	D34.2	3.25	3.25 V	E 7018	ARC	ø2.5	30 Nos.	34 Nos.	–	–	–
64	0-00-047-47725	EXHAUST PIPE+COVER PLATE (OR) SLEEVE (OR) SLEEVE PLATE	API 5L Gr.B + IS2062 Fe410A	–	–	5 △	E 7018	ARC	ø2.5	50 m	575 Nos.	–	–	–

PREPARED	CHECKED DESIGN	CHECKED WTC	APPROVED	DATE		REV
A. SHANMUGARAJ	V. GUNASEKAREN	G. SUBRAMANIAN	V. GUNASEKAREN	14/06/08	4-24-992-07510	

BHEL
355-005

ERECTION WELDING SCHEDULE.

~~PRESSURE PARTS~~ / NON PRESSURE PARTS.

PROJECT	JOJOBERA 1 x 120MW
CUST. Nos.	0162
PRODUCT GROUP	24

SL NO	DRAWING No.	DESCRIPTION OF PARTS	MATERIAL	SIZE OF THE ITEM	THICKNESS	WELD SPECN.	RECOMMENDED ELECTRODE / WIRE			TOTAL LENGTH/ NO OF WELD	ACTUAL QTY. (Nos.)	PREHEAT °C	PWHT °C	MIN. RECOMMENDED NDE
							SPECN.	PROCESS ARC/TIG	SIZE (mm)					
65	0-00-047-47725	ELL PIPE + DRIPPAN	SA106 Gr.B + IS2062 Fe410A	–	–	5△	E 7018	ARC	ø2.5	8 m	88 Nos.	–	–	–
66	0-00-047-47725	ISMC + PLATE	IS2062 Fe410A + IS2062 Fe410A	–	–	5△	E 7018	ARC	ø2.5	100 m	1317 Nos.	–	–	–
67	0-00-047-47725	PLATE + PIPE	IS2062 Fe410A + API 5L Gr.B	–	–	8△	E 7018	ARC	ø2.5 ø3.15	15 m	150 Nos. 120 Nos.	–	–	–
68	0-00-047-47725	ISMC + PLATE (OR) ISMB	IS2062 Fe410A + IS2062 Fe410A	–	–	6△	E 7018	ARC	ø2.5	75 m	52 Nos.	–	–	–
69	0-00-047-47729 0-00-047-47730 1-00-047-47532	PIPE + PIPE	IS 1239 + IS 1239	D113.9	3.65	3.65 V	E 7018	ARC	ø2.5	60 m	150 Nos.	–	–	–
70	0-00-047-47729 0-00-047-47730	PIPE + PLATE	SA106 Gr.B + IS2062 Fe410A	–	–	4 K	E 7018	ARC	ø2.5	10 m	193 Nos.	–	–	–
71	0-00-047-47729 0-00-047-47730	EYE HANGER + SUPPORTING STRUCTURE	IS2062 Fe410A + IS2062 Fe410A	–	–	13△	E 7018	ARC	ø3.15 ø4.00	6.8 m	45 Nos. 62 Nos.	–	–	–
72	0-00-047-47729 0-00-047-47730 1-00-047-47532	EYE HANGER + SUPPORTING STRUCTURE	IS2062 Fe410A + IS2062 Fe410A	–	–	7△	E 7018	ARC	ø2.5	3.2 m	64 Nos.	–	–	–
73	0-00-047-47729 0-00-047-47730 1-00-047-47532	EYE HANGER + ROUND	IS2062 Fe410A + IS2062 Fe410A	–	–	10 X	E 7018	ARC	ø2.5	3.2 m	115 Nos.	–	–	–
74	0-00-047-47729 0-00-047-47730	PIPE CLAMP + SUSPENSION PLATE (OR) ROUND	IS2062 Fe410A + IS2062 Fe410A	–	–	10-1/2 K	E 7018	ARC	ø2.5 ø3.15	5.8 m	58 Nos. 82 Nos.	–	–	–
75	0-00-047-47729 0-00-047-47730 1-00-047-47532 1-00-047-47531	ISMC + ISMC (OR) ISA (OR) PLATE (OR) FLAT (OR) SUPPORT PLATE (OR) SUPPORTING STRUCTURE	IS2062 Fe410A + IS2062 Fe410A	–	–	5△	E 7018	ARC	ø2.5	50 m	550 Nos.	–	–	–

PREPARED	CHECKED DESIGN	CHECKED WTC	APPROVED	DATE	DRG NO.	REV
A. SHANMUGARAJ	V. GUNASEKAREN	G. SUBRAMANIAN	V. GUNASEKAREN	14/06/08	4-24-992-07511	

BHEL

355-005

ERECTION WELDING SCHEDULE.

~~PRESSURE PARTS~~ / NON PRESSURE PARTS.

PROJECT	JOJOBERA 1x 120MW
CUST. Nos.	0162
PRODUCT GROUP	24

SL NO	DRAWING No.	DESCRIPTION OF PARTS	MATERIAL	SIZE OF THE ITEM	THICKNESS	WELD SPECN.	RECOMMENDED ELECTRODE / WIRE			TOTAL LENGTH/ NO OF WELD	ACTUAL QTY. (Nos.)	PREHEAT °C	PWHT °C	MIN. RECOMMENDED NDE
							SPECN.	PROCESS ARC/TIG	SIZE (mm)					
76	0-00-047-47729 0-00-047-47730	EYE HANGER + SUPPORTING STRUCTURE	IS2062 Fe410A + IS2062 Fe410A	–	–	8 ▵	E 7018	ARC	ø2.5	1.5 m	12 Nos.	–	–	–
77	0-00-047-47729 0-00-047-47730	EYE HANGER + ROUND (OR) SUPPORTING STRUCTURE	IS2062 Fe410A + IS2062 Fe410A	–	–	12 ⌒	E 7018	ARC	ø2.5 ø3.15	1.2 m	24 Nos. 22 Nos.	–	–	–
78	0-00-047-47729 0-00-047-47730	PIPE CLAMP + SUSPENSION PLATE (OR) ROUND	IS2062 Fe410A + IS2062 Fe410A	–	–	12-1/2 ⌒	E 7018	ARC	ø2.5 ø3.15	1.1 m	22 Nos. 22 Nos.	–	–	–
79	0-00-047-47729	EYE HANGER + ROUND	IS2062 Fe410A + SA105	–	–	25 ⌒	E 7018	ARC	ø3.15 ø4.0	1.0 m	15 Nos. 25 Nos.	–	–	–
80	0-00-047-47729	EYE HANGER + SUPPORTING STRUCTURE	IS2062 Fe410A + IS2062 Fe410A	–	–	10 ▵	E 7018	ARC	ø3.15	1.5 m	30 Nos.	–	–	–
81	0-00-047-47729	EYE HANGER + ROUND	IS2062 Fe410A + IS2062 Fe410A	–	–	16 ⌒	E 7018	ARC	ø3.15 ø4.0	1.0 m	15 Nos. 25 Nos.	–	–	–
82	0-00-047-47729 0-00-047-47730 1-00-047-47532	ERW PIPE + ERW TUBE	IS 1239 + IS 1239	–	–	4 ▵	E 7018	ARC	ø2.5	2.0 m	14 Nos.	–	–	–
83	ALL ERECTION DRGS.	NAME PLATE HOLDER + PIPE	SA106 Gr.B + SA240 TYPE 304	≤ D108	19	3 ▵	E309	ARC	ø2.5	20 m	80 Nos.	–	–	100% LPI
84	ALL ERECTION DRGS.	NAME PLATE HOLDER + PIPE	SA335 P22 + SA240 TYPE 304	≤ D108	≤12.5	3 ▵	E309	ARC	ø2.5	5 m	20 Nos.	150	–	100% LPI
85	0-00-047-47729	PIPE + PLATE	SA335 P22 + IS2062 Fe410A	159	30 10	5 ▷	E 9018-B3	ARC	ø3.15	1 m	11 Nos.	150		100% MPI / LPI

PREPARED	CHECKED DESIGN	CHECKED WTC	APPROVED	DATE	DRG NO.	REV
A. SHANMUGARAJ	V. GUNASEKAREN	G. SUBRAMANIAN	V. GUNASEKAREN	14/06/08	4-24-992-07512	

BHARAT HEAVY ELECTRICALS LIMITED
Tiruchirappalli - 620 014

PAINTING SCHEME FOR
HINDALCO INDUSTRIES LIMITED
6 X 150 MW HINDALCO-ADITYA ALUMINIUM
SAMBALPUR, ORISSA
CUSTOMER NO: U1/0172 TO U1/0177

Prepared by	**L. Gragori** **DM / P. Lab**		**Document No: Q: PL: C3 - PS /0172**
Reviewed by	**G.Venkataramani** **SDGM / PE / FB**		**Revision No: 00 Dated: 12-06-2009**
Approved by	**Dr.G.Ravichandran** **SDGM /P. Lab**		**Sheet No. : 1 of 11**

N/ CHEM/CONTRACTS 09/HINDALCO_00.DOC.

RECORD OF REVISIONS

Rev. No	Date	Details of revision	Remarks
00	**12-06-2009**	**NEW**	**Prepared in line with BHEL standard painting scheme applicable for normal environment.**

Sl. No.	Scheme No.	PGMA / Description	Surface Preparation & Surface Profile	Primer coat		Intermediate Coat		Finish coat			Total DFT µm (min)
				Paint	No. of Coats / DFT	Paint	No. of coats	Paint	No. of coats	Shade	
1.1	1AC	Drum (Except Internals) **04** – 114, 116, 118, 124, 126, 128, 210, 212, 214, 270	SSPC-SP3/ Power Tool Cleaning	Red Oxide Zinc phosphate Primer (Alkyd Base) to IS 12744	1 / DFT= 30µm per coat	--	--	Synthetic Enamel paint (Long Oil Alkyd) to IS 2932	2 DFT= 20µm per coat	Inter-national Orange Shade No: 592 of IS 5	70
1.2	1AC	Drum Suspension **04** -142, 144, 146, 148	SSPC-SP3/ Power Tool Cleaning	Red Oxide Zinc phosphate Primer (Alkyd Base) to IS 12744	1/ DFT= 30µm per coat	--	--	Synthetic Enamel paint (Long Oil Alkyd) to IS 2932	2 DFT= 20µm per coat	Inter-national Orange Shade No: 592 of IS 5	70
1.3	5	Drum Internals **04** – 134, 136, 138 Other Machined Components: **43** – 101, 102, 103, 104, 105, 106, 107	SSPC-SP1 or SP3 Solvent / Power Tool Cleaning	Rust Preventive Fluid to PR: CHEM: 09 – 04	1 DFT=20µm per coat	--	--	--	--	--	20
1.4	1AE	Drum Transport Structures **04** - 194, 196, **35** - 391, 810	SSPC-SP3/ Power Tool Cleaning	Red Oxide Zinc phosphate Primer (Alkyd Base) to IS 12744	1 DFT= 30µm per coat	--	--	Synthetic Enamel paint (Long Oil Alkyd) to IS 2932	2 DFT= 20µm per coat	Yellow Shade No: 356 of IS 5	70
2.1	11	Foundation Materials and Pin: **35** - 010, 011, 012, 013, 020, 030, 190 **38** – 010 **39** - 010, 011, 012, 020, 030, 040 48 – 019 & Columns below " 0 " level of PG 35,36, 38 & 39	- -	No Paint	- -	- -	- -	No Paint	- -	- -	- -

Sl. No.	Scheme No.	PGMA / Description	Surface Preparation & Surface Profile	Primer coat		Intermediate Coat		Finish coat			Total DFT µm (min)
				Paint	No. of coats	Paint	No. of coats	Paint	No. of coats	Shade	
2.2	1A	Buck Stays and Structural Items: Buck stays **08** – 001, 003, 006, 007, 101, 104, 107, 111, 380, 382, 400, 500, 501, 503, 700, 900, 901, 904, 907, 910 Boiler Supporting Structures **35** – 100, 110, 111, 112, 120, 121, 122, 130, 131, 132, 133, 134, 135, 136, 140, 141, 142, 143, 144, 150, 151, 152, 153, 160, 161, 162, 171, 172, 173, 174, 181, 182, 183, 184, 185, 186, 191, 192, 193, 194, 195, 196, 210, 211, 212, 213, 214, 220, 221, 222, 230, 231, 232, 240, 250, 310, 311, 312, 320, 321, 322, 330, 331, 332, 340, 341, 342, 350, 351, 352, 360, 361, 362, 380, 381, 382, 383, 390,392, 410, 420, 430, 440, 441, 442, 443, 451, 452, 453, 461, 462, 463, 471, 472, 473, 481, 482, 483, 500, 510, 511, 512, 513, 514, 520, 521,522, 523, 524, 530, 531, 532, 533, 540, 541, 542, 550, 551, 552, 561, 562, 563, 571, 572, 573, 581, 582, 583, 591, 592, 593, 594, 595, 596, 597, 598, 599, 610, 612, 613, 710, 711, 712, 713, 715 **36** – 110,120, 130, 150, 200, 210, 211, 212, 220, 221, 222, 230, 231, 232, 240, 241, 242, 250, 251, 252, 260, 261, 262, 270, 271, 272, 280, 281, 282, 290, 291, 292, 300, 301, 302, 310, 311, 312, 313, 314, 315, 316, 320, 321, 322, 323, 324, 325, 326, 327, 330, 331, 332, 333, 334, 335, 340, 341, 342, 343, 344, 345, 346, 347, 348, 350, 351, 352, 353, 354, 355, 360, 361, 362, 363, 370, 371, 372, 380, 381, 382, 383, 390, 391, 392, 393, 394, 395, 396, 397, 410, 420, 430, 490, 491, 492, 510, 520, 610, 612, 620, 621, 630, 631, 632 **38** – 110, 120, 130, 210, 211, 299, 310, 311, 380, 381, 390, 410, 510, 511, 512, 513, 521, 522, 610, 611, 612, 620, 710, 712, 720, 730 **39** - 100, 101, 102, 110, 120, 121, 130, 140, 141, 142, 143, 150, 160, 200, 210, 300, 301, 303, 304, 305, 306, 311, 312, 323, 390, 391, 392, 393, 901 Duct Supports **48** – 005, 015, 025, 045, 055, 065, 085, 105, 115, 125, 145, 155, 185, 195, 200,205, 215, 225, 235, 245, 255, 265, 275, 295, 305, 315, 325, 335, 345, 355, 365, 375, 385, 415, 425, 435, 445, 455, 465, 475, 485, 495, 665, 805, 815, 825, 845, 855, 865, 875, 885, 995 Piping Centre: 80-800 to 882, 920 to 933, 940	SSPC-SP3/ Power Tool Cleaning	Red Oxide Zinc phosphate Primer (Alkyd Base) to IS 12744	1 DFT= 30µm per coat	--	--	Synthetic Enamel paint (Long Oil Alkyd) to IS 2932	2 DFT= 20µm per coat	Smoke Grey Shade No: 692 of IS 5	70

Sl. No.	Scheme No.	PGMA / Description	Surface Preparation & Surface Profile	Primer coat		Intermediate Coat		Finish coat			Total DFT µm (min)
				Paint	No. of coats	Paint	No. of coats	Paint	No. of coats	Shade	
2.3	1A	Hangers: **36** - 740, 741, 742, 743, 744	SSPC-SP3/ Power Tool Cleaning	Red Oxide Zinc phosphate Primer (Alkyd Base) to IS 12744	1 DFT= 30µm per coat	--	--	Synthetic Enamel paint (Long Oil Alkyd) to IS 2932	2 DFT= 20µm per coat	Smoke Grey Shade No: 692 of IS 5	70
2.4	1AB	Floor grills, Guard plate** **35** – 811 **36** - 010, 810, 811, 812, 813, 814, 815, 816, 840 **38** - 810, 811 **39** – 810, 811, 840, 841	Floor Grills : Hot dip Galvanizing to a coating weight of 610 gm per sq.m (minimum) and to a coating thickness of 85.0 microns (minimum). ** Guard plates will be painted as given in Sl. No. 2.2.								
2.5	1AB	Hand Rails & Posts **35** - 850, 851 **36** - 850, 851, 852, 853 **38** - 850, 851 **39** - 850, 851	SSPC-SP3/ Power Tool Cleaning	Red Oxide Zinc phosphate Primer (Alkyd Base) to IS 12744	1 DFT= 30µm per coat	--	--	Synthetic Enamel paint (Long Oil Alkyd) to IS 2932	2 DFT= 20µm per coat	Black	70
2.6	1AB	Ladders & Stairs **35** – 820, 821, 822, 823 **36** – 820, 821, 822, 823 **38** – 820, 821 **39** – 820, 830, 831 **48** - 466	SSPC-SP3/ Power Tool Cleaning	Red Oxide Zinc phosphate Primer (Alkyd Base) to IS 12744	1 DFT= 30µm per coat	--	--	Synthetic Enamel paint (Long Oil Alkyd) to IS 2932	2 DFT= 20µm per coat	Black	70

Sl. No.	Scheme No.	PGMA / Description	Surface Preparation & Surface Profile	Primer coat		Intermediate Coat		Finish coat			Total DFT µm (min)
				Paint	No. of coats	Paint	No. of coats	Paint	No. of coats	Shade	
3.1	10	Components >95° C Un-insulated other than components coming in Gas Path **09** - 001, 002, 003 **21** - 800, 850, 875, 997 **24** – 120, 160, 173, 180, 185, 190, 195, 220, 260, 273, 280, 285, 290, 320, 345, 360, 373, 380, 385, 390, 395, 420, 460, 480, 485, 490, 495, 520, 560, 573, 580, 585, 590, 660, 680, 685, 690, 820, 860, 880, 885 **28** – 220 **42** – 300, 318, 328, 348, 358 **48** - 380	SSPC-SP3/ Power Tool Cleaning	Heat Resistant Aluminium Paint to IS 13183 Grade-I	1 (DFT =15 microns)	- -	- -	Heat Resistant Aluminium Paint to IS 13183 Grade-I	1 (DFT =15 µm per coat)	Aluminium	30
3.2	3	Components >95° C **Insulated** **05** - 137, 139, 147, 153, 154, 155, 158, 159, 175, 188, 195, 220, 227, 229, 231, 236, 241, 246, 251, 265, 281, 283, 296, 330, 340, 341, 350, 493, 879, 900 **07** - 101, 102, 104, 106, 107, 108, 109, 200, 201, 202, 203, 204, 211, 212, 214, 215, 216, 217, 218, 221, 222, 223, 225, 226, 229, 231, 232 **10** – 100, 120, 122, 135, 136, 140, 141, 151, 170, 174, 178, 179, 180, 191, 195, 218, 220, 222, 235, 236, 240, 241, 251, 270, 274, 278, 279, 280, 283, 284, 291, 295, 315, 687 **15** – 136, 138, 147, 174, 177, 192, 193, 236, 238, 274, 279, 292, 293, 999 **17** – 138, 177, 776, 807, 900, 903 **18** – 001, 002, 003, 010, 020 **19** – 701, 702, 753, 903 **21** – 600 **24** – 100, 115, 175, 200, 215, 275, 295, 300, 315, 375, 475, 500, 568, 600, 620, 675, **42** - 020, 021, 025, 030, 031, 032, 033, 036, 037, 038, 128, 150, 153, 158, 159, **48** –032,034,035,132,135,202, 204, 207, 208, 212, 214, 217, 221, 222, 224, 227, 228, 229, 232, 234, 242, 244, 252, 254, 261, 262, 264, 267, 272, 274, 276, 282, 284, 292, 294, 302, 304, 307,308, 309, 311, 312, 314, 318, 319, 322, 324, 332, 334, 342, 352, 362, 364, 372, 374, 381, 382, 384, 386, 388, 389, 392, 412, 414, 422, 424, 426, 432, 434, 438, 439, 442, 444, 452, 454, 462, 464, 467, 468, 469, 472, 474, 482, 484, 486, 487, 488, 489, 491, 492, 494, 496, 497, 498, 499, 602, 612, 622, 632, 646, 652, 654, 656, 662, 664, 666, 667, 668, 669, 676, 686, 696	SSPC-SP3/ Power Tool Cleaning	Red Oxide Zinc phosphate Primer (Alkyd Base) to IS 12744	2 DFT= 30µm per coat	-	- -	- -	- -	Red Oxide	60

Sl. No.	Scheme No.	PGMA / Description	Surface Preparation & Surface Profile	Primer coat		Intermediate Coat		Finish coat			Total DFT µm (min)
				Paint	No. of coats	Paint	No. of coats	Paint	No. of coats	Shade	
3.3	2	Heat Exchanger Coils: (SH, RH & Economiser Coils) **11** - 036, 037, 038, 074, 077, 078, 095, 135, 136, 138, 170, 174, 175, 178, 179, 235, 236, 237, 238, 248, 250, 251, 271, 272, 274, 275, 277, 278, 279, 280, 336, 337, 338, 340, 342, 356, 358, 370, 374, 377, 378, 395, 585, 587, 591, 606, 608, 616, 618, 682, 683, 684, 685, 686, 687, 688, 691, 694, 716, 717, 718, 767, 768, 769, 787, 791, 882, 883, 884, 885, 887, 916, 917, 918, 967, 968, 969, 986, 987, 988, 991, 994, 999 **12** – 135, 136, 170, 174, 178, 184, 187, 335, 395, 495, 515, 535, 551, 619, 800, 803, 805, 850, 851, 852, 900, 901, 903, 906, 914, 917, 924, 927, 928, 944, 948, 954, 968, 988, 999 **16** – 077, 079, 132, 235, 236, 237, 238, 256, 275, 277, 279, 281, 377, 379 **19** - 001, 104, 105, 114, 124, 184, 802, 814, 824, 884, 914, 924, 984	SSPC – SP2 or SSPC – SP3 Hand tool / Power tool cleaning	Red Oxide Zinc Phosphate Dip coat primer to PR: CHEM: 09 – 03	1 DFT= 35µm per coat	--	--	--	--	--	35
3.4	3	Components coming in Gas Path other than Coils **06** - 033, 036, 037, 041, 043, 046, 047, 052, 054, 089, 090, 091, 092, 093, 094, 130, 133, 136, 137, 141, 143, 146, 147, 152, 154, 189, 190, 191, 192, 193, 194, 231, 331, 350, 400, 430, 466, 467, 500, 530, 609, 611, 613, 614, 616, 620, 621, 623, 624, 630, 631, 633, 634, 636, 637, 639, 640, 641, 643, 644, 646, 647, 649, 650, 651, 652, 653, 654, 655, 657, 658, 659, 670, 689, 690, 691, 692, 693, 694, 695, 709, 713, 714, 715, 716, 720, 723, 730, 731, 733, 734, 737, 740, 741, 743, 744, 747, 749, 750, 751, 753, 755, 789, 790, 830, 840, 850, 851, 857, 895, 896, 897 **10** – 182, 183, 184, 185 **16** – 988, 999 **19** – 703, 704, 708, 763, 783, 850, 851, 900, 988, 999 **30** – 010, 104, 105, 211, 212, 216, 217, 218, 219, 220, 223, 227, 228, 233, 235, 993, **31** – 010, 101, 102, 103, 104, 105, 108, 301, 993 **32** – 001, 002, 005, 006, 007, 008, 009, 010, 011, 012, 021, 022, 023, 024, 025, 026, 027, 031, 033, 041, 042, 043, 044, 050, 055, 061, 073, 110, 120, 210, 310, 410, 510, 520, 610, 620, 710, 720, 810, 910, 993 **42** - 129	SSPC-SP3/ Power Tool Cleaning	Red Oxide Zinc phosphate Primer (Alkyd Base) to IS 12744	2 DFT= 30µm per coat	- -	- -	- -	- -	Red Oxide	60
3.5	8A	Uninsulated Fuel Pipes **47** – 229, 265, 266. 267, 268, 269 Duct for Tube Mill: **48** – 802, 804, 812, 814, 817, 822, 824, 832, 834, 842, 844, 852, 854, 857, 862, 864, 867, 872, 874, 882, 884,	SSPC-SP3/ Power Tool Cleaning	General purpose Aluminium paint to IS 2339	2	--	--	--	--	Alumunum	40

Sl. No.	Scheme No.	PGMA / Description	Surface Preparation & Surface Profile	Primer coat		Intermediate Coat		Finish coat			Total DFT µm (min)
				Paint	No. of coats	Paint	No. of coats	Paint	No. of coats	Shade	
4	15	Constant Load and Variable Load Hangers (CLH / VLH) **(See NOTE 14)** **07** - 400, 401, 402, 403, 404, 405, 410, 420, 431 **10** - 200 **17** – 904, 906, 919, 929 **19** – 901, 904, 905, 906, 907 **24** - 346, 351	Abrasive blast cleaning to Sa 2 ½ 35- 50 microns	Epoxy zinc rich primer to IS 14589 Gr. II %VS=35 (min)	1 DFT=40 µm / coat	--	--	Aliphatic acrylic Poly-urethane paint %VS=40 (min) t	1 DFT=30 µm per coat	Phirozi Blue Shade No. 176 of IS5	70
5.1	1A	Miscellaneous and Casing Sheets: **07**-500, 501, 600, 601, 997, 999, **19** – 101, 102,**21** - 601, 987, **24** - 101, 125, 130, 135, 140, 201, 225, 230, 235, 240, 301, 325, 335, 340, 350, 370, 374, 400, 401, 425, 430, 435, 440, 470, 471, 473, 501, 525, 535, 540, 570, 601, 625, 635, 640, 800, 801, 815, 825, 987, 989, 996, 998 **35** - 994, 995, **36** - 613, 903, 999, **37** - 010, 110, 210, 310, 410, 510, 610, **39** - 302, 924 Fuel Firing: **41** – 100, 110, 200, 310, 320, 330, 340, 350, 390, 410, 420, 430, 450, 460, 470, 997 Steam Blowing Piping: **42** – 002, 003, 005, 010 **42** – 040, 045, 050, 055, 060, 065, 070, 111, 112, 113, 114, 118, 119, 120, 121, 122, 123, 124, 130, 131, 132, 151, 152, 154, 155, 156, 157, 160, 165, 170, 176, 180, 195, 196, 989, 997, 998 **43** – 000, 001, 002, 003, 004, 005, 006, 007, 008, 997, 999 **45** – 050, 120, 160, 161, 180, 181, 220, 221, 260, 261, 321, 325, 326, 401 **47** – 121, 122, 123, 124, 125, 129, 140, 141, 142, 143, 144, 145, 146, 149, 161, 162, 163, 164, 165, 169, 180, 181, 182, 183, 184, 185, 189, 200, 201, 202, 203, 204, 205, 209, 221, 222, 223224, 225, 241, 242, 243, 244, 245, 246, 247, 248, 249, 261, 262, 263, 264, 647, 648, 649, 650, 746, 953, 959, 963 Duct Plates and Expansion Joints: **48** – 002, 004, 007, 011, 012, 014, 017, 018, 022, 024, 028, 032, 034, 040, 042, 044, 052, 054, 062, 064, 066,072, 074, 082, 084, 092, 094, 102, 104, 107, 112, 114, 116, 122, 124, 132, 142, 144, 152, 154, 162, 172, 182, 184, 192, 194 Coal Handling: **65** – 051, 060, 070, 260, 402, 403, 460, 724, 736, 738, 786 **67** – 204, 251, 256, 261, 266, 271, 272, 276, 277, 283, 286, 400, 801, 802, 803, 804, 999 **99** – 201, 299	SSPC-SP3/ Power Tool Cleaning	Red Oxide Zinc phosphate Primer (Alkyd Base) to IS 12744	1 DFT= 30µm per coat	--	--	Synthetic Enamel paint (Long Oil Alkyd) to IS 2932	2 DFT= 20	Smoke Grey Shade No: 692 of IS 5	70
5.2	3	Erection Materials and Commissioning Components: **04** - 988, **05**-993, **06**-993, **07** – 988, 993, **12**-993, **24** – 993, **28** – 993, **35** – 993, **36** – 993, **37** – 993, **38** – 993, **39** – 993, **48** – 988, 993, **65** – 988, **97**-585,**99** – 045, 099, 501, 502	SSPC-SP3/ Power Tool Cleaning	Red Oxide Zinc phosphate Primer (Alkyd Base) to IS 12744	2 DFT= 30µm / coat	- -	- -	- -	- -	Red Oxide	60

Sl. No.	Scheme No.	PGMA / Description	Surface Preparation & Surface Profile	Primer coat		Intermediate Coat		Finish coat			Total DFT μm (min)
				Paint	No. of coats	Paint	No. of coats	Paint	No. of coats	Shade	
6.1	10	Cast carbon steel valves (Conventional) Cast alloy steel valves (Conventional) All API valves, QCNRV, SV & SRV Silencers, Water Level gauge HP / LP system 22-101,889	SSPC-SP3/ Power Tool Cleaning	Heat Resistant Aluminium Paint to IS 13183 Gr.I	2	--	--	--	--	--	40
6.2	--	Forged valves	Phosphating	Coating weight of 1500 mg per sq.ft.	--	--	--	--	--	--	--
6.3	1AS	Soot Blower components 20-001,003,004,021,051,054,201,204,301,304,331,511,794,801,821,831,962,972	SSPC-SP3/ Power Tool Cleaning	Red Oxide Zinc phosphate Primer (Alkyd Base) to IS 12744	1 DFT= 30μm per coat	--	--	Synthetic Enamel paint (Long Oil Alkyd) to IS 2932	2 DFT= 20	Verdigris Green Shade No. 280 of IS**5**	70
6.4	36	On Shore OFE Components	SSPC-SP3/ Power Tool Cleaning	HB Chlorinated Rubber based Zinc Phosphate Primer DFT= 50μm per coat	2	--	--	Chlorinated Rubber Based Finish Paint DFT= 30μm per coat	2	French Blue Shade No: 166 of IS 5	160
6.5	35	Off Shore Components	SSPC-SP3/ Power Tool Cleaning	High Build Epoxy Mastic Aluminium Primer-	1 DFT= 100μm per coat	--	--	Aliphatic acrylic Poly-urethane paint %VS=40 (min)	1 DFT=30 μm per coat	French Blue Shade No: 166 of IS 5	130
6.6	8A	Hand Wheels	SSPC-SP3/ Power Tool Cleaning	General Purpose Aluminium Paint to IS 2339	2 DFT= 100μm per coat	--	--	--	--	--	40

PS for Arrows shall be as per valves and the final shade will be 'Post Office Red-Shade No. 538 of IS 5

NOTES:

1. **This painting scheme covers a comprehensive list of PGMAs being used in 125 / 150/ 210 / 250 / 500 MW and Industrial Boilers under Fossil Boilers working in normal environment, in an effort to standardise the painting scheme. Therefore, the entire list of PGMAs will not be applicable for any specific project and only those PGMAs applicable for the project may be used, while choosing the painting scheme applicable.**

2. Rust Preventive coating should be given on HSFG Bolt and Nut threads.

3. All threaded and machined surfaces & Retainers are to be applied with a coating of Temporary Rust Preventive oil.

4. All surfaces of foundation materials, insulation pins, Anchor channels, Sleeves shall be coated with Temporary Rust Preventive Fluid and during execution of civil works; the dried film of coating shall be removed using organic solvents.

5. PGMAs under Sub-Vendor items are not indicated. Please refer respective Engineering Document for all sub-vendor items. Wherever it is not specified, it shall be as per the painting scheme of the applicable PGMA.

6. No painting is required for Aluminium, Stainless Steel components and galvanized items. Abrasive blast cleaning to SSPC-SP6 (Sa 2) grade shall be done to prepare the surface of hot worked pipes prior to application of primer.

7. Wherever **inside surfaces** of components under PGMA 48 – XXX, need protection till erection, and all running meter items for spares and main item two coats of Red-oxide zinc phosphate primer paint to IS12744 to a DFT of 60 microns shall be applied, after power tool cleaning. For items meant for Spares and subcontracting where no further processing is involved, the painting scheme selected shall be the same as that of similar product configuration/ description.

8. The Temporary Rust Preventive coating that has already been applied on any component, tubes, pipes etc., shall be visually inspected for good adherence. If the coating is intact, direct coating of alkyd based red oxide paints over the coating is permitted. In case, the coating has peeled off over a large area, then the coating is to 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).

9. All currently active PGMAs are covered. Requirements for Missing / new PGMA s will be included under the relevant section, following the appropriate paint logic.

10. Ground shade/colour finish paints & identification tag/ band for equipments, piping, pipe service, boiler supporting structures and other boiler components shall be followed as per tender.

11. In components, wherever plates/sheets of thickness less than or equal to 5 mm, tubes/ rods/drain pipe are used, power tool /hand tool cleaning to SSPC-SP3/ SSPC-SP-2 shall be followed and the painting shall be done as described in Sl no: 5.1.

12. Touch-up painting of damaged areas shall be carried out as per clause applicable painting scheme.

13. Only weldable primer shall be applied on surfaces, which require to be welded subsequently at site. At those locations no other paint shall be applied.

14. DUs coming under Constant Load Hangers (CLH) shall be painted as per the system - **PS 15** indicated in Sl. No. 4 of the table. However, for DUs coming under Variable Load Hangers (VLH), the painting shall be as per Painting Scheme PS 1A indicated in Sl. No. 5.1 of the table. (i.e., one coat of Red Oxide Zinc Phosphate Primer followed by two coats of Synthetic Enamel Paint –shade smoke grey, total DFT – 70 microns)

15. For internal protection of Pipes, tubes,headers and other pressure parts, Volatile Corrosion Inhibitor (VCI) pellets shall be put (after sponge testing/ draining/ or drying) and subsequently end capped. The dosage of VCI pellets shall be approximately 100 gm/ Cu..m. For tubes typically 4 – 5 tablets per end are to be put. For C & I items the dosage of self indicating Silica Gel (colourless) shall be 250 gm/ cu.m. (About 2 to 3 bags weighing approximately 100 grams each) . **VCI pellets shall not be used for stainless steel components and its composite associates.**
16. All threaded components of spring assemblies and turnbuckles shall be galvanized and achromatized to 15 microns minimum thickness.
17. Painting scheme for all temporary structures shall be PS 1AE i.e. 1 coat of Red oxide Zinc Phosphate primer (Alkyd Base) to IS 12744-DFT-30 μ and 2 coats of Synthetic Enamel paint (Long Oil Alkyd) to IS 2932-DFT-2X20μ Shade Yellow –Shade No. 356 of IS 5- Total DFT 70μ.

Painting Scheme – Details for procurement & application purposes

Sl. No.	Material Code of Paint	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	120016131800	Heat Resistant Aluminium paint to IS 13183 Grade I	10	1	-	-	Aluminium	--	Brush / Spray	24
2	120011111900	Red oxide Zinc Phosphate primer paint to IS 12744	10	1	--	--	Red Oxide	--	Brush / Spray	12
3	120011121900	Red oxide Zinc Phosphate Dip coat primer paint to PR: CHEM: 09-03	10	1	--	--	Red Oxide	---	Dip	12
4	120011311200	Long oil alkyd synthetic enamel finish paint to IS2932	10	1	--	--	Reqd. shade	Corrpdg. Shade no.	Brush / Spray	12
5	120011140000	Temporary Rust preventive fluid to PR: CHE: 09 – 04	10	1	--	--	Amber	--	Brush / Spray	12
6	120012141700	Epoxy Zinc rich primer to IS14589 Gr. II	8	2	35	40	Grey	--	Spray	24
7	120013310200	Aliphatic acrylic polyurethane paint to IS13213	10	2	40	30	Phirozi – Blue./French Blue	176/166	Spray	24
8	120017101800	De Oxy Aluminate Weldable Primer- Colour Aluminium	10	1	--	--	Aluminium	--	Brush / Spray	24
9	120014111700	HB CR Based Zinc Phosphate Primer	10	1	40	50	Grey	--	Brush / Spray	12
10	120014300100	CR Based Finish Paint	10	1	30	30	French Blue	166	Brush / Spray	12
11	12001213800	High Build Epoxy Mastic Aluminium Primer-	8	2	80	100	Aluminium	---	Spray	24

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.

	Bharat Heavy Electricals Limited (A Government of India Undertaking) Boiler Auxiliaries Plant Ranipet - 632 406 **Commercial Department**	Phone No. FAX No. E-mail	04172 - 254349 04172 - 241158 mmani@bhelrpt.co.in smsamy@bhelrpt.co.in

Courier Service

Ref : Comml: R142 & R147 **Dt :19-04-10**

To,

MISS .G.POORNACHANDRIKA
ENGINEER / PSSR
BHARAT HEAVY ELECTRICALS LTD.
POWER SECTOR SOUTHERN REGION
OLD NO.474
ANNASALAI –NANDANAM
CHENNAI -600035

Dear Madam,

Sub : Painting scheme for ESP , FANs , APH, Gates and Dampers for Aditya Aluminium Project 6x150 MW –reg.

****

Please find the following manufacturing and shop painting scheme applicable for the above items.

Painting scheme for ESP components :

Surface Preparation: Power tool cleaning to St3
a.Surface exposed to atmosphere:
Primer : One coat of red oxide Zinc phosphate primer to IS:12744 to DFT of 30 µm (min)
Finish Paint : Two coats of synthetic of enamel to IS 2932 smoke grey (shade No. 692 of IS 5) DFT of 2x20=40 µm.(min)
Total DFT = 70 µm (min).

surfaces (Insulated & Flue gas path)

Primer : Two coat of red oxide Zinc phosphate primer to IS:12744 to DFT of 2x 30 =60 µm(min)
Emitting Electrode hook, Machined components and foundation bolts are applied with rust preventive.

Painting Scheme for Fans :

Surface exposed to atmosphere

Surface Preparation: Power tool cleaning St2.
Primer : One coat of red oxide Zinc Phosphate primer to IS 12744 , DFT = 30 µm (min)
Finish Paint : Two coat synthetic of enamel to IS 2932 (DFT 40 Microns)
Total DFT = 70 µm (min).

Surface in the flue gas path & insulated surfaces :

Surface Preparation: Power tool cleaning
Primer : Two coat of red oxide Zinc Phosphate primer to IS 12744 , DFT = 60 µm (min)

Machined & treated surfaces / non Ferrous :

Machined components and foundation bolts are applied with rust preventive
Stainless steel Aluminum and galvanized items are not painted.

Painting Scheme for Air pre Heater :

Surface exposed to atmosphere

Surface Preparation: Power tool cleaning
Primer : One coat of red oxide Zinc Phosphate primer to IS 12744 , DFT = 30 µm (min)
Finish Paint : Two coat synthetic of enamel to IS 2932 smoke gray shade no 692 IS 5 to a DFT of 40 µm

Total DFT = 70 µm (min).

Surface in the flue gas path & insulated surfaces :

Surface Preparation: Power tool cleaning
Primer : Two coat of red oxide Zinc Phosphate primer to IS 12744 , DFT = 60 µm (min)

Machined components are protected with rust preventive

Heating elements are dipped in rust preventive.

Painting Scheme for Gates and Damper :

Surface exposed to atmosphere

Surface Preparation: Power tool cleaning
Primer : One coat of red oxide Zinc Phosphate primer to IS 12744 , DFT = 30 µm (min)
Finish Paint : Two coat synthetic of enamel to IS 2932 smoke gray shade no 692 IS 5 to a DFT of 40 µm

Total DFT = 70 µm (min).

Surface under insulation and flue gas path (including Gate frame)

Primer : Two coat of red oxide Zinc Phosphate primer to IS 12744 , DFT = 60 µm (min)

Machined components and gate blades are protected with rust preventive .

Thanking you

19/04/2010

M.Mani
Manager / Commercial
BHEL /Ranipet-632 406

Copy to

SDGM / Commercial – for kind information please.

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 1420

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-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 “Rationalized 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 350^0C 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 100^0C 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 250^0C

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 electodes, 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 65^0C 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	a. For butt welds, upto 6mm including : E6013 Over 6 mm : E7018 b. For fillets, upto 8 mm including : E6013 Over 8 mm : E7018
Carton Steel + P1	E6013 or E7018
Carton + Carton Steel Steel	E8018-B2

WELDER QUALIFICATION

1.0 Scope:

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

2.0 Contents:

QUALIFICATION OF WELDERS AT SITES

1.0 Base Metal:

1.1 For selection refer tables in chapter II.

2.0 Test coupon:

Depending on the range to be qualified, choose the appropriate test coupon from table-1.

For plate butt welds, details of edge preparation shall be as per Figure-4.

For pipe butt welds, details of edge preparation shall be as per Figure-5.

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 mm
D = 3t + 1.6 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 Speciemen.
9. Figure – 7 - Bend Jig

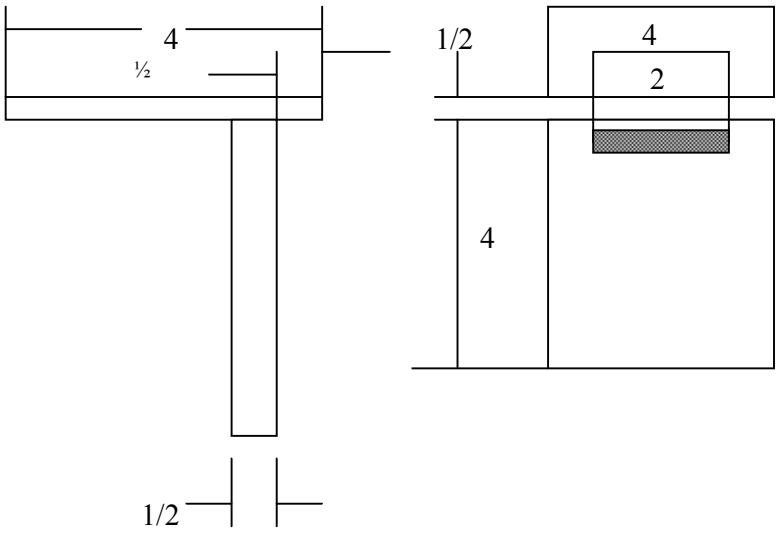
WELDER'S QUALIFICATION REQUIREMENTS

TABLE – 1

SL. NO	TEST FOR	BASE METAL Note -1	TEST COUPON DIMENSION OD, t	ELECTRODE TO BE USED Note 2.4	WELD POSITIONS	REFERENCE FIGURE	RANGE QUALIFIED DIA. & T	POSITION QUALIFIED	ELECTRODE QUALIFIED Note 2,4 REMARKS	
1.	Structural Tack	P1 Gr1	t=10 mm OR 12 mm	(E 6013 F2) (E 7018) F4	3F & 4F 3F & 4F	Fig. 1 &2 -do-	T = Unlimited T = Unlimited	ALL ALL	F2, F1 F4 & Below	Refer Fig.1,3
2.	Plate Welder (Structural)	-do-	t=>25 mm t>25 mm	F4 F4	3G & 4G 3G & 4G	Fig . 3 -do-	T=>3.2 mm T>3.2 mm <=2t	ALL ALL	F4 & Below F4 & Below	
3.	Plate Welder (Other than Structural)	-do-	t=>25 mm t>25 mm	F4 F4	2G 3G & 4G 2G 3G & 4G	-do- -do-	T = Unlimited OD=>600 mm T<=2t OD=>600 mm	 ALL ALL	 F4 & Below F4 & Below	
4.	Pipe Welder	-do-	OD=>25 mm OD=>25 mm & <=73 mm OD>=73 mm t<19 mm t.>=19 mm	F4 F4 F4 F4 F4	6G 6G 6G 6G 6G	-do- -do- -do- -do- -do-	OD=> Above OD &25 mm OD>73 mm T <=2t T= Unlimited	ALL ALL ALL ALL ALL	F4 & Below F4 & Below F4 & Below F4 & Below F4 & Below	

1

TACK WELDER QUALIFICATION



in	mm
1/2	13
2	50
4	100

Fig 1 – Fillet Held Break specimen

FORCE

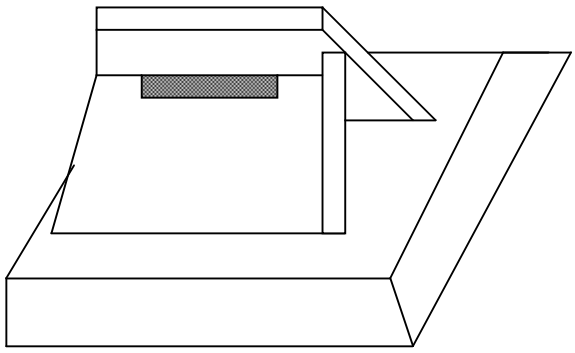
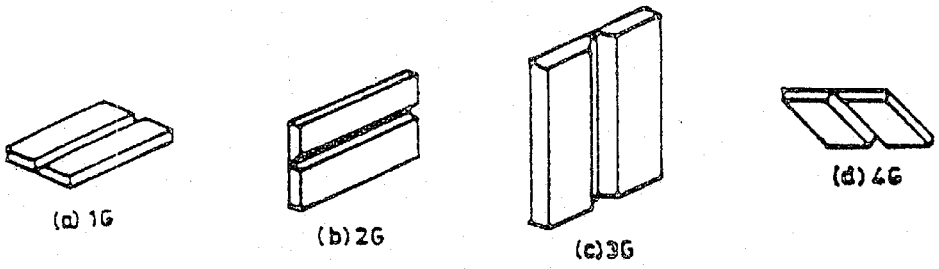
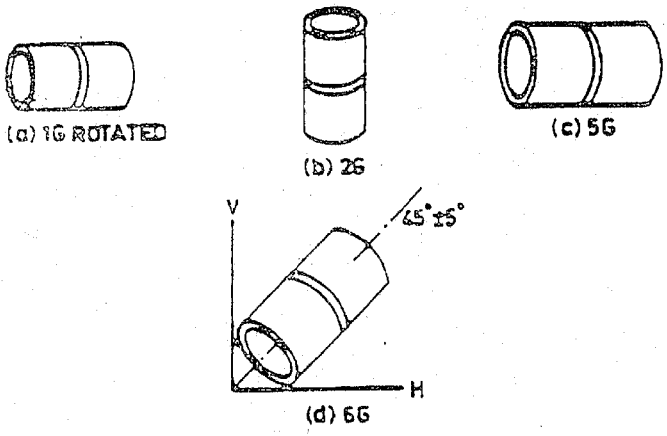


Fig – 2 – Method of Rupturing

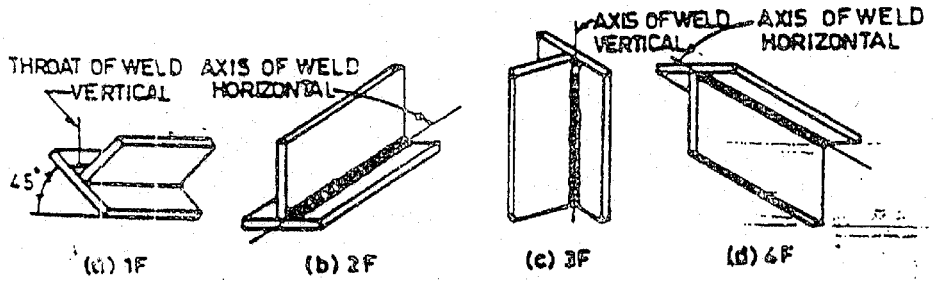
Fig. 3 - POSITIONS



GROOVE WELDS IN PLATE



GROOVE WELDS IN PIPE



FILLET WELDS PLATE

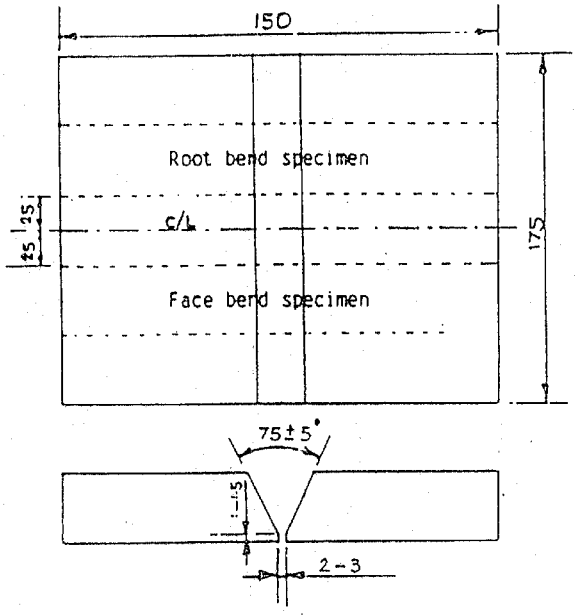
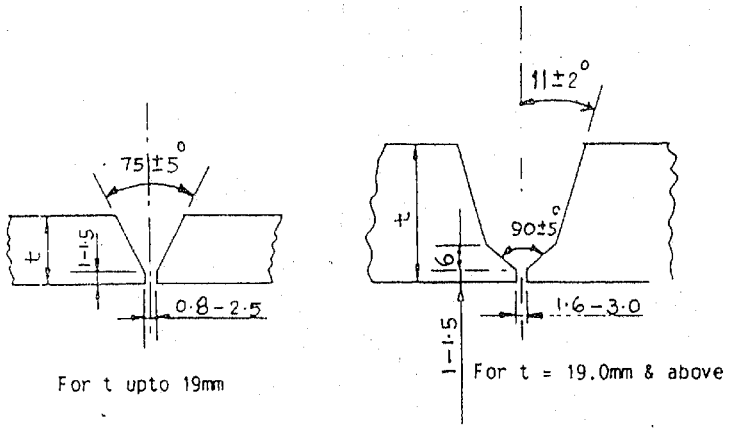
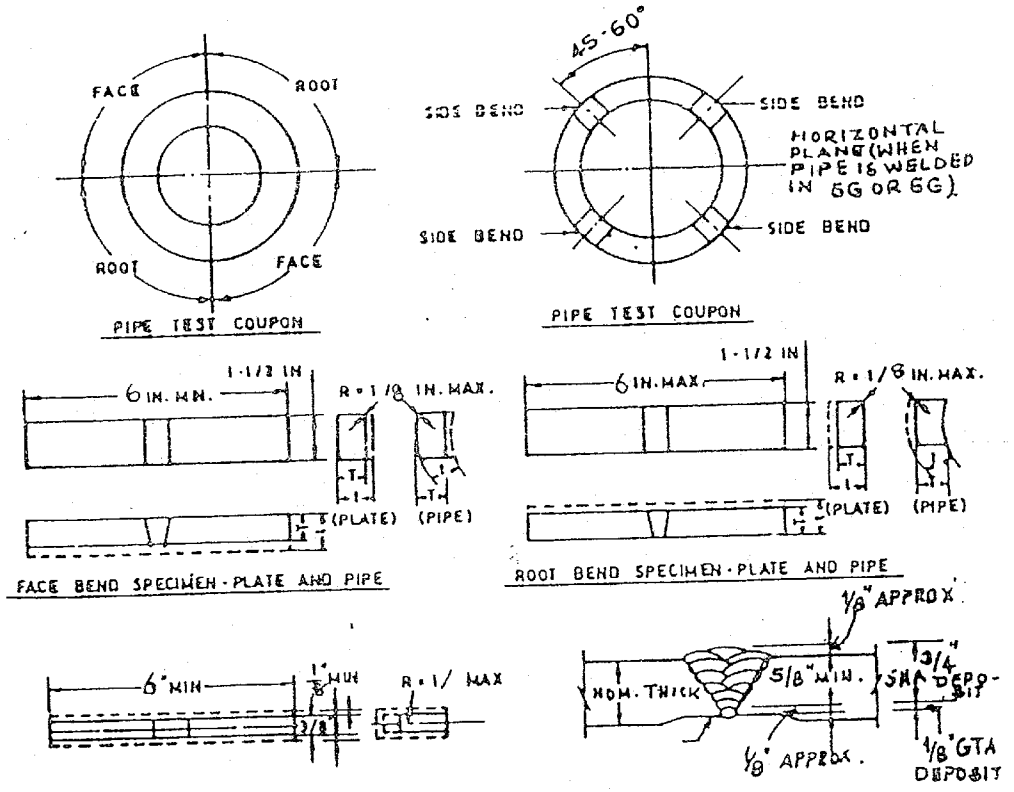


Fig.4: Plate Butt Weld Specimen



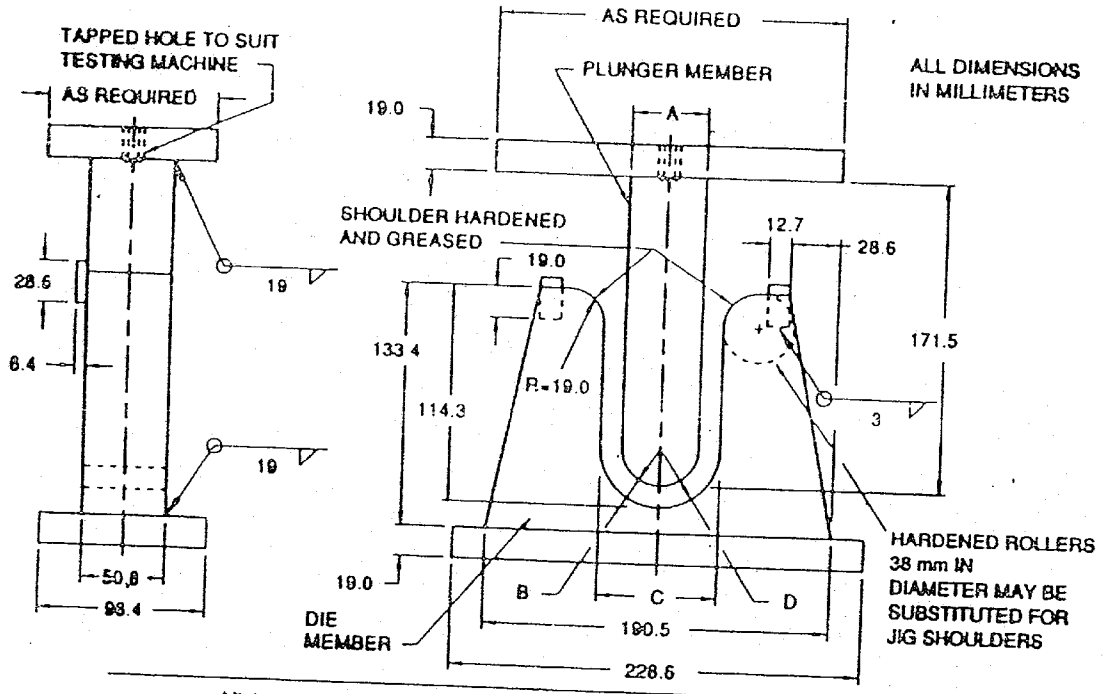
All dimensions in mm

Fig.5: Pipe Butt Weld Specimen



SIDE BEND

Figure - 6



Minimum specified base metal yield strength, MPa	A mm	B mm	C mm	D mm
345 & under	38	19	60	30
over 345 to 620	50	25	73	36.5
620 & over	65	32	86	43

Figure - 7

RECORD OF WELDER PERFORMANCE QUALIFIACATION 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 ;

inter Pass Temp:

Post-heat Temp :

Test joints

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 Dimensons 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 10^{th} 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 3.15	DCEN DCEN	70-120 110-160	12-20 12-20
E6013	SMAW	2.5 3.15 4.0	DCEP DCEP DCEP	50-100 90-140 130-190	18-26 18-26 18-26
@@ EXX18	SMAW	2.5 3.15 4.0	DCEP DCEP DCEP	70-120 100-160 150-220	18-26 18-26 18-26
## EXXX	SMAW	2.5 3.15 4.0	DCEP DCEP DCEP	70-100 100-140 120-170	18-26 18-26 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 Z87.1New 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 <= 400 mm or wall thickness <= 40 mm
2. For parts containing water : NPS <=250 mm or wall thickness <= 28 mm
3. For parts in flue gas path but not subject to radiation: NPS <=150 mm or wall thickness <= 19 mm
4. For parts in flue gas path and subject to radiation: NPS <= 100 mm or wall thickness <= 12.5 mm

II Where radiography is to be performed and geometric uncharpness 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 wides 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.

AMENDMENT NO : 1

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

$$\frac{250 \times 25}{T}$$ or 100 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.

SR Job Card:

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.

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

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 <= 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 x t

Heating Band = 6 x t

Insulation Band = 12 x 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 ≤ 76.1)

Applicable for Tahickness 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 ^{0}C	Post Heating (Note 2) ^{0}C	PWHT ^{0}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	250^0 for 4 hours	700-750
	Castings & forgings	200		

Note 1: For SA 106 Gr. C materials, a minimum preheat of 100^{0}C is required for all thickness and a post heat of 150^{0}C for two hours after completion of welding.

Note 2: All P5 headers shall be interstage heat treated at 700-750^{0}C 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:

P_1 Header to P_3 stub - 120^{0}C (min.)
P_1 Header to P_4 stub - 120^{0}C (min.)
P_1 Header to P_5 stub - 150^{0}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 Structurals (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	$t \leq 19$ – Nil $t > 19$ – 600-650^{0}C No<- soaking <- is required. (Note 1)	$t \leq 50$ – Nil $t > 50$, 100^{0}C	$t \leq 19$ 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.	$t \leq 25$ – 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.	$t \leq 13$, 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 680-730^{0}C 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 250^{0}C for 2 hours or 150^0 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.

VOLUME-IA PART-III
Annexure

In the next 06 pages as below

BACKUP GUARANTEE AGREEMENT

(To be executed on Rs.100/- non–judicial stamp paper)

THIS AGREEMENT is made and executed on this _____ day of _____, between M/s _____(the First Party, i.e, the Bidder) a company incorporated under the Company's Act 1956, having its registered office at _____(hereinafter called the "Bidder", which expression shall include its successors, administrators, executors and permitted assigns) and (2) M/s _____, (the Second Party, i.e, the Backup Guarantor), a company incorporated under the Company's Act 1956, having its registered office at _____ (hereinafter called the “Backup Guarantor", which expression shall include its successors, administrators, executors and permitted assigns).

WHEAEAS the owner, M/s.Bharat Heavy Electricals Ltd, a Government of India undertaking, proposes to issue / issued an NIT (hereinafter referred to as the said NIT) inviting bids from the individual bidders for undertaking the work of _____, at _____ (hereinafter referred to as the said works).

WHEREAS the said NIT enables submission of a bid with a Backup Guarantee subject to fulfillment of the Qualification criteria and other tender conditions specified in the said NIT.

AND WHEREAS M/s _____ (The First Party, i.e, the Bidder) will submit its proposal in response to the aforesaid invitation to bid by the Owner for _____ (as detailed in the Bid doc. no. < TENDER REF-------->)

AND WHEREAS M/s _____ (The First Party, i.e the Bidder) itself is meeting the qualifying requirements of financial criteria _____ (as detailed in the NIT) and in order to fully meet the qualifying requirements of technical in NIT, this back-up agreement is being entered into with M/s _____ (The Second Party, the Associates) , who fully meet the balance part of the said works (_____).

WHEREAS the First Party and the Second Party are contractors engaged in the business of carrying out similar/various items of works. WHEREAS the two parties have agreed to constitute themselves into a backup guarantee agreement for the purpose of carrying out the said works, and that the Backup Guarantee will be continued till the completion of the works in all respects. The backup guarantor will undertake and complete the work in case the bidder fails to execute the subject work with the same terms and conditions of the subject tender.

BACKUP GUARANTEE AGREEMENT

WHEREAS the parties have agreed to certain terms and conditions in this regard:

NOW THEREFORE THIS AGREEMENT WITNESSETH AS FOLLOWS :

1. First and Second parties hereby constitute themselves into a Backup Guarantee for the purpose of bidding and undertaking the said works pursuant to the said NIT as hereinafter stated.

2. The First Party will be the Lead bidder and will be responsible for the entire works.

BACKUP GUARANTEE AGREEMENT

3. The First Party shall undertake the following part(s) of work detailed in the NIT namely _____
_____

4. The Second Party shall undertake to provide a backup guarantee to ensure smooth & proper completion of the following part(s) of work detailed in the said NIT namely _____
_____

5. The parties hereby declare and confirm that each of them will fulfill the required minimum qualifying requirements as prescribed in the said NIT for the works agreed to be undertaken by them as stated here-in-above.

6. It is also agreed between the parties hereto that all of them shall be severally and jointly responsible for the completion of the said works as per the schedule. Further, if the Employer/Owner sustains any loss or damage on account of any breach of the contract(s), we(First party & Backup guarantor), severally and jointly undertake to promptly indemnify and pay such losses / damages caused to the Employer/Owner on their written demand without any demur, reservation, contest or protest in any manner whatsoever.

7. The parties hereby agree and undertake that they shall provide adequate finances, suitable tools, plants, tractors, trailers, other transportation equipment, other tools & plants, measuring & monitoring equipments (MMEs), men and machinery etc. for the proper and effective execution of the works to be undertaken by them as specified here-in-above.

8. It is agreed between the parties hereto that all the consequences, liabilities etc., arising out of any default in the due execution of the said

works shall be borne by the party in default, that is by the party in whose area of work the default has occurred, provided however, so far as M/s Bharat Heavy Electricals Limited is concerned, all the parties shall be liable severally and jointly.

9. The backup guarantor hereby ensures that they have submitted a BG equivalent to 10% of the bid amount in the prescribed format, valid for the duration of the tendered works in a SEALED cover superscribed as“BG from Back up guarantor” along with price bid (Volume II). A declaration certificate in his letter head to this effect is submitted by him to BHEL, duly signed along with the Techno Commercial bid.

IN WITNESS HEREOF the parties above named have signed this agreement on the day month and year first above written at _____(Place) .

WITNESS For

1. NAME (FIRST PARTY)
2. OFFICIAL ADDRESS

WITNESS For

1. NAME (SECOND PARTY)
2. OFFICIAL ADDRESS

[The successful bidder shall have to execute the "JOINT DEED OF UNDERTAKING " in the format to be made available by BHEL at the time of submission of tender].

BACKUP GUARANTOR DECLARATION

(THIS DECLARATION CERTIFICATE IN HIS LETTER HEAD WITH DULY SIGNED AND ENCLOSED IN THE BIDDER'S TECHNICAL OFFER).

I/WE_____(BACKUP GUARANTOR) DECLARES THAT A BANK GUARANTEE BEARING NO:_____,DT:_____ FOR 10% OF THE BID AMOUNT TOWARDS_____VALID UPTO_____FROM_____(BANK) IS ENCLOSED WITH PRICE BID (VOLUME II).WE CONFIRM THAT WE HAVE PROVIDED BACKUP GUARANTEE FOR THIS TENDER IN THIS PROJECT TO ANY OTHER BIDDER.

FOR AND BEHALF OF

M/S_____

(SIGNATURE WITH OFFICIAL SEAL)

Note: The tender will be liable to be rejected if the requisite BG is found to be not enclosed in the Price bid by the bidder.

BIDDER'S DECLARATION

(THIS DECLARATION CERTIFICATE IN HIS LETTER HEAD WITH DULY SIGNED AND ENCLOSED IN THE BIDDER'S TECHNICAL OFFER).

I/WE _____

DECLARE THAT WE GONE THROUGH THE TENDER CONDITIONS AND ACCORDINGLY WE SELECTED THE BACKUP GUARANTOR M/S_____

_WHO IS FULFILLING THE STIPULATED QUALIFICATION REQUIREMENT IN THE TENDER AND WHOSE QUALIFYING EXPERIENCE DOCUMENTS ARE ENCLOSED IN OUR OFFER.

FOR AND BEHALF OF

M/S_____

(SIGNATURE WITH OFFICIAL SEAL)

Note: The tender will be liable to be disqualified if the required documents of the backup Guarantor is found to be not enclosed in the offer.

Requirements for BACK UP Guarantor.

Backup Guarantor **MUST**

1. have executed at least **one unit of minimum 190 MW of BHEL make against order direct from BHEL, in the tendered package and can give back up guarantee only for units upto 189 MW.**
2. furnish a BG in the prescribed format, direct to BHEL, valid for the duration of the tendered works and equivalent to 10% of the bid amount in a SEALED cover superscribed "BG from Back up guarantor" as a part of the Bid documents.
3. also satisfy the assessment of Bidders capacity indicated for the Bidder in NIT and his performance in this project will also be assessed for loading purpose.
4. furnish a certificate that he has not provided back up in this tender to any other agency for this package.
5. also satisfy the financial criteria indicated for the bidder.
6. also attend the monthly reviews and be a joint signatory to monthly evaluation of progress.
7. function with the spirit of ensuring the performance of the bidder for successful completion of the scope of the works tendered.

On Completion of works, the experience of subject execution will be assigned to the bidder on whom the award has been placed. This bidder will be treated as eligible for the next higher group on his own strength.