BHEL PSSR SCT 1428 **DATE: 08.10.2010**

CORRIGENDUM-1 TO TENDER NOTICE SCT 1428

TENDER SPECIFICATION NO BHEL: PSSR: SCT: 1428

Sub: Erection, Testing and Commissioning and completion of trial operation of Boiler & Aux, Rotating Equipments including supply and application of final painting for units -1&2 of 2x800MW sets at Sri Damodaram Sanjeeviah TPP, Krishnapatnam, Near Nellore, AP

DUE DATE EXTENDED AS BELOW:-

TENDER SALE CLOSES ON	: 13.10.2010	
DUE DATE & TIME FOR TENDER SUBMISSION	: 14.10.2010	11.00 HRS.
DUE DATE & TIME FOR OPENING OF TECHNICAL BIDS	: 14.10.2010	11.30 HRS

Changes in the tender specification are furnished below

ALL OTHER CONDITIONS REMAIN UNCHANGED.

AGM / CONTRACTS

CORRIGENDUM-1 TO SCT 1428

Sl No	Reference:	Existing	Revised/added
1	**NIT,CL 5.0 ,page-5 Procedure for Submission of Tenders** on volume 1A(TCC)	• 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)	• 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.
2	Page-13, Annexure -2 ,checklist, volume 1A(TCC)	Point 20-nil	Point-20 is added as "Unquoted Price bid submitted or not" – Applicable –Yes/No
3	Page-13, Annexure -2 ,checklist, cl-9volume 1A(TCC)	Integrity pact-Not Applicable	Corrected as "Applicable"-"Applicable"
4	Page 19,chapter-II,Scope of works, CL 2.1.1	Handling of materials at BHEL/Client's stores/storage yard; transportation to site, Erection, Testing & Assistance for commissioning, Trial Operation and handing over of Boiler and its Auxiliaries, Air Pre-heaters, Ducts and Dampers, Fuel Piping, Boiler Integral Piping, Fans, Power Cycle Piping, Coal Mills and Coal Feeders, Final Painting etc of 2x800MW sets at Sri Damodaram Sanjeeviah TPP, Krishnapatnam, Near Nellore, AP	Handling of materials at BHEL/Client's stores/storage yard; transportation to site, Erection, Testing & Assistance for commissioning, Trial Operation and handing over of Boiler and its Auxiliaries, Air Pre-heaters, Ducts and Dampers, Fuel Piping, Boiler Integral Piping, Fans, Coal Mills and Coal Feeders, Final Painting etc of 2x800MW sets at Sri Damodaram Sanjeeviah TPP, Krishnapatnam, Near Nellore, AP

5	Page 20,chapter-III,Facilities in the Scope of Contractor/BHEL, CL 3.2.1	Electricity for construction purposes of voltage 415/440V BHEL Scope -Yes Bidder scope - “yes”	Bidders scope “Yes” is deleted
6	Page 22,chapter-III,Facilities in the Scope of Contractor/BHEL, Cl 3.9.1,g	Weekly erection schedule BHEL scope “nil” Bidders scope -yes	BHEL scope “yes” is added
7	Page 23,chapter-III,Facilities in the Scope of Contractor/BHEL, Cl 3.9.1,h	Daily erection /work plan based on Sl NO g BHEL scope “nil”	BHEL scope “yes” is added
8	Page 23,chapter-III,Facilities in the Scope of Contractor/BHEL, Cl 3.9.1,k	Laying of racks for gantry crane if provided by BHEL or brought by the contractor /bidder himself	Not applicable
9	Page-23,CL 3.10.2 Electricity	For construction purpose and for contractors office and stores shed electricity will be provided **on chargeable basis @ Rs 3.00per Kwh at one single point**. Further distribution shall be arranged by the contractor at his cost. The required energy meter for measuring power consumption will be provided BHEL and installed by the contractor.	For construction purpose and for contractors office and stores shed electricity will be provided on chargeable basis @ Rs 3.00per Kwh at one single point. Further distribution shall be arranged by the contractor at his cost. The required energy meter for measuring power consumption will be provided BHEL and installed and taken care by the contractor.
10	Page 27,chapter IV, T&Ps provided by BHEL	THE FOLLOWING T & Ps ARE PROVIDED BY BHEL TO MEET THE MILE STONE ACTIVITY List……..	THE FOLLOWING T & Ps ARE PROVIDED BY BHEL PER UNIT TO MEET THE MILE STONE ACTIVITY **Revised List enclosed below**

		Note: nil	Note: All the above T&Ps shall be given to the contractor on sharable basis and the allotment is made by BHEL/Site-in charge on need basis.
11	Page 28,chapter V, T&Ps to be arranged by Bidder	THE FOLLOWING MINIMUM EQUIPMENTS HAS TO BE ARRANGED BY THE CONTRACTOR AT THEIR COST. Note: …….	THE FOLLOWING MINIMUM EQUIPMENTS HAVE TO BE ARRANGED PER UNIT BY THE CONTRACTOR AT THEIR COST. **Revised List with note enclosed below**
12	Page 30 chapter VI, Time schedule	6.1 Time schedule and Mobilisation	6.1 Time schedule and Mobilisation **revised and enclosed below**
13	Page-31-33,Chapter VII, Terms of payment	3.0 Guarantee period -nil	3.0 GUARANTEE PERIOD:- Guarantee period of 12 months shall commence from the date of handing over of the each unit to customer or 6 months from the date of first synchronization of the each unit whichever is earlier, (Provided all erection, testing and commissioning works are completed in all respects).
14	Page 34,Chapter VIII Taxes and Duties	Taxes and duties…….	**Taxes and Duties revised and enclosed below**
15	Page-36,Chapter IX ,CL 9.1.7 Important Conditions For payment	Point 5: Initial 50% security Deposit	5.Initial 50% Security Deposit as per CL 1.10 of GCC.
16	Part-II, Technical Specifications Page 43,Chapter	Detailed procedure available with BHEL site office should be collected before taking up the job by	Detailed procedure available with BHEL site office should be collected before taking up the job by the contractor for

	-3 Erection, CL2.3.5	the contractor for preassembly of ceiling girders. EACH CEILING GIRDER WILL BE SUPPLIED IN MAXIMUM 3 PIECES AND CEILING GIRDERS ARE TO BE PRE-ASSEMBLED AT SITE AND WELDING, NDT TESTS AND STRESS RELIEVING (AS APPLICABLE) ARE TO BE CARRIED OUT, INCLUDING 100% RADIOGRAPHY FOR THE WELDED JOINTS IN CEILING GIRDERS. THE HEAVIEST ASSEMBLED CEILING GIRDER WEIGHT WILL BE AROUND 120MT AND MAXIMUM ELEVATION OF CEILING GIRDER IS 64M AND HEIGHT OF CEILING GIRDER IS 3.8M	preassembly of ceiling girders. EACH CEILING GIRDER WILL BE SUPPLIED IN MAXIMUM 3 PIECES AND CEILING GIRDERS ARE TO BE PRE-ASSEMBLED AT SITE AND WELDING, NDT TESTS AND STRESS RELIEVING (AS APPLICABLE) ARE TO BE CARRIED OUT, INCLUDING 100% RADIOGRAPHY FOR THE WELDED JOINTS IN CEILING GIRDERS. Dimensions of ceiling girders as below:- Web thick=max40mm, flange thick=max115mm, flange width =1300mm, Height 4.6mtrs
17	Part-II, Technical Specifications Page 49,50 Chapter -3 Erection,	CL2.3.39,2.3.40,2.3.41,2.3.49,2.3.50,2.3.51, 2.3.52	Repeated clauses -hence deleted
18	Part-II, Technical Specifications Page 51,Chapter -3 Erection, CL 2.3.59	The contractor has to remove the scrap/debris periodically as and when required and returned to BHEL stores. In case the contractor fails to remove the scrap/debris, the same shall be done by BHEL at the cost of contractor. The temporary structures/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.	The contractor has to remove the scrap/debris periodically as and when required and returned to BHEL stores. In case the contractor fails to remove the scrap/debris, the same shall be done by BHEL at the cost of contractor. The temporary structures/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. Refer Form F15 in Volume I D
19	Part-II, Technical Specifications Page 52,Chapter	Down comer pipes erection can be done by carrying out preassembling the pipes what ever feasible as per availability. The suction manifold	Down comer pipes erection can be done by carrying out preassembling the pipes what ever feasible as per availability. The suction manifold received in **loose** pieces and to pre-

	-3 Erection, CL 2.3.60, point-11	received in **3** pieces and to pre-assembled in the floor nearby. After welding the suction manifold, it is to be positioned, aligned and then only the down comers from the drum are to be connected. Erection of suction spool pieces, and hand operated valves for the system to be erected. The CC pump volute without impeller is fitted to the bottom of the suction spool .Bottom flange of the volute is carefully leveled and aligned before welding the suction spool. After completion of welding in all respects cutting and trimming of erection attachment to be done.. CC pumps volute is to be blanked for carrying out hydro test. After hydro test, the blanks are removed and pump erection taken up. The tightening of the bolts to be done with torque wrench as per the instructions of the supplier.	assembled in the floor nearby. After welding the suction manifold, it is to be positioned, aligned and then only the down comers from the drum are to be connected. Erection of suction spool pieces, and hand operated valves for the system to be erected. The CC pump volute without impeller is fitted to the bottom of the suction spool .Bottom flange of the volute is carefully leveled and aligned before welding the suction spool. After completion of welding in all respects cutting and trimming of erection attachment to be done.. CC pumps volute is to be blanked for carrying out hydro test. After hydro test, the blanks are removed and pump erection taken up. The tightening of the bolts to be done with torque wrench as per the instructions of the supplier.
20	Part-II, Technical Specifications Page 53,Chapter -3 Erection, CL 2.3.60,point : 13	Erection of LTSH and economiser coils can be done by preassembling the upper and lower coils. Pre erection checks like width, length etc, and sponge test of coils for thoroughness to be done before erection. Required hanger tube erection to be completed before coils erection. Erection of cassette baffles for LTSH and Eco coils can be preassembled and coils erection can be done.	Erection of LTRH and economiser coils as applicable can be done by preassembling the upper and lower coils. Pre erection checks like width, length etc, and sponge test of coils for thoroughness to be done before erection. Required hanger tube erection to be completed before coils erection. Erection of cassette baffles for LTRH and Eco coils can be preassembled and coils erection can be done.
21	Part-II, Technical Specifications Page 53,Chapter -3 Erection, CL	Other tapping points meant for monitoring the level should be erected and protocol is to be made. Maximum use of the pads and lugs welded	Other 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 **steam separator**/drum to be used for

	2.3.60,sub cl 21	on the drum to be used for giving supports	giving supports
22	Part-II, Technical Specifications Page 55,Chapter -3 Erection, CL 2.3.61	Ensuring the verticality of the columns before and after the Drum erection	Ensuring the verticality of the columns before and after the Drum /steam separator erection
23	Part-II, Technical Specifications Page 57, Chapter -5 Progress of work, CL 2.5. 1	Contractor is required to draw mutually agreed monthly erection programs in consultation with BHEL well in advance. Contractor shall ensure achievement of agreed program and shall also timely arrange additional resources considered necessary at no extra cost to BHEL.	Refer forms F14, F15, F16, F17 and F18 in volume IC. Plan and review will be done as per the formats 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.
24	Part-II, Technical Specifications Page 64,Chapter -6 Welding & NDT/SR,	CL 2.6. 55 –not existing	CL 2.6. 55 added as The extra work rate for additional joints if any in pressure parts over and above the number of joints indicated in the pressure parts welding schedule is as follows. **The rate per equivalent joint for pressure parts welding of carbon steel is Rs350/- and alloy steel is 600/- including NDT&SR if applicable**. “The welding process, weld joint details, joint configuration and material specification may change to suit the design requirements. The contractor’s quoted rates shall be inclusive of each contingency. All welds involved in the erection of temporary pipe lines for hydraulic test, chemical cleaning, steam blowing etc to be carried out within the quoted rates. The number of joints to be welded as mentioned in the welding schedule consists of butt welds. All other welds viz attachment welds on pressure parts/non pressure parts, fillet welds in non

			pressure parts welding in the boiler and Rotating Machines has to be carried out by the bidder within quoted rates".
25	Part-II, Technical Specifications Page 69,Chapter -6 Welding & NDT/SR,	P91 Welding procedure –not existing	P91 Welding procedure-enclosed below
26	Part-II, Technical Specifications Page 76,Chapter -7 testing and Commissioning, CL2.7.50	After floating of safety valves, the commissioning activities and trail operations will continue upto handing over of the unit. It shall be the responsibility of the contractor to provide various categories of workers in sufficient numbers as per the work requirement along with supervisors including necessary consumable tools etc., during this period. The rate quoted shall indicate all these contingencies also. The various categories of workers required for pre-commissioning, commissioning and post-commissioning activities are as follows: a. Pipe fitters b. Millwright Fitters c. HP& structural welders d. Riggers e. Unskilled workers f. Supervisors	After floating of safety valves, the commissioning activities and trail operations will continue upto handing over of the unit. It shall be the responsibility of the contractor to provide various categories of workers in sufficient numbers as per the work requirement along with supervisors including necessary consumable tools etc., during this period. The rate quoted shall indicate all these contingencies also. The various categories of workers required for pre-commissioning, commissioning and post-commissioning activities are as follows: a. Pipe fitters b. Millwright Fitters c. HP& structural welders d. Riggers e. Unskilled workers f. Supervisors g. Electricians h. Any other category of workers as may be

		g. Electricians h. Any other category of workers as may be required. Further in addition to the above, contractor has to arrange the following minimum manpower exclusively for assisting BHEL commissioning engineers during stabilization and trial operation period. This manpower will be directly controlled by BHEL commissioning engineers. One Engineer per shift for three shifts. One supervisors per shift for three shifts One fitters per shift for three shifts Two helpers per shift for three shifts It shall be specifically noted that the above employees of the contractor may have to work round the clock along with BHEL commissioning Engineers and hence, overtime, may be involved. The contractor‘s quoted rate shall be inclusive of all these factors also.	required. Further in addition to the above, contractor has to arrange the following minimum manpower exclusively for assisting BHEL commissioning engineers during stabilization and trial operation period. This manpower will be directly controlled by BHEL commissioning engineers. One Engineer per shift for three shifts. Two supervisors per shift for three shifts Three fitters per shift for three shifts Six helpers per shift for three shifts It shall be specifically noted that the above employees of the contractor may have to work round the clock along with BHEL commissioning Engineers and hence, overtime, may be involved. The contractor‘s quoted rate shall be inclusive of all these factors also.
27	Page 80 Annexure 1A Weight Schedule	Total Weight 30697MT	Weight schedule summary table revised and enclosed below the notes in the tender remain same

	Summary		
28	Page 81 Annexure 1B Weight Schedule Summary	PG 80 not existing	PG 80 added with 72MT
29	Page 86 Annexure 1D Weight Schedule Summary Pressure parts	PGMA 80300,80301 not existing	PGMA 80300,80301 added- Weight schedule table revised and enclosed below
30	Page 91 Annexure 1E Weight Schedule Summary Non Pressure parts	PG MA 80-920 not existing	PGMA 80920 added Weight schedule table revised and enclosed below
31	Page 222 Drawings	The enclosed drawings are for information purpose only. This may undergo revision during execution.	The enclosed drawings below are for information purpose only. This may undergo revision during execution. List of Drawings enclosed below
32	Page 49 CL 2.3.49	The contractor has to erect the passenger cum goods lift excluding civil foundation, as per instruction of BHEL Engineer, including transport of materials from BHEL Stores. The dismantling of the erected lift, Transport / Handing over to BHEL Stores is also covered in this scope of work. The contractor has to arrange operators, Technicians for round the clock operation and maintenance is to be carried out by the contractor at his cost. The operation and maintenance shall be carried out till the end of contract period, or the date, on which the lift is dismantled as per the directives of BHEL, whichever is earlier.	The contractor has to erect the passenger cum goods lift **including civil foundation**, as per instruction of BHEL Engineer, including transport of materials from BHEL Stores. The dismantling of the erected lift, Transport / Handing over to BHEL Stores is also covered in this scope of work. The contractor has to arrange operators, Technicians for round the clock operation and maintenance is to be carried out by the contractor at his cost. The operation and maintenance shall be carried out till the end of contract period, or the date, on which the lift is dismantled as per the directives of BHEL, whichever is earlier. **Foundation Drawing for the proposed passenger lift will be issued separately for information.**

33	Page 41 Chapter II Foundation and Grouting CL 2.2.5	Total grouting of the columns/equipments including pocket grouting, grouting at the gap between foundation and base plates top surface of column/equipments is in the scope of the contractor. All the grouting should be carried out by non-shrink cement like conbextra GPI/Conbextra GP II / Shrinkkomp or its equivalent etc. This special non-shrink cement shall be arranged by the contractor at his cost. The quoted rate shall inclusive of the same.	Total grouting of the columns/equipments including pocket grouting, grouting at the gap between foundation and base plates top surface of column/equipments is in the scope of the contractor. All the grouting should be carried out by non-shrink cement like conbextra GPI/Conbextra GP II / Shrinkkomp or its equivalent etc. This special non-shrink cement shall be arranged by the contractor at his cost. The quoted rate shall inclusive of the same .**The approximate quantity of grouting cement required per unit is 160T. If any additional quantity required during execution also to be arranged by the bidder within quoted rate.**
34	Page 31 Chapter VII Terms of Payment	Clause 4.0 Compression of schedule-Not existing	Clause 4.0 added as below. 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.
		CLARIFICATION SOUGHT BY BIDDERS	BHEL REPLY
35	Page 43 Part II –TS – Chapter 3 – Clause 2.3.5 Clarification sought by a bidder	Please provide the ceiling girder drawing to calculate the volume of welding, NDT and HT. Consolidation of area for positioning of crane – please provide approximate volume to consider the pricing or exclude from bidder scope	600 T capacity crane will be provided. consolidation is in the scope of bidder
36	Page 46-Part II –TS –Chapter 3 – 2.3.15 & 20	Ducts / Expansion pieces are dispatched to site in loose walls/plates. We assume that it will be delivered in panel form with stiffeners welded together.	Walls with stiffeners in welded condition will be provided

37	Part II –TS – Chapter 8 – 2.8.1	Please provide the final painting quantity or litres of paint	As per standard practice
38	Page 71 Part II –TS –Chapter 7 -2.7.8	Please confirm the supply of N2 gas for preservation of boiler – whose scope?If in bidder scope, please provide the boiler volume.	N2 will be provided by BHEL for boiler preservation.
39		Insulation hooks – welding at site	It shall be welded on the fins by manual welding. Hooks are of SS material. Approximate qty of hooks is 1.10 lakhs per boiler.
40		P92/T92 welding procedure. Clarification regarding providing induction heating machine.	Similar practice of P91/T91 materials. Filler wires, electrodes and induction heating machines will be provided by BHEL.
41	Volume II price Bid		Revised price bid is issued separately to quote

Volume 1A Part-1 Chapter- IV T&Ps provided by BHEL

THE FOLLOWING T & Ps ARE PROVIDED BY BHEL PER UNIT TO MEET THE MILE STONE ACTIVITY

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

S.No	Description	Qty
1	Suitable higher capacity crane (more than 75Tcapacity on need basis)	As Required
2	Hydraulic pressure testing pump with accessories	Set as required
3	Chemical cleaning pump with Motor	As required
4	Sky climber	1No
5	Passenger cum goods Lift	1No
6	Boiler fill pump	As required
7	Air blowers for Gas Tightness	2 Nos
8	Induction Heating Machine With Complete Accessories for P91 welding	As required

Note: All the above T&Ps shall be given to the contractor on sharable basis and the allotment is made by BHEL/Site-in charge on need basis.

Volume 1A Part-1 Chapter- V T&Ps to be arranged by Bidder

THE FOLLOWING MINIMUM EQUIPMENTS HAS TO BE ARRANGED PER UNIT BY THE CONTRACTOR AT THEIR COST.

75 T CRAWLER CRANE	2NOs
18 T CRAWLER CRANE	2 NOs
8T MOBILE CRANE	2 NOs
Tractor trailer 20T& **60T**	Each 1 No

NOTE:

1. BHEL may provide either BHEL owned cranes or hired cranes at the discretion of BHEL. Bidder to note the following:-

a. In the event of providing BHEL Cranes :

a.1: For 75 T cranes - Operator fuel and lubricant has to be arranged by the contractor at his cost.

a.2: For 100 T and above capacity cranes, BHEL will provide Operator. Fuel and lubricant has to be arranged by the bidder at his cost

b: In the event of providing hired cranes :

b.1: Operator will be provided by BHEL through hiring agency free of charges for 100 T or above capacity cranes.

b.2: 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. Cranes are for erection purpose and shall not be available for material handling at stores and for transportation purpose for which contractor shall make his own arrangement.

4. The day-to-day and routine maintenance including replacement of Spares for BHEL T&Ps will be carried out by the contractor at his own cost. However BHEL shall supply spare parts free of charges.

5 Apart from above, any other tools and plants required for satisfactory completion of the work have to be arranged by the contractor.

Taxes and Duties

Value Added Tax (VAT) for the works

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

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

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.

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).

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.

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

8.2.0 Service Tax

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.

8.3.0 Other Taxes & Levies

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.

8.4.0 **New Levies / Taxes**

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..

8.5.0 **Statutory variations**

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 .

8.6.0 **Direct Tax**

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.

Chapter -6, Welding & NDT/SR

ERECTION WELDING PRACTICE FOR SA 335 P91 MATERIAL

1.0 SCOPE

1.1 This document details salient practices to be adopted during erection of SA335 P91 material.

2.0 MATERIAL

Materials shall be identified as follows : -

1. Colour Code: Brown & Red
2. Hard Stamping : Specification, Heat No. Size
3. Paint / Stencil: WO DU, as per the relevant drg & document.

2.1 When any defect like crack, lamination, deposit noticed during visual examination the same shall be confirmed by Liquid Penetrant inspection. If confirmed, it shall be referred to unit.

3.0 ERECTION

3.1 Edge Preparation and fit up

3.1.1 Cutting of P-91 material shall be done by band saw / hacksaw / machining / grinding only. Edge preparation (EP) shall be done only by machining. In extreme cases, grinding can be done with prior approval of Welding Engineer / Quality Assurance Engineer. During machining / grinding, care should be taken to avoid excessive pressure to prevent heating up of the pipe edges.

3.1.2 All Edge Preparations done at site shall be subjected to Liquid Penetrant Inspection (LPI). Weld build-up on Edge Preparation is prohibited.

3.1.3 The weld fit-up shall be carried out properly to ensure proper alignment and root gap. Neither tack welds nor bridge piece shall be used to secure alignment. Partial root weld of minimum 20 mm length by GTAW and fit-up by a clamping arrangement is recommended. Use of site manufactured clamps for fit up is

acceptable. The necessary preheat and purging shall be done as per **clause 4.1 and 3.2.2.**

3.1.4 The fit-up shall be as per drawing. Root gap shall be 2 to 4 mm; root mismatch shall be within 1 – mm. Suitable Reference punch marks shall be made on both the pipes (at least on three axis)

a) At 200 mm from the EP for UT.
b) At 1000 mm from the EP for identifying weld during PWHT.

3.2.0 FIXING OF THERMOCOUPLE (T/C) AND HEATING ELEMENTS DURING PREHEATING AND PWHT

3.2.1 No Preheating is required for fixing T/C with resistance spot welding Following are the equipment / facilities for heating cycles

1. Heating methods : Induction heating
2. Thermo couples : Ni-Cr / Ni-A1 of 0.5 mm gauge size.
3. Temp. Recorders : 6 Points / 12 Points.

3.2.2 **ARRANGEMENT FOR PURGING** : -

Argon gas of 99.99% conforming to Gr 2 IS 5760 – 1998 shall be used for purging the root side of weld. The purging dam (blank) shall be fixed on either side of the weld bevel prior to pre-heating. The dam shall be fixed inside the pipe and it shall be located away from the heating zone. Purging is to be done for root welding (GTAW) followed by two filler passes of SMAW in case of butt welds. Purging is not required in the case of nozzle and attachment welds, when they are not full penetration joints. The Argon to be used shall be dry.

The flow rate is to be maintained during purging is 10 to 26 litres / minute and for shielding during GTAW IS 8 to 14 litres / minute (A minimum flow rate as per welding Procedure specification shall be maintained).

Start purging from inside of pipe when root temperature reaches 220 deg. C. Provide continuous and adequate Argon Gas to ensure complete purging in the root area.

The minimum pre-flushing time for purging before start of welding shall be 5 minutes, irrespective of the size.

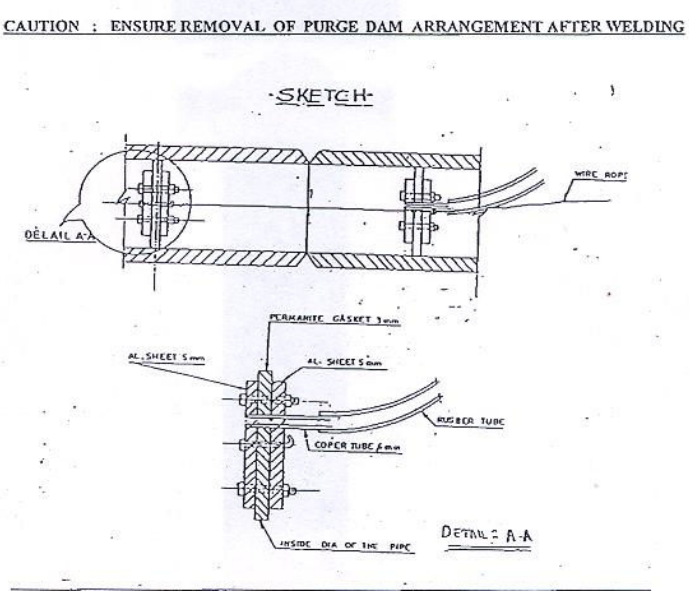
Wherever possible, solid purging gas chambers are to be used which can be removed after welding. If not possible, only water-soluble paper is to be used. Plastic foils that are water-soluble are NOT acceptable.

3.2.3 USING ALUMINIUM DAM ARRANGEMENT

In order to retain the Argon gas at the inside of the pipe near root area of the weld joint, the purging dams made of Aluminium (or other suitable material like mild steel) and permanent gaskets may be provided during the weld fit-up work as indicated in the sketch.

The Aluminium discs shall be firmly secured with a thin wire rope. After completion of the root welding followed by two filler passes, the disc may be pulled outwards softly.

CAUTION: ENSURE REMOVAL OF PURGE DAM ARRANGEMENT AFTER WELDING:



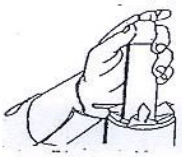
3.2.4 **USING OF WATER SOLUBLE PAPER**

The dams can be made of water-soluble paper for creating the purging chamber. The advantage in such dam arrangement is that dissolving in water can flush the dams. The following are different methods used.

3.2.4:-

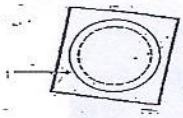
The purge damming process is illustrated as below

1. For small diameter pipes, simply stuff water soluble paper into each section to be joined. (refer sketch)



SKETCH-1

2. For larger pipes, cut out a circular disc slightly larger than the diameter and shape it to the inside pipe circumference. (A small hole may be punched in the paper to ensure complete evacuation of air when purging) (Refer Sketch)

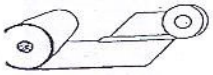


SKETCH-2

3. Position the disc within the pipe and tape in place with water soluble paper. Repeat procedure for the other section. Insert the backing gas into the joint with a needle valve and make root pass in the usual manner. (Sketch)

SKETCH-3

4. For pipes larger than 508 mm diameter , simply splice two sheets of water soluble paper together with water soluble wat and repeat procedure in picture 2 and 3. (Sketch)



SKETCH-4

4.0 **WELDING / WELDERS QUALIFICATION**:

Only qualified welding procedures are to be used. Welders Qualified as per ASME Sec IX and IBR on P91 material shall only be engaged. Welders log book to be maintained and welders performance to be monitored by site welding engineer / Quality assurance engineer. The applicable WPS for P91 + P91 shall be WPS No.1034.

4.1 **PREHEATING**

Prior to start of pre heating ensure that surfaces are clean and free from grease, oil and dirt. Preheating temp shall be maintained at 220 deg C (min) by using Induction heating. The Temperature shall be ensured by using a Calibrated autographic recorder and two calibrated then no couples fixed at 0 deg and 180 deg positions on both pipes 50 mm away from the EP. The thermocouple shall be welded with the condenser discharge portable spot welding machine. The preheating arrangements shall be inspected and approved by welding engineer / Quality Assurance Engineer. (Ref Fig – 1) Alternate arrangements shall be made during power failure. Two additional spare thermocouple to be fixed (as described above) for emergency use. Gas burners shall be employed to maintain the Temperature until the power resumes.

4.2 WELDING:-

Root Welding shall be done using GTAW process (as per WPS) five minutes after the start of argon purging. Filler wire shall be cleaned and free from rust or oil. Argon purging shall be continued minimum two filler passes of SMAW.

4.3 STORAGE OF WELDING CONSUMABLES

a. Welding consumables are received with proper packing and marking which includes the relevant batch number for easy identification.
b. Electrodes are stored in their original sealed containers / packages until issued and kept in dry and clean environment as per the instructions of electrode manufacturers, taking care of shelf life.
c. Welding filler wires are received with proper packing and marking which includes the relevant batch number for easy identification.
d. The filler wires are stored in their original packages until issue and kept in dry and clean environment.

4.3.1 The electrode GTAW wires issued to the welders should be controlled through issue slips. SMAW electrodes used must be dried in drying ovens with calibrated temperature Controller. The drying temp shall be as recommended by the electrode manufacturer. The drying Temp shall be 200 – 300 deg C for two

hours if it is not specified by the manufacturer. Portable flasks shall be used by the welders for carrying electrodes to the place of use. The electrodes shall be kept at minimum 100 deg C in the flask. Welding shall be carried out with short are and stringer bead technique only.

4.4 The inter-pass temperature shall not exceed 350 deg. C. After completion of Welding bring down the temp to 80 – 100 deg C and hold it at this temp for one hour minimum. The PWHT shall commence after completing one hour of soaking.

CAUTION :- No LPI / Wet MPI shall be carried out on weld before PWHT.

5.0 **POST WELD HEAT TREATMENT**

Arrangements :- A minimum of four thermocouples shall be placed such that at least two are no the weld and the other two on the base material on either side of the weld within the heating band at 180 degrees apart about 50mm from the weld joint. Two stand by thermocouple shall also be provided on the weld in case of any failure of the thermocouple. The width of the heated circumferential band on either side of the weld must be at lease 5 times the thickness of the weld. In case of fillet joints the heating band shall be six times the thickness of the base material. (Ref Fig – 2). An insulation of about 10mm thickness shall be provided between the cable and weld joint.

5.1 Obtain the clearance for post weld heat treatment cycle from QAE / Welding Engineer. The PWHT temp for P91 material shall be 760 $\pm$ 10 deg C and the soaking time shall be 2.5 minutes per mm of weld thickness, subject to a minimum of TWO Hours**. All records shall be reviewed by Welding Engineer prior to PWHT clearance.**

Heating shall be done by Induction heating only.

The rate of heating / cooling :- (above 350 deg C)

Thickness up to 50 mm – 110 deg C/hr.(max)

Thickness 50 to 75 mm – 75 deg C/hr.(max)

Thickness above 75 mm – 55 deg C/hr.(max)

Thickness = Actual thickness as measured.

5.2 INSULATION :

The width of the insulation band beyond the heating band shall be at least two times the heating band width on either side of the weldment.

The recording of time & temp shall be continuously monitored with a calibrated recorder right from preheating. This will be ensured at every one hour by site authorized personnel.

5.3 PREVENTIVE MEASURES DURING POWER FAILURE AND NON-FUNCTIONING OF EQUIPMENTS**.**

No interruption is allowed during welding and PWHT. Hence all the equipment for the purpose of power supply, welding, heating etc., shall have alternative arrangements. (diesel generator for providing power to the welding and heating equipments, standby welding and heating equipments, reserve thermocouple connections, gas burner arrangement for maintaining temp etc.) Following preventive measures shall be adopted until normal power supply or backup power supply through diesel generator is restored.

(a) During start of preheating **:**

In case of any power failure / interruption during preheating, the weld fit-up shall be insulated and brought to room temperature. After the electric supply resumes the joint shall be preheated as per Clause No:4.1. (Ref : Fig 3)

(b) During GTAW / SMAW: **-**

Use gas burner arrangement to maintain the temperature at 80 deg – 100 deg C up to a length of 50 mm on either side from weld center line along the complete circumference of the pipe. Root welding shall be continued after power is restored and preheating temperature is raised to 220 Deg. C. During the above period temperature shall be recorded through contact type Thermometer. (Ref: Fig 4)

(c) During cooling cycle after SMAW welding to holding temperature at 80 to 100 deg C for one hour (Ref: Fig 5)

Care shall be taken to avoid faster cooling rate by adequate insulation. The required temp 80 – 100 deg C shall be maintained by gas burner arrangements till power resumes / start of PWHT.

(d) During post weld heat treatment.

The following shall be followed

*** 1) During heating cycle**

The whole operation to be repeated from the beginning (Ref : Fig 6)

*** 2) During soaking**

Heat treat (soak) subsequently for the entire duration. (Complete period). (Ref : Fig 7)

The heating rate shall be as per the chart.

3) During cooling (above 350 deg C).

Reheat to soaking temperature and cool at the required rate. (Ref: Fig 8)

*** Temp should not be allowed to fall below 80 – 100 deg C. Gas burner arrangement shall be used to maintain the temperature.**

5.4 In all the above cases (a to d) the temp. Measurement on the weld joint by means of contact type calibrated temp. gauges shall be employed to record the temperature at regular Intervals of 15 minutes in the log book by Quality Assurance Engineer / Welding Engineer.

5.5 TEMPERATURE MONITORING:

The welding and heat treatment chart given in Figure 9 shall be followed for the following details. The actual PWHT chart shall be monitored for the following:

a) Preheat

b) Inter pass Temperature (GTAW ÷ SMAW)

c) Controlled cooling and Holding at 80-100 Deg C for minimum one hour under insulation. Start PWHT after minimum one hour of soaking.

d) Heating to PWHT

e) Soaking at PWHT

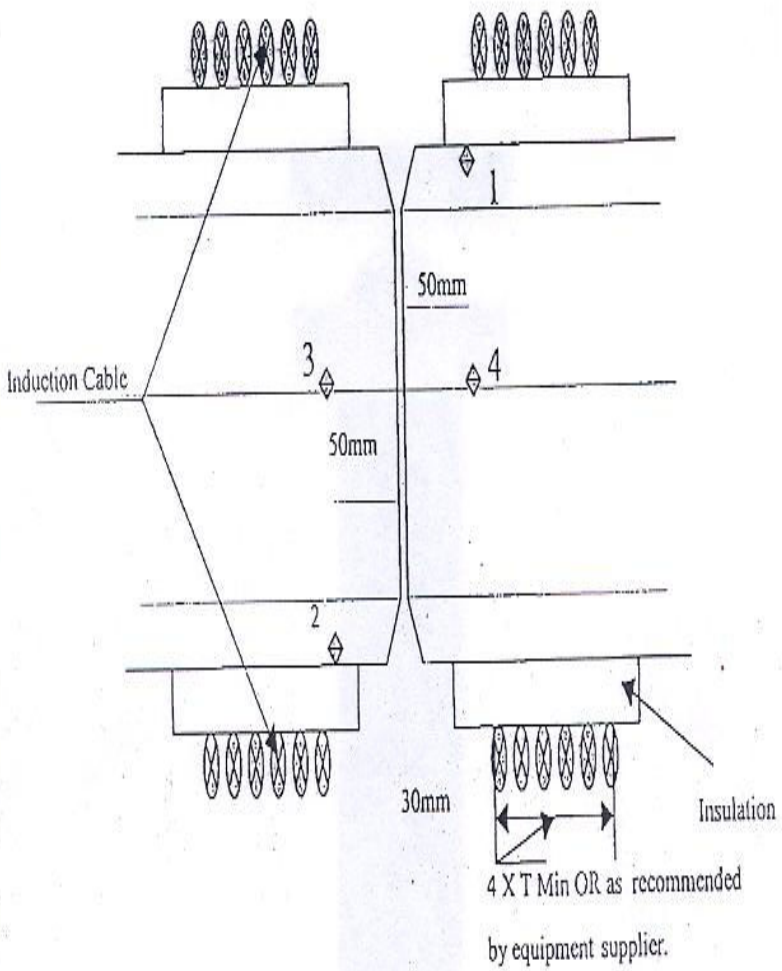
f) Cooling to 350 Deg C

g) Cooling to Room Temperature (under insulation)

5.6 CAUTION

THE PWHT TEMP. SHALL NOT DEVIATE FROM THE VALUES SPECIFIED IN THE CHART RANGE SINCE ANY DEVIATIONS TO THE SPECIFIED HOLDING TEMPERATURE RANGE, WILL ADVERSLY AFFECT THE MECHANICAL PROPERTIES OF THE WELDMENT AND MAY LEAD TO REJECTION OF THE WELDMENT. THE WELD JOINTS SHOULD BE KEPT DRY. UNDER NO CIRCUMSTANCES ANY WATER / LIQUID IS ALLOWED TO COME IN CONTACT WITH WELD AS WELL AS PREHEATED PORTION OF PIPE.

INDUCTION HEATING (for all Thickness)



1&2 Measurement TC, 3&4 Spare TC

THERMOCOUPLE (TC) ,PREHEATING ARRANGEMENT

Fig - 1

ARRANGEMENT FOR POST WELD HEAT TREATMENT

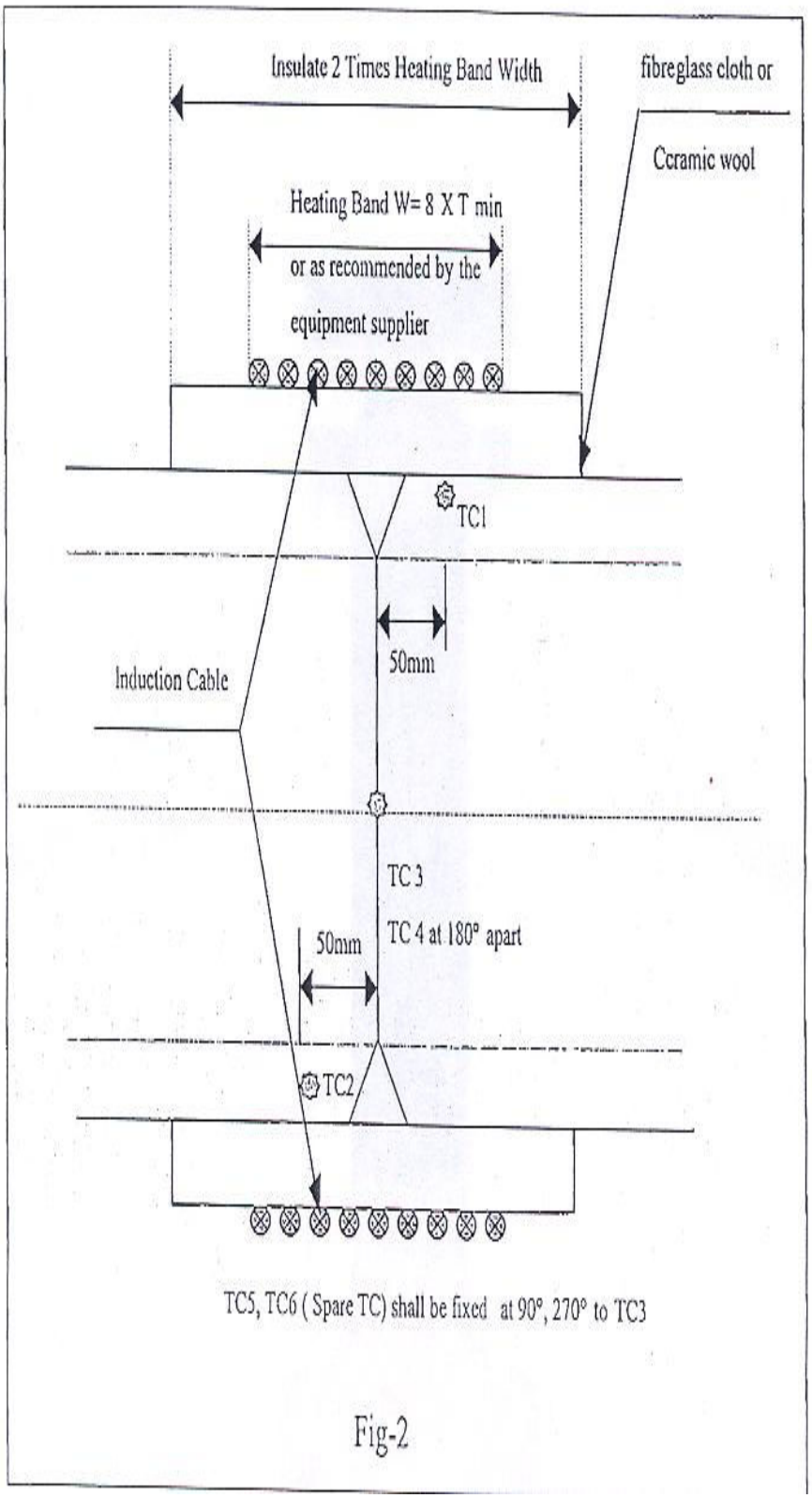
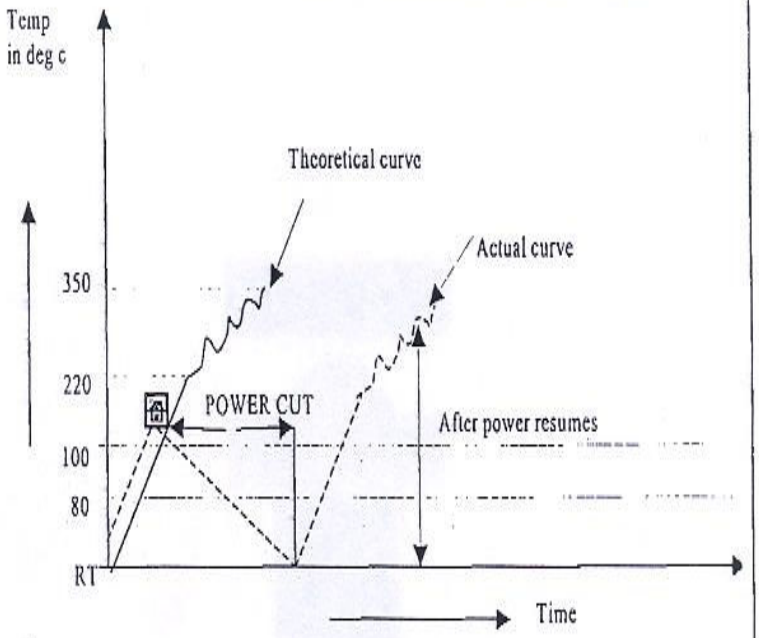


Fig-2

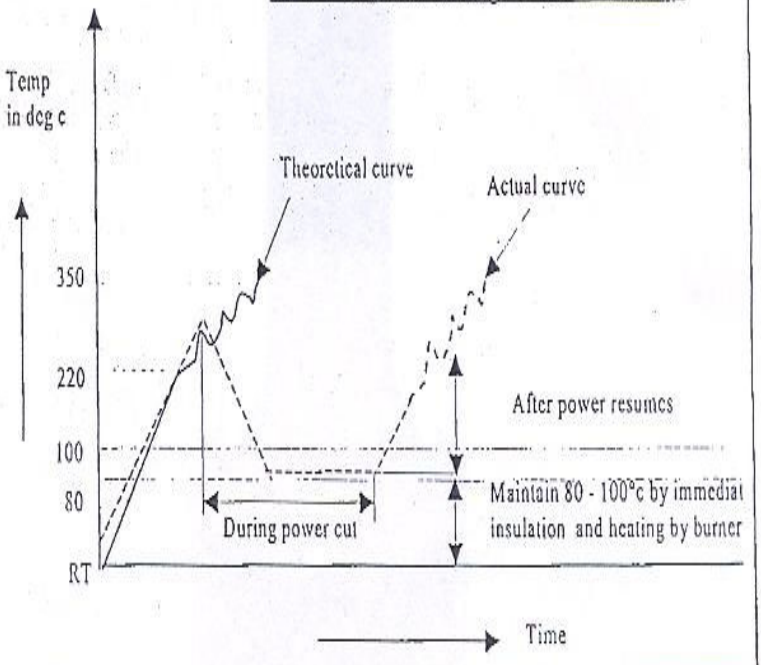
Power Failure during Preheating



Immediately cover the joint by insulation, if welding has not been started. Start preheat as per Cl.4.1 after power resumes

Fig - 3

Power Failure during GTAW/SMAW



Power Failure during cooling / holding

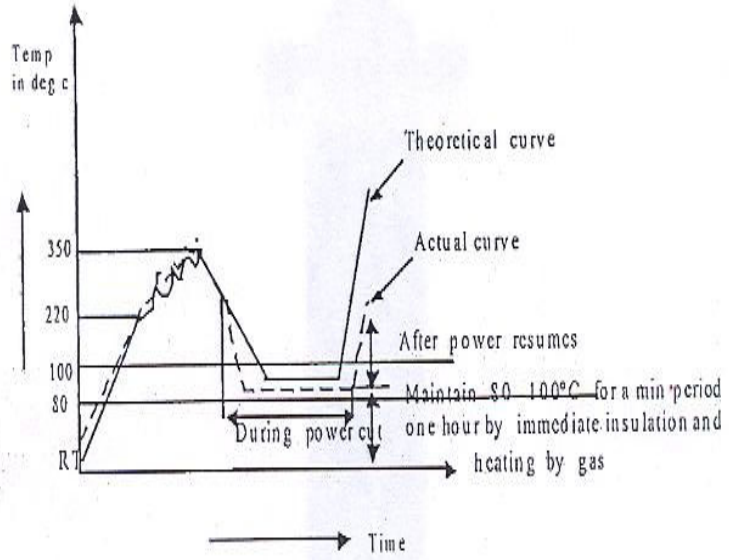


Fig - 5

Power Failure during PWHT heating cycle

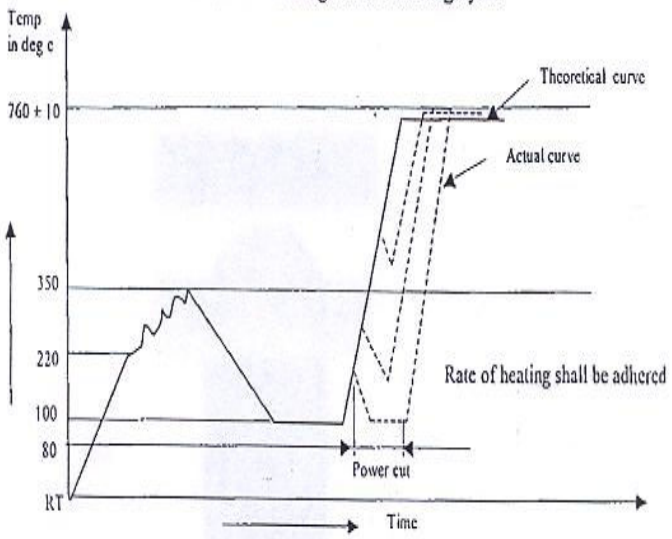


Fig - 6

Power Failure during PWHT soaking cycle

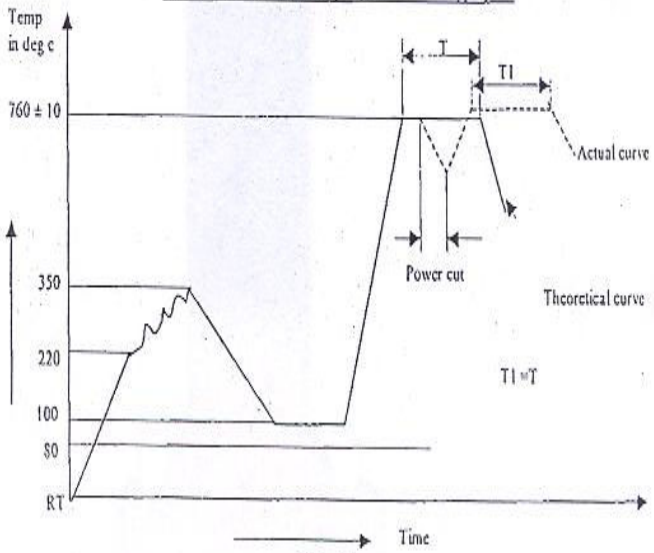


Fig - 7

Power Failure during PWHT cooling cycle

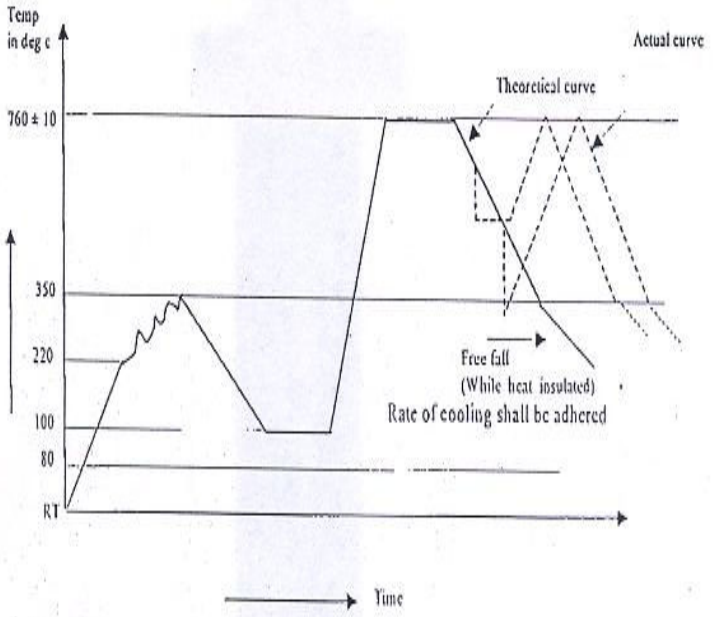


Fig - 8

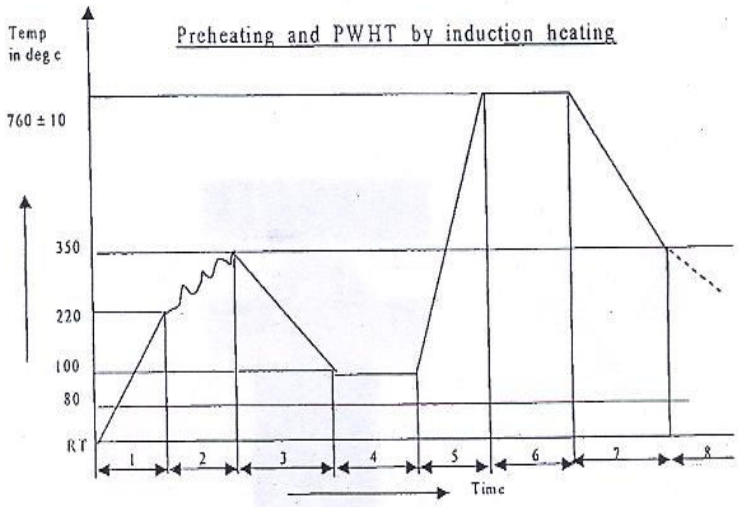


Fig -9

Slno	operation	Temp °c	Rate of cooling/Heating
1	Preheat	220° C	100 °C/hr
2	Welding by GTAW+SMAW	220°C-350°C	
3	Cooling	80 - 100 °C	100 °C/hr
4	Holding at 80-100 °C for min 1 hr.Holding shall continue till the start of PWHT		
5	Heating to PWHT	Reach 760 ±10 °C for P91 + P91	As per clause 5.1
6	Soaking at PWHT	760 ± 10 at 2.5minutes /mm (minimum 2 hrs)	
7	Cooling	Cooling to 350 °C	As per clause 5.1
8	Cooling	Cooling to Room temperature under insulation	

NOTE 1.Purging shall be ensured for minimum root and two further passes of SMAW.
2.Ensure removal of all purging dam arrangements after welding..
3.For electrodes details strictly follow WPS/EWS.

5.7 CALIBRATION

All equipments like recorder, thermocouple, compensating cable, oven thermostat etc. should have valid calibration carried at BHEL approved labs. The calibration reports shall be reviewed and accepted by Calibration In-Charge at site prior to use.

6.0 **NONDESTRUCTIVE EXAMINATION**:

6.1 All NDE shall be done after PWHT only.

Prior to testing all welds shall be smoothly ground.

All welds (fillet & butt) shall be subjected to MPI (MPI shall be done by YOKE type only).

In addition to MPI, butt-welds and all full penetration welds shall be examined by UT.

LPI procedure shall be BHE: NDT : PB : PT : 01 – Rev 13 and

MPI procedure shall be BHE : NDT : PB : MT : 05 Rev 02

The penetrant materials (Dye Penetrant, Solvent cleaner & Developer) and medium (dry /wet particles) used in MPI shall be of BHEL approved brands only.

UT procedure shall be as per BHE:NDT:PB:UT21 – Rev 04 with additional requirements as in (a) through (c)

a. The calibration blocks used shall be of same material specification (P91) dia & thickness.
b. The UT equipment shall be calibrated prior to use and should be of 'digital type' – Krautkramer Model USN 50 of equivalent, capable of storing calibration date as well as ultrasonic test results as per UT-21 / Rev 04.
c. All recordable indications will be stored in memory of – either the digital flaw detector or a PC for review at a later period.
d. The equipment calibration data for specific weld as well as the hard copy of 'Static echo-trace pattern' – Showing the flaw – echo amplitude with respect to DAC, flaw depth, projection surface distance (probe position) and beam – path shall be attached to UT test report. This hard – copy of echo-trace with equipment calibration data will form part of test documentation.
e. The examination as well as evaluation will be performed by a qualified Level II personnel, and a test report will be issued. Any defect noticed during NDT shall be marked with marker.

7.0 REPAIR OF WELD JOINTS**:**

(A) WELD REPAIR AT ROOT:

On visual examination during root welding if it reveals any surface defects, the same shall be removed by grinding maintaining temperature 80 – 100 deg. C and rewelded with GTAW maintaining 220 deg. C before starting SMAW.

(B) **WELD REPAIR ON COMPLETION**:

Any defect observed on the weld shall be brought to the notice of Quality assurance engineer. The size and nature of defect shall be reviewed. Any repair on weld to be carried on their approval only.

If any defects are noticed on the fully completed weld while performing U.T. after completion of PWHT, the same may be assessed in order to find the seriousness of the defect and to locate where exactly the defect lies from the weld outside surface. The defect area shall be marked and repaired as below:

a) The weld shall be removed by grinding (**gouging not permitted**) such that the area for repair welding is free from sharp corners and provided with sufficient slope towards the weld face sides. Incase of cut & weld joints HAZ (=5 mm) will have to be removed by grinding.

b) Surface examination (MPI / LPI) on the ground and welded area to be performed to ensure a sound base metal before depositing weld layers using SMAW.

c) The temp. of the weld is to be maintained at preheat temp.

d) Carry out SMAW using the same procedure as that of welding.

e) All the specified precautions w.r.t to welding consumables, heating cycles, post weld heat treatment etc. as followed for original welding, shall be strictly adhered.

f) The NDE shall be conducted for the entire weld joint.

g) If any further defects are observed on the repaired weld, the same may be further reworked as mentioned above.

8.0 HARDNESS SURVEY

The equipment recommended to measure the hardness are EQUOTIP **or** MICRODUR **make or equivalent portable equipment.**

The equipment used for the hardness measurement shall be calibrated as recommended by the manufacturer and also on a P91 calibration block provided by PC.

The surface shall be cleaned and prepared as per hardness test instrument manufacturer's recommendation prior to hardness survey.

Hardness survey shall be done on each joint at three locations along the circumference. At each location three readings shall be taken on weld and parent metal. The readings on the parent metal shall be taken within 15 mm from the weld fusion line.

All the hardness values shall be recorded.

The max allowable hardness at weld and parent metal shall be 300 HV10. Joints having hardness above 300 HV shall be reheat treated and hardness shall be checked again. If hardness is still more refer to unit.

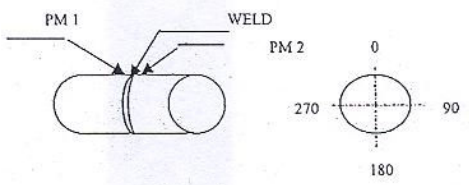


Figure - 10

LOCATION	PM 1				WELD				PM 2			
READINGS	1	2	3	AVE	1	2	3	AVE	1	2	3	AVE
0												
90												
180												
270												

PM : PARENT MATERIAL AVE : AVERAGE

9.0 COMBINATION WELDING

For other combination of material like P22 with P91, and X22 with P91 the applicable WPS for the involving material shall be obtained from equipment supplier / WTC / PC and the same shall be used.

9.1 SOAKING TIME FOR COMBINATION WELDING

WPS No	Material	Temp.	Soaking time
1035 MS W0454	P91 + P22	$745+15^0C$	2.5 mts / mm minimum one hour
	P91 + X22	$750 + 10^0C$	2.5mts / mm minimum two hour for thickness Up to50 mm and minimum four hours for thickness above 50 mm.

However the precautions as required for P91 shall be fully taken care of.

10.0 DEMAGNETISATION

In case magnetization is noticed on the pipes, the following procedure shall be Followed during welding.

Use Residual field-indicator at one end of pipe and measure the residual field. Note reading and direction of field (+ ve or – ve & No units)

IIIIIIIIIIIIIIIIIIIIIIIIIIIIIIII

+ 10 0 - 10

Indicator may show readings greater than + or – 10 Divisions. A small size electrode or gem clip will get attracted & stick to pipe.

Wrap insulated welding cable 5 turns – clockwise on the OD surface or pipe.

Wrapped cable to be 50 to 100 mm away from joint end.

One cable end connect to ÷ ve terminal of welding generator and the other to – ve terminal.

Complete electrical circuit & pass 400 amps current for 3 to 4 seconds.

Measure residual field now at the same end of pipe.

If demagnetization is effective the reading will come closer to 'O'

For eg. If it is formerly > + 10 Divisions, it may show – 5 Division.

The electrode or gem-clip will not stick to pipe – end.

If de-magnetization is NOT effective

The readings will be greater in the same direction

The gem clip / electrode will Still stick to pipe, Then repeat the following.

Now wrap the insulated cable (5 turns) in anti-clockwise direction pass current slightly excess of 400 Amps

Reduce the current gradually to 0 amps in one minute when current is on. Check for demagnetization using gem-clip / electrode. The gem-clip/electrode WILL NOT GET attracted.

If the reading is shifted to opposite direction, reverse the turns.

11.0 TRAINING

11.1 The personnel engaged in P91 piping fabrication shall be trained in the following areas.

a. Method and Care during fit-up
b. Argon gas root purging arrangement
c. Fixing of thermocouple and wires.

d. Arrangements for Pre/Post heating requirements and methods.
e. Adjustment of heating pads / cables at the time of controlling the temperature within specified tolerance limits during welding or PWHT in case of induction heating.
f. Good appreciation of the WPS requirements.
g. Handling of P91 welding consumables and re-drying conditions.
h. Special precautions during the power / equipment failure.
i. Weld joints of dissimilar thickness / material specification.
j. Weld defect control and weld repair system.

11.2 SPECIFIC TRAINING FOR WELDERS

a. The qualified welders who will be engaged in P91 welding shall be given training or pipe joints simulated with P91 welding and heating cycle conditions.
b. The acquaintance on welding positions, as applicable shall be given using P91 pipes and P91 welding consumables.
c. Welding techniques and instructions on Do's and Do Nots of P91 welding.
d. Welders only who are qualified on P91 welding alone shall be engaged. Whenever new welders have to be engaged they shall undergo all the training as above and shall be qualified with P91 material only.

11.3 CONTROL ON WELDERS

The welder during welding at site follow the following procedures.

The welder shall interact with the HT operator (Induction equipment operator) to ensure that preheat and interpose temperature during welding are maintained as per requirements.

The welder shall not mix the welding electrodes with that of the other welder. At the end of the shift, the unused electrodes shall be returned to the stores.

11.4 PERSONNEL / CONTRACTORS ENGAGED FOR HEATING CYCLES (HT Operator)

11.4.1 The Personnel / Contactor shall have adequate heat treat experience on P91 or similar material.

11.4.2 HT operator shall be aware of the following :

a. The equipment used and its working principle and operation.
b. The procedures to be followed in using heating equipments.
c. Procedure to be followed in case of power failure or equipment non-functioning so that heating cycle is not disrupted.
d. Calibration of equipments
e. Method of fixing thermocouples and compensating cables leading to HT recorder.
f. Fixing of heating pads or elements on the pipe joints and also in maintaining the temperature within the specified limits.

11.5 NDE PERSONNEL QUALIFICATIONS

All NDE personnel performing NDT like UT & MPI / LPI shall be qualified in accordance with BHEL Procedure meeting the requirements of recommended practice SNT – TC – 1A.

MPI & LPI shall be carried out by level I qualified personnel and shall be evaluated by level II qualified personnel. However UT examination and evaluation shall be done by level II qualified personnel.

11.6 LEVEL OF SUPERVISION

Site in-charge Shall be responsible for the completion of all activities from weld fit-up to final clearance of weld joints after satisfactory NDE and acceptance by BHEL/Customer / IBR.

12.0 DO's and DON'Ts during P91 welding, heat treatment and NDE at construction site.

12.1 DO's

a. Cutting by Band saw / Hack saw / Machining
b. Pipes Edge Preparation by machining. Machining shall be done without excessive pressure to prevent heating up of pipe.
c. Grinding may be done on exceptional cases after approval and taking adequate care to prevent overheating.
d. Thermocouple wire (hot/Cold junctions) shall be welded with condenser discharge portable spot-welding equipment.
e. Reserve Thermocouples shall be made available, incase of failure of connected thermocouple elements.
f. Ensure adequate Argon Gas for complete purging of air inside the pipe before starting GTAW root welding.
g. Ensure Preheating at 220 Deg. C minimum before GTAW root welding.
h. Start preheating only after clearance from Welding engineer / Quality assurance engineer for weld fit-up and alignment of the joint as well as fixing of Thermocouple connections (for Induction heating)
i. Do visual inspection on root weld maintaining weld preheating temp.
j. Continue Argon purging until the GTAW root welding followed by minimum two filler passes SMAW, is completed.
k. Perform partial root welding to facilitate fit-up if necessary.
l. Ensure that only one layer of root welding using TGS 2 CM filler wire (2 ¼ Cr 1 Mo) is deposit (wherever specified).
m. Ensure proper use of TIG wires as identified by colour coding or suitable hard punching.
n. Keep the GTAW wires in absolutely clean condition and free from oil, rust, etc.
o. Dry the SMAW electrodes before use.
p. Ensure the interpass temperature is less than 350 Deg.C.
q. Hold at 80-100 Deg. C for a period of Minimum 1 hour before the start of PWHT.
r. Record entire heating cycle on Chart through recorders.

s. Exercise control during grinding of weld and adjoining base metal while removing surface / sub-surface defects or during preparation for NDE.
t. Ensure no contract with moisture during preheat, welding, post heat and PWHT of weld joints.
u. Ensure removal of argon purging arrangements after welding.
v. Use short Arc only. The maximum weaving shall be limited to 1.5 times the dia of the electrode.

13.0 **DON'Ts**

a. Avoid Oxy-Acetylene flame cutting.
b. Avoid Weld-build up to correct the weld end-di or to set right the lip of the weld bevel.
c. Avoid Are strike on materials at the time of weld fit up or during welding.
d. Do not Tack weld the thermocouple wires with Manual Are/TIG welding.
e. NO GTAW root welding without thorough purging of root area.
f. Do not use Oxy-acetylene flame heating for any heating requirements.
g. Do not use Thermal chalks on the weld groove.
h. Do not stop argon purging till completion of GTAW root welding and two layers of SMAW.
i. No Tack welding or Bridge piece welding is permitted.
j. Do not use unidentified TIG wires or electrodes.
k. Do not exceed the maximum interpass temperature indicated in WPS
l. Do not allow moisture, rain, water, cold wind, cold draft etc. to come in contact with the weld zone or heating zone during the entire cycle from preheat to PWHT.
m. Do not exceed the limits of PWHT soaking temperature.
n. Do not Interrupt the Welding / heating cycle except for unavoidable power failures
o. Do not use uncalibrated equipment for temperature measurement during heating, welding, post weld, heat treating etc.,

14.0 **NDE Consumables**

Technically approved Brands by BHEL HPBP.

1. Liquid Penetrant, Penetrant Remover (Solvent cleaner) and Aerosol Developer from the same manufacturer considered as a family group.

VENDOR	BRAND		
	PENNETRANT	PENNETRANT REMOVER	DEVELOPER
ITW SIGNODE INDIA LTD.,	SPETCHECK SKL-SP	SPOT CHECK SKC-1	SPOT CHECK SKD-S2
P.MET CO.,	FLAW CHECK a. PP - 15 b. PP – 110	FLAW CHECK a. PP - 21 b. PP – 120	FLAW CHECK a. PD – 31A b. PD – 131A
CHECK MATE CHEMICALS (P) LTD.,	CHECK MATE SUPER PT 97	CHECK MATE SUPER CL 96	CHECK MATE SUPER DV 98
PRADEEP METAL TREATMENT CHEMICAL (P) LTD.,	FLAW GUIDE GP	FLAW GUIDE GP	FLAW GUIDE GP
FERROCHEM	CRACK CHECK FC 911	CRACK CHECK FC 911	CRACK CHECK FC 911

2. Dry Magnetic powder:

   a. MAGNAFLUX – PRODUCT GREY; 8A – RED
   b. FERROCHEM PRODUCT NO : 266
   c. K-ELECTRONICS PRODUCT – RD – 200 (SPECIAL)

3. Non-fluorescent magnetic ink:

(Prepare bath as instructed by supplier)

   a. MAGNAFLUX – Product 9C RED with MX/MG carrier II oil vehicle.
   b. FERROCHEM – PRODUCT NO: 146 A with oil vehicle (with high flash point 92^0C)

c. SARDA MAGNA CHECK INK with oil vehicle (with high flash point 92^0C)

4. Fluorescent magnetic ink:

(Prepare bath as instructed by supplier)

a. MAGNAFLUX – Product 14A with MX/MG carrier II oil vehicle.
b. MAGNA FLUX – Product 14 AM - Prepared bath of 14A and MG/MX carrier II ready to use without measuring and Mixing in aerosol container with MS/MG carrier II oil vehicle.

15.0 DOCUMENTATIONS

The documentation shall be as per the customer approved BHEL Quality Plan.

Annexure 1A

KRISHNAPATNAM 2 X 800 MW UNIT-

WEIGHT SCHEDULE – *BOILER, ROTATING EQUIPMENTS & AUXILIARIES*

SUMMARY

Sl.No.	***DESCRIPTION***	***WEIGHT IN MTPER UNIT***	***WEIGHT IN MT FOR TWO UNITS***	***Rate Schedule ID as in Price bid***
1	*STRUCTURES*	***11846***	***23692***	***1A***
2	*PRESSURE PARTS*	***9633***	***19266***	***1B***
3	*NON-PRESSURE PARTS*	***7392***	***14784***	***1C***
4	*ROTATING EQUIPMENTS*	***1898***	***3796***	***1D***
	TOTAL WT IN MT PER UNIT (Approximately)	***30769***	***61538***	

Note:
Note in the tender is applicable

Volume 1A **PART –II ANNEXURE- 1D PGMA WISE WEIGHT SCHEDULE**			
PRESSURE PARTS:PG-04,05,06,07,08,09,10,11,12,15,16,17,18,19,20,21,24,97			
PG	**MA**	**PGMA Description**	**Weight(kg)**
04	146	Supp. for collecting	10000
04	321	Sep Vessels With In	30000
04	323	Coll Vessels With	50000
04	988	Commg spares-Support	100
		TOTAL WEIGHT OF PG-4	**90100**
05	137	Inlet Front Lower Ww	16000
05	147	Inlet Rear Lower Ww	16000
05	155	Inlet Side Lower Ww	10000
05	227	Waterwall Rear Hange	10000
05	231	Outlet Front Upper W	10000
05	251	Outlet Side Upper Ww	17000
05	327	Rear Intermediate Ha	10000
05	331	Fbhe Evap Inlet Head	10000
05	351	Fbhe Evap Right Wall	18000
		TOTAL WEIGHT OF PG-5	**117000**
06	400	Unclassified Burner	80000
06	500	Burner Panels With A	20000
06	731	Front Upper Ww Pnl +	120000
06	734	Front Intermediate W	85000
06	737	Front Ww Lower Panel	70000
06	741	Rear Upper Ww Pnl +	70000
06	744	Rear Intermediate Ww	100000
06	747	Rear Lower Ww Pnl +	70000
06	751	Side Upper Ww Pnl +	150000
06	753	Side Intermediate Ww	150000
06	755	Side Lower Ww Pnl +	40000
		TOTAL WEIGHT OF PG-6	**955000**
07	102	Downcomer Piping-Con	70000
07	108	Down Comer Piping Up	10000
07	215	Relief Tubes From Si	40000
07	216	Relief Tubes From Re	30000
07	218	Relief Tubes From Fr	30000
07	223	Furnace Screen Tubes	40000
07	225	Furnace Rear Hanger	20000
07	231	Lower Corner Transit	10000
07	232	Upper Corner Transit	12000
07	402	Ww Front Header Susp	8000
07	403	Ww Side Header Suspe	10000

07	404	Ww Hanger Header Sus	10000
07	405	Ww Screen Header Sus	10000
07	406	Furnace Inter Header	4000
07	407	Furnace Interheader	4000
07	408	Furnace Interm Heade	8000
07	409	Furnace Wall Suppor	20000
07	410	Downcomer Suspension	10000
07	411	Module Supports&Susp	25000
07	412	Support-Dc&Disch Pip	25000
07	420	Downcomer Guides	8000
07	431	Riser Tube Support	10000
07	500	Misc Components - Pr	10000
07	601	Pressure Seals	5000
07	991	Indegenous Electrode	100
07	992	Imported Electrodes	100
07	993	Consumables & Erecti	5000
		TOTAL WEIGHT OF PG-7	**434200**
08	001	Furnace Upper Buckst	141200
08	003	Furnace Upp.Inter Bu	225800
08	006	Furnace Inter.Buckst	174400
08	007	Furnace Lower Buckst	156100
08	111	Furnace Rear Arch Bu	73200
08	380	Furnace Bottom Suppo	91300
08	382	Furnace Bottom Suppo	91300
08	400	Furnace Guide	12800
08	501	Furnace Backpassbuck	148300
08	503	Furnace Back Pass Bu	170900
08	901	Furnace Key Buckstay	8800
08	907	Furnace Key Buckstay	3900
08	910	Ex.Movement Measurem	2000
		TOTAL WEIGHT OF PG-8	**1300000**
09	001	Seal Boxes For Furna	5000
09	002	Seal Boxes For Instr	2000
09	003	Material For Instrum	2000
		TOTAL WEIGHT OF PG-9	**9000**
10	174	Vertical Spaced Sh C	30000
10	178	Vertical Platen Sh 1	27000
10	182	Sh Rear Wall Inlet H	25000
10	183	Sh Frontwall Inlet	26000
10	184	Sh Extended Side Wal	15000
10	185	Sh Rear Roof Inlet H	20000
10	191	Sh Radiant Wall Roof	10000

10	274	Vertical Spaced Sh C	50000
10	278	Vertical Platen Sh O	32000
10	283	Sh Frontwall Outlet	25000
10	284	Sh Extended Side Wal	15000
10	285	Front Wall Sh Outlet	35000
10	291	Sh Radiant Wall Roof	26000
TOTAL WEIGHT OF PG-10			**336000**
11	074	Sh Vert Spcd Front C	300000
11	078	Sh Vertic1l Platen C	160000
11	374	Sh Vertical Spaced C	300000
11	378	Sh Vertical Platen C	160000
11	606	Sh Front Upper Panel	25000
11	608	Sh Front Lower Panel	25000
11	684	Sh Extended Side Wal	25000
11	694	S.H.Extended Bottom	15000
11	716	Sh Rear Upper Pnl +	16000
11	717	Sh Rear Inter Pnl +	16000
11	718	Sh Rear Lower Pnl +	18000
11	767	Sh Stm Cool Side Wal	25000
11	768	Sh Stm Cool Side Wal	25000
11	769	Sh Stm Cool Side Wal	25000
11	787	Sh Rear Roof Panel +	25000
11	791	Sh Radiant Wall Roof	30000
11	916	Sh Stm Cool Rear Wal	16000
11	917	Sh Stm Cool Reor Wal	16000
11	918	Sh Stm Cool Rear Wal	18000
11	967	Sh Stm Cool Side Wal	25000
11	968	Sh Stm Cool Side Wal	25000
11	969	Sh Stm Cool Side Wal	25000
11	987	Sh Stm Cool Rear Roo	25000
11	991	Sh Radiant Roof Pane	30000
TOTAL WEIGHT OF PG-11			**1370000**
12	178	Sh Vertical Platen I	30000
12	184	Roof Inlet Sh Pipes	40000
12	187	Sh Inlet Rear Roof P	25000
12	803	Sh Steam Cooled Spac	10000
12	805	Super Heater Hanger	40000
12	850	Sh Conn Pipes-Satura	30000
12	852	Sh Desh Links	40000
12	900	Sh Desh	7000
12	903	5h Miscl Components	125000
12	906	Sh Suprts For Lines	30000
12	914	Suspension Of Sh Rad	8000

12	917	Suspension Of Radian	8000
12	924	Suspension Of Sh Bac	40000
12	927	Suspension Of Rear R	6000
12	928	Suspension Of Sh Rea	20000
12	944	Suspension Of Sh Pla	6000
12	948	Suspension Of Vertic	50000
12	954	Suspension Of Vertic	6000
12	968	Suspension Of Platen	30000
12	991	Indegenous Electrode	100
12	992	Imported Electrodes	100
12	993	Consumables & Erecti	3000
TOTAL WEIGHT OF PG-12			**554200**
15	136	Ltrh Inlet Header	10000
15	177	Rh Vertical Spaced R	36000
15	236	Ltrh Outlet Header	40000
15	279	Rh Vertical Platen F	50000
TOTAL WEIGHT OF PG-15			**136000**
16	079	Rh Ver Platen Front	125000
16	235	Rh Hor Spaced Coil	270000
16	236	Rh Hor Spaced Upper	270000
16	238	Htrh Coil	270000
16	379	Rh Ver Platen Front	125000
TOTAL WEIGHT OF PG-16			**1060000**
17	174	Rh Vertical Spaced I	85000
17	776	Rh Ver Spaced Centre	150000
17	903	Rh Miscellaneous Com	2000
17	904	Rh Hdr Suprts & Susp	30000
17	906	Rh Suprts For Lines	30000
17	919	Rh Front Suspension	30000
17	929	Rh Rear Suspension	30000
17	991	Indegenous Electrode	100
17	992	Rh Site Electrodes I	100
TOTAL WEIGHT OF PG-17			**357200**
18	002	First Pass Roof Skin	20000
18	003	Second Pass Roof Sk9	10000
18	010	Pr Pts Attachmnts In	10000
18	020	Vibration Snubbers	5000
TOTAL WEIGHT OF PG-18			**45000**
19	701	Inlet Eco Headers	40000
19	702	Outlet Eco Headers	35000

19	753	Headers Of Rear In	10000
19	763	Headers Of Front In	10000
19	783	Headers Of Centre In	10000
19	793	Headers Of Centre In	10000
19	802	Eco Hanger Tubes	150000
19	814	Economisercoil Assy	350000
19	824	Economiser Coil Assy	350000
19	850	Eco Feed Pipe	40000
19	851	Eco Links To Drum	170000
19	852	Hp Economiser-I To E	50000
19	903	Eco. Miscellaneous C	5000
19	904	Eco Suprts & Suspens	50000
19	905	Eco Suprts & Suspens	10000
19	906	Eco Suprts For Lines	30000
19	907	Eco Supports/Feed Pi	20000
19	914	Econ-Miser Coil Assy	350000
19	924	Economiser Coil Assy	350000
19	991	Indegenous Electrode	100
19	992	Imported Electrodes	100
TOTAL WEIGHT OF PG-19			**2040200**
21	600	Soot Blower Piping A	26000
21	601	Sootblower Piping Su	16000
21	700	Bulked Bps Component	2865
21	800	Sb Valves (Bhel)	3000
21	825	Sb Valves (Sub Deliv	2000
21	850	Soot Blower Safety V	60
21	992	Imported Electrodes	75
TOTAL WEIGHT OF PG-21			**50000**
24	316	Rh Desh	10000
24	350	Boiler Filling Pipin	3500
24	351	Hangers And Supports	900
24	700	Bulked Bps Component	1200
24	800	Boiler Trim Piping	105350
24	801	Supports For Trim Pi	29950
24	805	Link To Boiler Recir	80563
24	806	Mixing Vessel	11659
24	807	Recircu Pump Suction	41574
24	808	Recircu Pump Dischar	37381
24	809	Boilr Recircu Link F	21217
24	810	H And S For Startup	13000
24	815	Desuperheater Pipes	9113
24	820	Exhaust Pipe For Saf	60375
24	825	Silencer Supports	36663

24	835	Startup Vent Diffuse	4563
24	840	Sample Cooler And Su	1144
24	855	Recirculating Pumb C	40313
24	860	Valves (Bhel)	85613
24	864	Valves Sub_Delivery	3588
24	865	Valves Subdelivery	5200
24	866	Valves For Boiler Pi	1250
24	867	Valves For Startup R	6250
24	874	Cooler Strainer As	1000
24	875	Headers For Trim Pip	3625
24	880	Safety Valves	4000
24	881	Safety Valves And Er	1250
24	882	Safety Values Sub_De	1200
24	885	Silencers	87250
24	886	Silencers - Sd	12500
24	950	Special Tools	225
24	955	Lapping Tools For Sv	150
24	960	Lapping Tools For Co	50
24	992	Imported Electrodes	88
24	993	Consumables & Erecti	31
24	994	Name Plates	388
TOTAL WEIGHT OF PG-24			**722123**
80	300	MS FROM SUPER HEATER TO BOILER STOP VALVE	50000
80	301	MS FROM BOILER STOP VALVE TO ESV	7000
TOTAL WEIGHT OF PG-80			**57000**
97	297	Mtm Clamps And Pads	50
TOTAL WEIGHT OF PG-97			**50**
TOTAL WEIGHT OF PGs 04-12,15-19,21,24,80,97			**9633073**
TOTAL WEIGHT OF PRESSURE PARTS:9633 MT			
97	297	Mtm Clamps And Pads	50
TOTAL WEIGHT OF PG-97			**50**
TOTAL WEIGHT OF PGs 04-12,15-19,21,24,97			**9576073**
TOTAL WEIGHT OF PRESSURE PARTS:9576 MT			

Volume 1A **PART –II** ANNEXURE-1E PGMA WISE WEIGHT SCHEDULE			
NON PRESSURE PARTS: PG-20,28,30,41,42,43,45,48,50,57&99			
PG	MA	PGMA Description	Weight(kg)
20	51	Long Retractable Soo	144475
20	054	Wall Box Non Pressur	3220
20	201	Wall Deslagger Rw5e	15360
20	204	Wall Box Non Pressur	1900
20	794	Wall Box Non 7ressur	70
20	962	Temp Probe Duplex Wi	2800
20	988	Sdot Blower Commissi	8
20	998	Special Tools For So	7
TOTAL WEIGHT OF PG-20			**167840**
28	220	Doors	14000
28	700	Bps Fasteners	1000
TOTAL WEIGHT OF PG-28			**15000**
30	103	Seal Plate Assy	5500
30	105	Furnace Bottom Enclo	12000
30	211	Furnace Rear Arch En	8500
30	212	Furnace Extd Side Bo	6500
30	215	Main Boiler	20000
30	219	Vertical Roof Enclos	85000
30	220	Deck Support And Sea	90000
30	223	Gas Distribution Baf	4500
30	235	Enclosure Support St	35000
TOTAL WEIGHT OF PG-30			**267000**
41	350	Air Cooled Oil Gun A	1800
41	390	Oil Gun Vice Assy An	1800
41	500	High Energy Arc Igni	900
TOTAL WEIGHT OF PG-41			**4500**
42	001	Pneumatic Fittings	600
42	002	Steam Blow Materials	2000
42	005	Instrument Fittings	500
42	010	Lfo Pump Set	5000
42	020	Hfo Pump Set	15000
42	030	Hfo Heater Set	47000
42	046	Drain Oil Pump-Motor	1000
42	065	Drain Oil Tank	8000
42	070	Burner Station Skid	7200
42	120	Piping, Pump House-F	20000
42	128	Piping,Pump House St	600

42	152	Piping,Opr'G Floor L	2000
42	153	Piping,Opr'G Floor H	8000
42	154	Piping,Opr'G Floor D	3000
42	157	Piping,Opr'G Floor A	2500
42	158	Piping,Opr'G Floor S	4500
42	200	Subdelivery Fuel Oil	2000
42	300	Bhel Valve F.O. Syst	6000
42	358	Bhel Valve,Opr'G Flo	2000
42	700	Bps Fasteners	3000
42	800	Electric Tracer,Fuel	1500
42	992	Imported Electrodes	100
TOTAL WEIGHT OF PG-42			**141500**
43	004	Assy Comp Scanner &	2800
43	005	Assy Comp Mill Seal	28250
43	104	M/C Comp Scanner & G	19500
43	105	M/C Comp Mill Seal A	36000
43	200	Subdel,Ignitor&Scann	10000
TOTAL WEIGHT OF PG-43			**96550**
45	321	Wind Box Support 32	12000
45	325	Windbox For One And	100000
45	326	Windbox For Two And	101000
45	804	Wind Box Assy	28000
TOTAL WEIGHT OF PG-45			**241000**
47	221	Fuel Piping Supports	60000
47	223	Pipe Couplings,Orifi	24300
47	229	St Pipes,Shop Bends	450000
TOTAL WEIGHT OF PG-47			**534300**
48	012	Rect Duct Bet F.D F	226000
48	014	Expn Piecesbet F.D F	13000
48	015	Supportsetcbet F.D F	25000
48	019	Foundation Materials	7000
48	022	Rect Duct Sec.Air I	24000
48	32	Rect Duct A.H Bypas	60000
48	112	Rect Ducts Pri Fan T	195000
48	114	Expn Piecespri Fan T	15000
48	115	Supportsetcpri Fan T	32000
48	132	Rect Duct Pri Air F	127000
48	141	Seal Air Hag And Id	17000
48	142	Rect Duct Coldairbu	140000
48	144	Expn Piecescoldairbu	12000
48	145	Supportsetccoldairbu	17000

48	152	Rect Duct Pri Air F	11000
48	200	Instrument Tappings	15000
48	202	Rect Ductsairheater	251000
48	204	Expn Piecesairheater	23000
48	205	Supportsetcairheater	46000
48	207	Flowmeters For Secon	42000
48	212	Wind Box Connecting	44000
48	214	Expn Pieceswindbox C	23000
48	222	Rect Duct-Airheater	142000
48	224	Expn Piecesairheater	17000
48	225	Supports For Hot P.A	21000
48	232	Rect Ducts Hot Air B	90000
48	234	Expn Pieceshot Air B	12000
48	235	Support Hot Air Bus	41000
48	382	Rect Duct Economise	224000
48	384	Expn Pieceseconomise	41000
48	385	Supportsetceconomise	42000
48	386	Duct Below Divertor	466000
48	432	Rect Duct Airheater	186000
48	434	Expn Piecesairheater	10000
48	435	Supportsetcairheater	30000
48	462	Rect Duct Boiler Ou	455000
48	464	Expn Piecesboiler Ou	44000
48	465	Bof To Ep Ducting Su	26000
48	662	Rect Duct Hot Air B	94000
48	664	Expn Pieceshot Air B	22000
48	665	Supports For Hot Pa	23000
48	667	Venturi-Primary Air	26000
48	700	Bulked Bps Component	17000
48	891	Primary Air Pre Heater	600000
48	892	Secondary Air Pre Heater	1200000
48	993	Erection Materials	4000
TOTAL WEIGHT OF PG-48			**5198000**
50	510	SCAPH	12000
TOTAL WEIGHT OF PG-50			**12000**
57	010	GATE FAN OUTLET	40000
57	013	DAMPERS BET FD FAN & A	33500
57	033	SA SCAPH INLET DAMPER	72000
57	110	GUILLOTENE GATE PA FAN	40000
57	113	DAMPERS BETWEEN PAFAN	17000
57	133	SEAL AIR HAG AND ID FA	36000
57141	141	DAMPER COLD AIR BUS(TE	15000
57	143	COLD AIRGATE, AIRBUS T	6500

57	160	DAMP APH TO WINDBOX DU	28000
57	203	LINKAGES FOR DAMPERS	37600
57	209	DAMP APH PRIMARY SIDE	15000
57	223	GUILLOTENE GATE DUCT T	44250
57	383	FLUE GAS SAH INLET DAM	120000
57	433	DAMPER APH BOILER OUTL	35000
57	460	GUILLOTENE GATE EP INL	86000
57	663	DAMPER HOT AIR BUS TO	7600
57	988	G&D COMMISSIONING SP	100
TOTAL WEIGHT OF PG-57			**633550**
80	920	H&S FOR HYDRO TEST	15000
TOTAL WEIGHT OF PG-80			**15000**
99	100	Fan Handling Equipme	30000
99	300	Cir.Pump,Feed Pump,H	9000
99	400	Airheater,Steamcoil	9000
99	502	Pre.Parts Handling E	8000
99	514	Furnace Cradle 4 Wal	7500
99	600	Fo System Handling E	2000
TOTAL WEIGHT OF PG-99			**65500**
TOTAL WEIGHT OF PGs 20,28,30,41,42,43,47,48,50,57,80,99			**7391740**
TOTAL WEIGHT OF NON PRESSURE PARTS-7392MT			

Volume 1A PART –II

Reference Drawings

The enclosed drawings below are for information purpose only. This may undergo revision during execution.

List of Drawings

SLNO	Descpn	Drg No
1.	Boiler Foundation Plan	0-00-281-03497/00
2.	General Arrangement (side elevation 02-02)	00109-1E0002/02
3.	General Arrangement (side elevation 03-03)	00109-1E0003/02
4.	General Arrangement (plan section 05-05)	00109-1E0005/02
5.	General Arrangement (plan section 06-06)	00109-1E0006/02
6.	General Arrangement (plan section 07-07)	00109-1E0007/02

Volume 1A Part-1 Chapter VI

Time Schedule

6.1 TIME SCHEDULE & MOBILIZATION

6.1.1 INITIAL MOBILIZATION

The contractor is required to refer Form F15 in Volume 1D for all the instructions to be taken immediately after receipt of fax LOI.

6.1.2 COMMENCEMENT OF CONTRACT PERIOD AND TENTATIVE SCHEDULE

Erection/placement on its designated foundation / location, of the first major permanent equipment / component / column covered in the scope of these specifications shall be recognized as "start of contract period". Smaller items like packer plates, shims, anchors, inserts etc. will not be considered as start of contract period.

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

Boiler and rotating Machines for KRISHNAPATNAM 2x800MW MILESTONES (ZERO DATE:29-8-2008)		
S No	**Milestone activity**	**COMPLETION**
1	Boiler Hydro Test (Drainable)	**18th month from date of commencement**
2	Boiler Hydro Test (Non Drainable)	**24th month from date of commencement**
3	Boiler Light up	**25th month from date of commencement**
4	Safety Valve floating	**28th month from date of commencement**
5	Synchronization (with oil)	**28th month from date of commencement**
6	Trial Operation	**29th month from date of commencement**
7	Commercial Operation Declaration (COD)	**30th month from date of commencement**

In order to meet the 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 Engineer.

6.1.4 **CONTRACT PERIOD**

The contract period for each unit is **30months** (thirty months)**from the "start of contract period" as specified earlier** with a maximum phase shift of 3 months for unit-2 commencement from the date of commencement of unit-1. Bidder to note that if earlier commencement for unit -2 is required at site shall be suitably advanced by the contractor

The period from the commencement of preparatory work for erection till the actual “start of contract period” shall not be reckoned for the above purpose.

Note: Each unit will be treated as separate contract as1428A for UNIT-1&1428B for UNIT-2