VOLUME – IA
Part I & II

TECHNICAL CONDITIONS OF CONTRACT (TCC)

BHARAT HEAVY ELECTRICALS LIMITED

CONTENTS

9	Format for Form no.: F-14 (Rev 01); Monthly Plan & Review with Contractor	Chapter-9	06
10	Format for Form no.: F-15 (Rev 02); Monthly Performance-Evaluation of Contractor	Chapter-10	06
11	Hire charges on issue of capital tools & Plants (Only corresponding charges)	Chapter-11	10
12	Proforma of Bank Guarantee (in lieu of Earnest Money)- Form WAM 23	Chapter-12	03
13	Proforma of Bank Guarantee (in lieu of Security Deposit)- Form WAM 22	Chapter-13	03
14	Procedure 2.3 for conduct of conciliation proceedings	Chapter-14	11

VOLUME - IA PART – I CHAPTER – I
PROJECT INFORMATION

5X800 MW SETS AT YADADRI TPS

1	Name of the Project	YADADRI Thermal Power Station
2	Station Capacity	5X800 MW (Coal based)
3	Owner	Telangana State Power Generation Corporation Limited (**TSGENCO**)
4	Site Location	Site is located 7 km from the NH565 (SH2). Veerlapalem village, Dameracherla Mandal, NALGONDA DISTRICT, TELANGANA STATE
5	Latitude	*16° 42'*20.40 N
6	Longitude	79° 34'41.56 E
7	Nearest Town	30 Km Miryalaguda
8	Nearest Railway Station	6.5 Km Damercherla
9	Nearest Airport	130 Kms (Vijayawada)
10	**Site Conditions**	
	Ambient Temperature	
	Daily minimum (average)	10°C
	Daily maximum (average)	47°C
	Design Ambient Temperature	50°C
	Ambient temperature (performance)	38°C
	Relative Humidity for design / efficiency	48-84 %
	Annual rainfall, mm	600 mm
	Plant Elevation above MSL	85 m above MSL
	Mean Wind Speed	8 km/h
	Wind Pressure	As per the latest revision of IS 875/1987
	Seismic co-efficient	Zone-II as per IS- 1893 (Part-IV)

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

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

(All the works mentioned hereunder shall be carried out within the accepted rate unless otherwise specified.)

1.2.1 Erection, Testing and Commissioning of Power Cycle Piping and all associated Piping & Insulation works including handling at site stores / storage yard, transporting to site, inspection, pre-assembly, erection, alignment, welding, NDT, fixing of hangers & supports, chemical cleaning / pickling, oil flushing, water flushing, hydro testing & steam blowing, surface finish, supply & application of primer & finish paints and application of refractory & insulation works as per requirement / as given in the drawings including labeling & flow direction on the piping / over insulation & hangers and supports, pre-commissioning, commissioning, trial operation & handing over to customer and supply & application of final painting, etc. for Unit-5 of 5X800 MW Yadadri Thermal Power Project Veerapalem Village, Dhamarchala Mandal, Nalagonda Telengana.

1.2.2 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.

1.2.3 Receipt of materials from all the BHEL Stores and Transportation to Erection site, stacking, storage and preservation.

1.2.4 The scope of works also includes Erection and Commissioning of piping including pipes, valves, flanges, fittings, fasteners etc. as required, making the system complete in all respects.

1.2.5 Erection, testing and commissioning of Flash Tanks and other miscellaneous tanks as per the shipping list provided.

1.2.6 Pre assembly, installation, testing and commissioning Trial operation of the erected equipment along with accessories.

1.2.7 Lifting, laying, bolt tensioning, bolt torque tightening, supporting and installation, pre and post weld heat treatment, inspection, non-destructive testing including radiography and hydro test, water/steam flushing, card board blasting, air drying, argon / nitrogen purging and other testing of piping installations, above and below ground.

1.2.8 Fabrication and installation, setting and commissioning of pipe supports, guides, anchors and spring supports as required.

1.2.9 Obtain Necessary Statutory clearances and approvals, co-ordination with all applicable statutory / Government agencies e.g. IBR, Electrical Inspectorate, Labour Inspectorate etc.

1.2.10 Installation and Dismantling of temporary piping.

1.2.10.1 Temporary lines for **Detergent flushing of Boiler Feed Lines, Condensate line, Drips and Drains of heaters and Any other associated piping systems 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 has to be arranged by the contractor at the rates specifically quoted / accepted for this work. After the successful completion of chemical cleaning, 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. Temporary Piping Erection related to Boiler Chemical Cleaning activity is included in the scope of Boiler Erection Contractor. However, Materials any (if required) for the completion of the Chemical Cleaning of the Boiler may be issued on returnable basis from the temporary piping materials supplied in the piping package also. After completion of the activity, all the temporary lines to be dismantled and restoration of piping to be carried out, within the quoted rates.

1.2.10.2 Temporary lines for **Steam blowing** of Power Cycle 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 has 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 the quoted rates.

1.2.10.3 Apart of clause 1.2.10.1 & 1.2.10.2 any temporary piping to be carried for commissioning of any equipment is within the quoted rates.

1.2.11 Installation of any necessary blind or additional valves to isolate lines to facilitate phased commissioning and start-up is covered under the scope within the quoted rates.

1.2.12 Execute all mechanical jobs identified during owner / Licensors check list, Technical audits, pre-commissioning and commissioning, including additional supports required to restrain pipe movement avoiding interference with nearby structural / piping.

1.2.13 Installation of all valves and other miscellaneous in line / on line items is also included. Open ends of piping valves shall be protected with wooden blanking plates securely fastened with wire or by plastic insert plugs.

1.2.14 Cleaning, pickling, if required, water / steam flushing, air drying disposal of fluids offsite, reinstatement, preservation of piping and miscellaneous items following hydro test, nitrogen purging, cleaning, chemical cleaning, painting, insulation, as per specifications is covered under the scope within the quoted rates.

1.2.15 Insulation of TDBFP Drive turbine piping only (drains, vent lines, seal steam pipelines, etc.), Heat exchangers (HP Heaters, LP Heaters, Dearator, Drain cooler, etc.), Flash tanks, MDBFP, TDBFP pumps, etc along with associated piping and insulation of all the piping covered under this scope of works are also included in the scope of this work within the quoted rates.

1.2.16 Testing of welds/flanged joints.

1.2.17 Execute final painting and labelling including supply of paints, painting of all equipments, piping (including small bore piping), and structures like platform, supports etc.

1.2.18 Preparation of As-Built Drawings.

Note to Chapter-II

i) The following materials that will go as a part of the permanent system of the plant will be supplied by BHEL at free of any charges:

Pipes, valves, flanges, fittings, fasteners.

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

iii) The welding process, weld joint and material specification indicated in the welding schedules may change to suit site requirement.

iv) Consumables are within the scope of contractor for both temporary and main piping except those which are in BHEL scope. Please refer to SCC Rev-01- Clause 4.1.1 for further details.

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
		BHEL	Bidder	
1.3.1	**PART I**			
1.3.1.1	**ESTABLISHMENT**			
1.3.1.1.1	***FOR CONSTRUCTION PURPOSE:***			
1.3.1.1.1.1	Open space for office	Yes		Free
1.3.1.1.1.2	Open space for storage	Yes		Free
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 equipment, 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	Firefighting equipment 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 of Voltage 415 / 440 V for construction purposes***			
1.3.1.2.1.1	Single point source	Yes		Free
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	

Sl No.	Description	Scope to be taken care by		Remarks
		BHEL	Bidder	
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	Calibration certificate to be provided
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	
1.3.1.2.2.4	Demobilization of the facilities after completion of works		Yes	
1.3.1.2.2.5	Demobilization of the facilities after completion of works		Yes	
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	Refer the relevant clauses elsewhere in this tender
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		Free
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	

Sl No.	Description	Scope to be taken care by		Remarks
		BHEL	Bidder	
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 equipment 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
		BHEL	Bidder	
1.3.2	**PART II**			
1.3.2.1	**ERECTION FACILITIES**			
1.3.2.1.0	Engineering works for construction	Yes		
1.3.2.1.1	Providing the erection drawings for all the equipment covered under this scope	Yes		
1.3.2.1.2	Drawings for construction methods		Yes	In consultation 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	
1.3.2.1.4	Shipping lists etc for reference and planning the activities	Yes		
1.3.2.1.5	Preparation of site erection schedules and other input requirements		Yes	In consultation with BHEL
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	

Sl No.	Description	Scope to be taken care by		Remarks
		BHEL	Bidder	
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	
1.3.2.1.9	Periodic visit of the senior official of the bidder to site to review the progress so that works is 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			Not applicable

1.3.3 **OPEN SPACE:**

1.3.3.1 Minimum Open space will be provided at free of charges to the contractor within the plant premises or adjacent to the plant boundary for construction of temporary office shed, contractor's stores shed(s). **Contractor shall adopt pre-engineered / pre-fabricated constructions made of steel with single / double skin, insulated for un- insulated roof and wall coverings (fabricated out of permanently color coated metal sheets) for his site office, covered store or any other temporary building. Alternatively, contractor can adopt readymade 'porta cabin' or similar construction.**

1.3.3.2 Only land for labour colony and staff colony will be provided by BHEL adjacent to the plant boundary to contractor at free of cost. Contractor has to make labour colony and residential accommodation to his staff at his cost.

1.3.3.3 Contractor has to furnish along with their offer, the details of requirements of area of space for his office, stores, storage shed, labour colony etc.

1.3.3.4 Location and area requirement for office/storage sheds/ fabrication yard shall be discussed and mutually agreed to.

1.3.4 **ELECTRICITY**:

1.3.4.1 The construction power (415V) will be provided at a single point for construction purpose free of charge. Construction power shall be provided from the nearest Substation / tapping point within the plant premises. For the purpose of measurement of power consumed, the contractor shall provide Energy meter with valid calibration certificate. Distribution from this

source to different locations is to be arranged by the bidder at his cost.

1.3.4.2 Electricity for labour colony and staff colony will be provided at single point on chargeable basis at the prevailing rate of TSGENCO. Distribution from this source to different locations is to be arranged by the bidder at his cost.

1.3.4.3 Any duty, deposit involved in getting the Electricity shall be borne by the bidder. As regards to contractor's office shed also, all such expenditure shall be borne by the contractor. Demand charges if any to be borne by the contractor

1.3.4.4 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.

1.3.4.5 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.

1.3.4.6 Necessary "Capacitor Banks" to improve the Power factor to a minimum of 0.8 shall be provided by the contractor at his cost. Penalty if any levied by customer on this account will be recovered from contractor's bills.

1.3.5 CONSTRUCTION WATER

1.3.5.1 Water (Raw water) shall be provided by BHEL at one point within the plant premises free of charge for construction purpose and bidder has to make their own arrangement for further distribution by arranging required pipes, valves, pumps, etc.

1.3.5.2 Water (Raw water) for labour colony and staff colony shall be provided at single point on chargeable basis at the prevailing Government Tariff and bidder has to make their own arrangement for further distribution by arranging required pipes, valves, pumps, etc.

1.3.5.3 In case of non-availability of water, the contractor shall make his own arrangements for uninterrupted work. No separate payment shall be made for any contingency arrangement made by contractor, due to delay / failure for providing water supply. Contractor has to make his own arrangements for his water requirement for his labour colony at his cost.

1.3.6 DRINKING WATER

Bidder shall provide drinking water at their cost.

1.3.7 **ONLINE SITE CONSTRUCTION MANAGEMENT SYSTEM [SCMS]:**

Contractor has to provide minimum 2 computers [along with one operator per PC] for online material management, reporting of daily progress, billing and other similar activities, within the quoted rate. Computers shall have minimum configuration of Windows 7 OS, 4GB RAM and Internet Explorer 8 or above etc.

1.3.8 **CONSUMABLES:**

1.3.8.1 Any special welding electrodes / consumables as provided by manufacturing units for Power Cycle Piping, will be supplied by BHEL free of cost. All other electrodes including stainless steel electrodes required shall be arranged by the contractor at his cost. The Contractor shall use the BHEL / Customer approved quality electrodes only. The utilization of the welding electrodes issued by BHEL shall be duly accounted for exercising maximum care and ensuring economical usage for minimum wastage. If during erection, it is found that the consumption of electrodes is more than the actual requirement by improper usage, the cost for the additional quantity so consumed shall be recovered from the contractor

1.3.8.2 The contractor shall provide within finally accepted price / rates, all consumables like welding electrodes (including alloy steel and stainless steel), all gases (inert, welding, and cutting), soldering material, dye penetrants, radiography films. Other erection consumables such as wrap cloth, tapes, jointing compound, grease, lubricants, M-seal, Araldite, petrol, CTC / other cleaning agents, grinding and cutting wheels are to be provided by the contractor. Steel, H&S, packers, shims, wooden planks, scaffolding and pre-assembly materials, hardware items etc required for temporary works such as supports, scaffoldings, bed are to be arranged by him. Sealing compounds, gaskets, gland packing, wooden sleepers, for temporary work, required for completion of work except those which are specifically supplied by manufacturing unit are also to be arranged by him.

1.3.8.3 All consumables to be used for the job shall have to be approved by BHEL prior to use.

1.3.8.4 All the shims, gaskets and packing, which go finally as part of equipment, shall be supplied by BHEL free of cost.

1.3.8.5 In the event of failure of contractor to bring necessary and sufficient consumables, BHEL shall arrange for the same at the risk and cost of the contractor. The entire cost towards this along with standard BHEL overhead shall be deducted from the contractor's immediate due bills.

1.3.9 **GASES:**

1.3.9.1 All the required gases like Oxygen / Acetylene / Argon / Nitrogen required for work shall be supplied by the Contractor at his cost. It shall be the

responsibility of the contractor to plan the activities and store sufficient quantity of these gases. Non availability of gases cannot be considered as reason for not attaining the required progress.

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

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

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

1.3.10 **ELECTRODES SUPPLY AND STORAGE**

1.3.10.1 It shall be the responsibility of the contractor to obtain prior approval of BHEL, before procurement, regarding suppliers, type of electrodes etc. On receipt of the electrodes at site, it shall be subject to inspection and approval by BHEL. The contractor shall inform BHEL details regarding type of electrodes, batch number and date of expiry etc. Test certificates for electrodes and other consumables should be submitted to BHEL Engineer as per requirement.

1.3.10.2 Shortage of any of the electrodes or the equivalent suggested by BHEL shall not be quoted as reason for deficiency in progress or for additional rate. Contractor shall submit weekly/ fortnightly/ monthly statement/ report regarding consumption and available stock of all types of electrodes for avoiding stoppage of work on consumable scarcity.

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

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

1.3.10.5 In case of improper arrangement of procurement of above electrodes BHEL reserves the right to procure the same from any source and recover the cost from the contractor's first subsequent bills at market value plus departmental charges of BHEL communicated from time to time. Postponement of such recovery is not permitted.

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

1.3.11 **MATERIAL SUPPLY:**

BHEL will supply the materials/equipment indicated in the weight schedule from their respective manufacturing units which are to be executed/incorporated in the permanent system. In addition, the material such as lube oil, grease, required for commissioning the erected equipments and chemicals required for chemical cleaning/detergent flushing of equipments will be supplied free of cost by BHEL.

1.3.12 **POSSESSION OF GENERATORS**

As there are bound to be interruptions in regular power supply, power cut/ load shedding in any construction sites, suitable extension of time, if found necessary only be given and contractor is not entitled for any compensation. It shall be the responsibility of the tenderer / contractor to provide, and maintain the complete installation on the load side of the supply with due regard to safety requirements at site. It shall be responsibility of the contractor to have at least 1 diesel operated welding generator sets to get urgent and important work to go on without interruptions. The consumables required to operate the generators are to be provided by tenderers. This may also be noted while quoting.

1.3.13 **LIGHTING FACILITY:**

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

1.3.14 **OTHER FACILITIES**

1.3.14.1 Adequate water less urinals [at least 2 nos. at suitable locations] shall be arranged by the contractor within quoted rates, at site of construction, with proper disposal arrangement.

1.3.15 **BID DRAWINGS**

1.3.15.1 Bid drawings published in this tender specification are for information and this may get revised during execution.

1.3.16 **CONTRACTOR'S OBLIGATION ON COMPLETION**

On completion of work, all the temporary buildings, structures, pipe lines, cables etc. shall be dismantled and leveled and debris shall be removed as per instructions 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.

VOLUME-IA PART-I CHAPTER – IV

T&Ps and MMEs TO BE DEPLOYED BY CONTRACTOR

1.4.1 The following minimum major Tools & Plants (T&P) shall be arranged by the Contractor within the quoted rate for execution of the scope of works covered under this contract.

Sl. No.	Description	Qty
01	Trailer (20 T/ 30 T)	As required
02	Diesel Generator (1 numbers as mentioned below) providing a rated capacity of 500 KVA as standby for P91 welding)	1 Nos **
03	Fill pump	As required
04	HT pump for hydro test (up to 50 Kg/Sq.cm) of LP piping	As required.
05	Ultrasonic Hardness Testing Machine [Ultrasonic Contact Impedance (UCI)]	As Required

**Back-up power capacity as mentioned in Sl. No.2 above can be achieved by deploying either a single DG set of 500 KVA capacity or a combination of 250 KVA or above capacity machines

1.4.2 All the T&Ps required for this scope of work, except the Tools & Plants provided by BHEL are to be arrange by the contractor within the quoted rates.

1.4.3 T&Ps mentioned above is tentative requirement considering parallel working in all areas mentioned in scope of work. However, mobilization schedule and quantity / numbers as mutually agreed at site for major T&Ps, have to be adhered to. Numbers / time of requirement of T&Ps will be reviewed time to time by BHEL site and contractor will provide required T&Ps / equipment's to ensure completion of entire work within schedule / target date of completion without any additional financial implication to BHEL. Vendor will give advance intimation and certification regarding capacity etc. prior to dispatch of heavy equipments. Also, on completion of the respective activity, demobilization of T&P in total or in part can be done with the due approval of engineer in charge. Retaining of the T&P's during the contract period will be mutually agreed in line with construction requirement.

1.4.4 Facility to be provided by Contractor for P 91 Welding

1.4.4.1 Diesel Generator, as standby supply for P91 Welding (along with required cables, switches, fuel and operator) has to be arranged by the contractor within the quoted rates. In the eventuality of contractor not making

necessary arrangements to ensure availability of DG set as per requirement at site, BHEL will arrange the same at the contractor's risk and cost. All the necessary certificates and licenses required to operate the DG set are to be arranged by the contractor then and there at his cost.

1.4.4.2 Required number of operators / Technician / Electrician for installation, Commissioning & Operating continuously.

1.4.4.3 Ultrasonic Flaw Detector with recording device & complete accessories (Digital Type-Krautkramer model USN 50 or equivalent capable of storing calibration Data. All recordable indications will be stored in memory of digital Flaw detector and in PC (to be provided by the contractor) for review at later period.

1.4.4.4 GE or Kraut Kramer or Microdur make or reputed branded ultrasonic hardness testing machine (Ultrasonic Contact Impedance (UCI))

1.4.4.5 MPI / LPI kits with consumables.

1.4.4.6 Only One set of Annealing cable (2 nos) will be supplied by BHEL irrespective of number of Induction Heating Equipments deployed by BHEL. Additional sets of annealing cables have to be arranged by the contractor within the quoted rates.

1.4.4.7 Gas Burners arrangement with required gas for maintaining temperature in the event of power failure.

1.4.4.8 Digital Temperature Indicator.

1.4.4.9 Consumables

i). Glass Fibre Cloth -1mmx1000mm–Temp Rating 1260ºC.

ii). Glass fibre cord Dia 3mm (twisted)- Temp Rating 1260ºC.

iii). Ceramic Fibre Blanket -RT Grade, density 96 kg/m^3 –Temperature rating 1260ºC.

iv). Ceramic fibre rope- Fibre Glass Braided, Dia 12 mm –Temperature rating 1260ºC.

v). K Type Thermocouple- 0.5 mm Dia Single Strand individual fibre glass insulated.

vi). Heavy Duty TC connectors for K Type Thermocouple.

vii). All other consumables / equipments to carry out the work.

1.4.5 The contractor to furnish a list of Tools and plants including cranes, tractors / trailers / trucks etc. which contractor proposed to deploy for this work.

1.4.6 Fill pumps shall be arranged by the contractor, wherever required.

1.4.7 For testing LP lines necessary Hydraulic Test pumps/ Hand pumps are to be arranged by the contractor.

1.4.8 For handling at store and transportation, contractor shall make his own

arrangement.

1.4.9 For transportation, material handling, loading & unloading of all components / equipments, the contractor has to make his own arrangements at his own cost. BHEL will not provide any crane / T&Ps for unloading the above components. All necessary T&P such as, Trailers, Cranes Winches, welding generators, Slings, Jacks, Sleepers, Rails etc. are to be arranged by the contractor.

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

1.4.11 **Required Mobile Crane for completion of piping system has to be arranged by contractor**. The age of the contractor deployed cranes upto 150 T should be within 15 years as on date of deployment. Contractor has to provide documentary proof for the age of the crane at the time of deployment to the BHEL Engineer.

1.4.12 In the event of non-mobilization of Tools, Plants, Machinery, Equipment, Material or non-availability of the same owing to breakdown and as a result progress of work suffered, BHEL reserves the right to make alternative arrangement (available or higher capacity) in line with SCC clause no. 4.2.1. 7 and hire charges shall be applicable as under:

Case 1: BHEL provides its own Capital T&P: If BHEL provides owned T&P then BHEL, hire charges (as per BHEL norms) will be recovered from the contractor as per the prevailing BHEL Corporate hire charges applicable (as enclosed in Volume I Book I TCC- Volume 1A Part II) as per following cases

- In case the T&P is specifically listed in "T&Ps to be deployed by Contractor", 'Rates of hire charges applicable to outside agencies other than contractors working for BHEL' will apply.
- In case the T&P is not specifically listed in "T&Ps to be deployed by Contractor", 'Rates of hire charges applicable to contractors working for BHEL' will apply.

The hire charges of Capital Tools & Plants are exclusive of operating expenses e.g., Operator, fuel & Consumables and the same shall be arranged by the contractor at his cost.

Case 2: BHEL provides hired T&P: In all cases other than that specified in Case 1 above, actual expenses incurred by BHEL along with applicable overheads will be back-charged to the contractor.

The present rates of BHEL's Corporate Crane hire charge, are enclosed in Chapter 11 of part II of Technical Conditions of Contract (Volume-I Book-I). This may get revised further as per the BHEL corporate guidelines. The prevailing rates as on date of execution shall be applicable.

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

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

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

1.4.16 Also Refer clauses in connection with BHEL T&Ps in chapter V of this booklet.

1.4.17 Other Relevant clauses shall be referred in Special Conditions of Contract (SCC) published in Volume IB of Book II.

1.4.18 Also refer clause 1.3.7 on providing computers in chapter-III of Technical Conditions of Contract (VOLUME-IA PART- II) of this booklet.

Note to Chapter-IV:

i) The induction heating equipment and other equipment shall be drawn from BHEL stores, transported and installed & commissioned wherever required. For routine maintenance & attending all type of break-down maintenance, contractor shall deploy sufficient manpower, tools and plant within the quoted rate.

ii) The contractor shall provide electrical cables & switches required for extending power supply to the induction heating equipment. All the equipment shall be protected by providing covers or sheds at site by the contractor with in the quoted rate.

VOLUME-IA PART-I CHAPTER - V
T&Ps & MMEs TO BE DEPLOYED BY BHEL ON SHARING BASIS

1.5.1 List of Tools & Plants to be made available by BHEL to contractor on free of hire charges on sharable basis for execution of works within the scope of this tender are as below.

Sl. No.	Description	Qty.
01	EOT Crane at TG Hall without operator	1 No.
02	Induction Heating Machines	As Required
03	Spot Welding Machine	1 No.
04	Chemical Cleaning Pumps with accessories	As Required
05	Suitable capacity Hydro Test pump for HP lines	1 No.

1.5.2 All the T&Ps mentioned in clause 1.5.1 above shall be issued to contractor on shareable basis and the allotment is made by BHEL on need basis for erection / pre-commissioning activities only.

1.5.3 Apart from the above mentioned T&Ps, any other Tools & Plants required for satisfactory completion of the work has to be arranged by the contractor.

1.5.4 EOT Crane – Allotment will be made only on need basis. Trained operators are to be arranged by the contractor within the quoted rates. Contractor has to plan the activities on item wise where the EOT crane is required to be used and submit to BHEL site for approval. In case the erection can be carried out by using other T&Ps, contractor shall make his own arrangement. The decision of BHEL Site I/c on this will be final and binding.

1.5.5 Providing manpower assistance required for free movement of trailing cable of EOT Crane is included in the scope of this contract.

1.5.6 BHEL will not provide crane operators for EOT cranes. Trained operators for EOT crane to be arranged by the contractor at his cost.

1.5.7 **P91 WELDING**

1.5.7.1 Facility and Consumables to be provided by BHEL for P91 Welding free of any charges:

a) Required no. of Induction heating machine.
b) Spot Welding machine for fixing thermocouple
c) Compensating cables.

d) Only One set of Annealing cable (2 nos) will be supplied by BHEL irrespective of number of Induction Heating Equipments deployed by BHEL. Additional sets of annealing cables have to be arranged by the contractor within the quoted rates.

e) Filler wire and Welding Electrodes for P91 Welding as supplied by manufacturing units. In case of additional requirements of the Filler Wire and Welding electrodes, the same shall be arranged by Bidder at own cost. BHEL will provide the Filler Wire and Electrodes as per the shipping list only.

1.5.7.2 For P91 welding, BHEL will only provide the facility and Consumables as indicated in TCC. Other consumables and facility required to complete the work shall be arranged by the contractor with in the quoted rate.

1.5.8 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

1.5.9 Necessary electrical / water / air connection required for operation of any of the above equipment shall be Contractor's account.

1.5.10 The Contractor shall be responsible for the safe and proper use of the above equipments issued to him. Day-to-day maintenance and operation of equipment's shall be the contractor's responsibility and shall be as per instructions / standard practice of BHEL Engineer

1.5.11 In case of non-availability of the above, due to any unavoidable reason, like breakdown, overhaul etc., the contractor shall make arrangement at his own cost to meet the erection schedules. No extra claim will be admitted due to the non-availability of any of the above equipment. No delay in execution of work shall be accepted on this account.

1.5.12 The contractor shall return the T & P issued to him by BHEL in good working condition as and when so desired by BHEL. (Completion or reduction in work load) for diversion for other work. If such return is delayed by contractor due to his fault without written consent of BHEL, hire charges as applicable according to BHEL policy will be levied from such time it was requisitioned by BHEL to the time of actual return and the amount so decided and arrived at, will be recovered from the contractor's bill.

1.5.13 Contractor shall have at all times experienced operators and technicians for routine and breakdown maintenance of the equipment. Any delay in rectification of defects will warrant BHEL rectifying the defect and charging the cost to the contractor.

1.5.14 If at any time it is noticed that contractor is not using any of the T & P or equipment properly according to the instructions of BHEL, BHEL will have the right to withdraw any and all such equipment and any cost due to this shall be contractor's account.

1.5.15 All the T&P would be issued only at BHEL stores and it shall be the responsibility of the contractor to take delivery from BHEL stores, transport the same to site and return the same to BHEL stores in good condition after use.

1.5.16 Contractor shall make good any loss or damage to the equipments supplied to him and day to day maintenance and operations of equipments shall be borne by the contractor including all consumables like petrol, oil and air filters etc.

1.5.17 Any Loss / Damage of tools by the contractor, the same shall have to be replaced by the contractor or otherwise cost thereof shall be recovered from the contractor.

1.5.18 Any loss / damage to any or part of the above equipments shall be to contractor's account and the expenditures on these account will be recovered from contractor's bills in case contractor fails to make good the loss.

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 Power Cycle Piping and all associated Piping & Insulation works for Unit#5 as detailed elsewhere in the Tender Specification shall be completed within **Twenty (20) months** from the date of commencement of work at site.

1.6.1.2. During the total period of contract, the contractor has to carry out 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 on the contractor. The scope of work under this contract is deemed to be completed only when so certified by the site Engineer.

1.6.1.4. The contractor is required to refer "Form F15: Monthly Performance Evaluation of Contractor" for all the instructions to be taken immediately after receipt of LOI. Please note that Form-15 in the Volume 1D- Forms and Procedures is revised. For details please refer Sl No. 10 of Part-II, Chapter-1 of Technical Conditions of Contract (VOLUME-IA PART II) of his booklet.

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.,

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

1.6.3.2. The contractor has to augment his resources in such a manner that following major milestones of erection & commissioning are achieved on specified schedules mentioned below.

1.6.3.3. **TENTATIVE MILESTONES:**

Milestone Activity	**Milestone Month**
Start of Erection	1st Month
Readiness for Boiler Light Up	9th Month

Milestone Activity	Milestone Month
Readiness for Steam Blowing	12th Month
Readiness for Synchronisation	15th Month
Readiness for Full Load & Trial Operation	18th Month
Completion of Contractual Obligations	20th Month

1.6.3.4. 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.

1.6.4. MAJOR INTERMEDIATE MILESTONES

Sl. No.	Milestone Description	Month	Intermediate Milestone
1.	Readiness for Steam Blowing	12th Month	**M1**
2.	Readiness for Synchronisation	15th Month	**M2**

Note: Please refer Sl No. 5 Part II Chapter-1 of Technical Conditions of Contract (Volume 1A of Volume I Book I) for Penalty for Intermediate Milestones

1.6.3 CONTRACT PERIOD

The contract period for completion of entire work under scope shall be Twenty (20) months from the "COMMENCEMENT OF CONTRACT PERIOD" as specified earlier for completion of the entire work.

1.6.4 GUARANTEE PERIOD

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 synchronization 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 **Terms of payment:**

1.7.1 The progressive payment for erection, testing and commissioning on accepted price of contract value will be released as mentioned below.

1.7.2 Progressive payment against monthly running bills will be made up to 85% of the value of the erected tonnage pro rata as per Cl. 1.7.2.1 to 1.7.2.13 of the following table.

Cl. No.	Description	Piping				Insulation
		1) P91 2) HP 3) LP 4) SS	1) H&S 2) Others	1)Tanks	1) Temp Piping Steam blowing/ Chemical cleaning	1) Fixing components 2) Mineral wool 3) Aluminum 4) Sealing compound
	Pro rata payments (85%)					
1.7.2.1	On pre assembly where ever applicable (if not applicable this portion shall be clubbed with placement in position)	20	15	-	-	-
1.7.2.2	Placement in position	20	25	-	-	50
1.7.2.3	Alignment	10	15	-	-	15
1.7.2.4	Welding/ Bolting/ Fixing	15	30	-	-	20
1.7.2.5	Completion of NDT (if not applicable , then this portion to be paid along with welding)	5	-	-	-	-
1.7.2.6	Installation of temp. piping	-	-	-	60	-
1.7.2.7	Dismantling of temp. piping, edge preparation and return to BHEL stores, area cleaning	-	-	-	25	-
1.7.2.8	Hangers & Supports etc. wherever necessary as per drawing	10	-	-	-	-
1.7.2.9	Hydraulic test / Pneumatic test	3	-	-	-	-
1.7.2.10	Floating of lines, final adjustment of supports for cold & hot values (if not applicable, this portion to be clubbed along with hydraulic test/ pneumatic test)	2	-	-	-	-
1.7.2.11	Erection of tanks and vent silencers	-	-	30	-	-

Cl. No.	Description	Piping				Insulation
		1) P91 2) HP 3) LP 4) SS	1) H&S 2) Others	1)Tanks	1) Temp Piping Steam blowing/ Chemical cleaning	1) Fixing components 2) Mineral wool 3) Aluminum 4) Sealing compound
1.7.2.12	Alignment of tanks & vent , silencers and their associated approach plat form with ladders etc.	-	-	40	-	-
1.7.2.13	Testing & commissioning of Tanks & Vent silencers	-	-	15	-	-
	Total for pro rata payments (85%)	**85**	**85**	**85**	**85**	**85**

1.7.3 Further 15% payment on pro-rata basis common to all PG shall be released on achievement of the following stage/mile stones events in unit (as per the following table) for the tonnage erected

Cl. No.	Description	Piping				Insulation
		1) P91 2) HP 3) LP 4) SS	1) H&S 2) Others	1)Tanks	1) Temp Piping Steam blowing/ Chemical cleaning	1) Fixing components 2) Mineral wool 3) Aluminum 4) Sealing compound
	Stage/ Milestone payments (15%)					
1.7.3.1	Boiler light up	1	1	1	-	1
1.7.3.2	ABO/Chemical cleaning	-	-	-	-	-
1.7.3.3	Steam blowing (Wherever Steam Blowing is not applicable, this may be payable for Chemical /detergent cleaning as applicable)	1	1	2	-	1
1.7.3.4	Safety Valve Floating	1	1	1	-	1
1.7.3.5	Rolling and synchronization	1	1	2	-	1
1.7.3.6	Coal firing	-	1	1	-	1
1.7.3.7	Full load	1	1	1	-	1
1.7.3.8	Trial operation of Unit	2	2	1	-	2
1.7.3.9	Completion of all drains and vents to respective locations and placement of instrument sensors after steam blowing	2	-	1	-	-
1.7.3.10	Painting	1	1	2	-	-

Cl. No.	Description	Piping				Insulation
		1) P91 2) HP 3) LP 4) SS	1) H&S 2) Others	1)Tanks	1) Temp Piping Steam blowing/ Chemical cleaning	1) Fixing components 2) Mineral wool 3) Aluminum 4) Sealing compound
1.7.3.11	Area cleaning, temporary structures cutting/removal and return of scrap	1	2	-	-	3
1.7.3.12	Punch list points/pending points liquidation	1	1	1	-	1
1.7.3.13	Submission of as built drawings	1	1	-	-	-
1.7.3.14	Material reconciliation	1	1	1	15	2
1.7.3.15	Completion of contractual obligation	1	1	1	-	1
	Total for stage/ milestone payments (15%)	**15**	**15**	**15**	**15**	**15**

Note to Terms of Payment:

For PVC, ORC, RA Bill Payment, Performance Security Deposit, please refer Part II Chapter 1: Corrections/ Revisions in Special Conditions of Contract, General Conditions of Contract and Forms & Procedures of technical Conditions of Contract (Volume- I Book- I)

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

1.8.1 Goods and service Tax (GST) & Cess

1.8.1.1 The successful bidder shall furnish proof of GST registration with GSTN Portal in the State in which the Project is being executed, covering the services under this contract. Registration should also bear endorsement for the premises from where the billing shall be done by the successful bidder on BHEL for this project/ work.

1.8.1.2 Contractor's price/rates shall be exclusive of GST & Cess (if applicable) (herein after termed as GST). Contractor shall submit to BHEL the GST compliant tax invoice/debit note/revised tax invoice on the basis of which BHEL will claim the input tax credit in its return. Since this is a works contract, the applicable rate shall be @ 18% GST, as applicable presently.

1.8.1.3 Bidder shall note that the GST Tax Invoice complying with GST Invoice Rules wherein the 'Bill To' details will be as below:

BHEL GSTN : 36AAACB4146P1ZG

NAME : BHARAT HEAVY ELECTRICALS LIMITED

ADDRESS : BHEL- PSSR SITE OFFICE,
Yadadri Thermal Power Station, 5X800 MW (Coal based),
Veerlapalem village, Dameracherla Mandal,
Nalgonda District, Telangana State

1.8.1.4 GST charged in the tax invoice/debit note/revised tax invoice by the contractor shall be released separately to the contractor only after contractor files the outward supply details in GSTR-1 on GSTN portal and input tax credit of such invoice is matched with corresponding details of outward supply of the contractor and has paid the GST at the time of filing the monthly return.

1.8.1.5 In case BHEL has to incur any liability (like interest / penalty etc.) due to denial/reversal / delay of input tax credit in respect of the invoice submitted by the contractor, for the reasons attributable to the contractor, the same shall be recovered from the contractor.

1.8.1.6 Further, in case BHEL is deprived of the Input tax credit due to any reason attributable to contractor, the same shall not be paid or Recovered if already paid to the contractor.

1.8.1.7 Tax invoice/debit Note/revised tax invoice shall contain all such particulars as prescribed in GST law and comply to the timelines for issue of the same. Invoices shall be submitted on time to the concerned BHEL Engineer In Charge.

1.8.1.8 TDS under GST (if/ as & when applicable) shall be deducted at prevailing rates on gross invoice value from the running bills.

1.8.1.9 E-way bills / Transit passes / Road Permits, if required for materials / T&P etc., bought into the project site is to be arranged by the Contractor only.

1.8.1.10 BHEL shall not reimburse any amounts towards any interest / penalty etc., incurred by contractor. Any additional claim at a later date due to issues such as wrong rates / wrong classification by contractor shall not be paid by BHEL.

1.8.2 All taxes and duty other than GST & Cess

The contractor shall pay all (except the specific exclusion viz GST & Cess, which is defined in relevant clauses elsewhere in the tender specification) taxes, fees, license charges, deposits, duties, tools, royalty, commissions, Stamp Duties, or other charges / levies, which may be levied on the input goods & services consumed and output goods & services delivered in course of his operations in executing the contract and the same shall not be reimbursed by BHEL. In case BHEL is forced to pay any of such taxes, BHEL shall have the right to recover the same from his bills or otherwise as deemed fit.

1.8.3 Statutory Variations

Statutory variations are applicable under the GST Acts, against production of proof. The changes implemented by the Central / State Government 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.

1.8.4 New Taxes/Levies –

In case Government imposes any new levy / tax after submission of bid 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 Direct Tax

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

VOLUME-IA PART-I CHAPTER IX

BILL OF QUANTITY

1.9.1 Weight Schedule- Summary

Sl. No.	DESCRIPTION	APPROX WT (In MT) for UNIT-5	Rate Schedule ID
1	P91 Piping	796.21	1A
2	HP Piping	1278.38	1B
3	LP Piping	368.18	1C
4	SS Piping	5.39	1D
5	Hangers and Supports including Tanks, Vessels, Pumps, etc	668.06	1E
6	Temporary Piping for Chemical Cleaning	105.31	2A
7	Temporary Piping for Steam Blowing	192.34	2B
8	Fixing components	7.70	3A
9	Mineral wool	593.67	3B
10	Aluminium Sheets	149.05	3C
	TOTAL WEIGHT (in MT)	**4164**	

1.9.2 PGMA wise Weight Details

PIPING CENTRE SUPPLIES				
PGMA	**Description**	**Tonnage In MT UNIT#5**	**Category**	**Rate Schedule ID**
80300	MS FROM SUPER HEATER TO BOILER STOP VALVE	46.17	P-91	1A
80301	MS FROM BOILER SV TO ESV	267.45	P-91	1A
80303	MS HEADER TO AUX PRDS	3.96	P-91	1A
80304	MS HEADER TO HPBP VALVE	17.29	P-91	1A
80307	HP AND LP BYPASS WARM UP	0.45	P-91	1A
80310	HRH FROM REHEATER TO IV VALVE	364.67	P-91	1A
80312	LPBP VALVE UPSTREAM AND DOWNSTREAM	96.21	P-91	1A
80320	CRH FROM TURBINE TO REHEATER	207.19	HP PIPING	1B
80321	HPBP VALVE TO CRH PIPING	13.58	HP PIPING	1B
80322	CRH PIPING TO DEAERATOR HEATER	18.56	HP PIPING	1B
80323	STEAM TO BFP TURBINE	6.74	HP PIPING	1B
80324	CRH HEADER TO AUX PRDS	1.28	HP PIPING	1B
80329	EXTRACTION STEAM TO BFP DRIVE TURBINE	10.72	HP PIPING	1B

80332	EXTRACTION STEAM TO LP HEATER 3	9.91	HP PIPING	1B
80334	EXTRACTION STEAM TO LP HEATER 5	9.96	HP PIPING	1B
80335	EXTRACTION STEAM TO DEAERATOR HEATING	15.68	HP PIPING	1B
80336	EXTRACTION STEAM TO HP HEATER 6	7.96	HP PIPING	1B
80337	EXTRACTION STEAM TO HP HEATER 7	6.32	HP PIPING	1B
80338	EXTRACTION STEAM TO HP HEATER 8	5.62	HP PIPING	1B
80339	AUX STEAM TO BFP TURBINE	1.71	HP PIPING	1B
80340	AUX STEAM HEADER	9.43	HP PIPING	1B
80342	AUX STEAM TO SCAPH	11.77	HP PIPING	1B
80343	AUX STEAM TO AH SOOT BLOWERS	4.39	HP PIPING	1B
80344	AUX STEAM TO FO SYSTEM TP		HP PIPING	1B
80345	AUX STEAM TO DEAERATOR HEATING	7.24	HP PIPING	1B
80349	AUX STEAM TO GLAND SEALS	1.00	HP PIPING	1B
80351	AUX STEAM TO MILLS-SG SCOPE	19.03	HP PIPING	1B
80355	STEAM TRACING PIPING	10.00	HP PIPING	1B
80395	AUX STEAM TO FUEL OIL ATOMISING	0.32	HP PIPING	1B
80418	ERECTION MATERIALS FOR INSTRUMENTS	0.73	HP PIPING	1B
80420	BOILER FEED PUMP SUCTION	25.13	HP PIPING	1B
80421	BOILER FEED RECIRCULATION	13.50	HP PIPING	1B
80423	BOILER FEED PUMP TO HPH INCLUDING BYPASS	147.71	HP PIPING	1B
80424	BFD BETWEEN HEADERS AND GROUP PROTECTION VALVES	105.43	HP PIPING	1B
80425	BFD FROM FINAL HPH TO SG TP	64.89	HP PIPING	1B
80430	SPRAY WATER TO HPBP	3.05	HP PIPING	1B
80433	SPRAY WATER FROM BFP INTERSTAGE	13.82	HP PIPING	1B
80650	FUEL OIL SUPPLY AND RETURN	50.00	HP PIPING	1B
80901	SUB DELIVERY VALVES FOR LIGHT UP	6.76	HP PIPING	1B
80992	WELDING ELECTRODES	10.42	HP PIPING	1B
81411	DIRECT GUAGES FOR STEAM LINES	0.72	HP PIPING	1B
81412	DIRECT GUAGES FOR NON-STEAM LINES	0.75	HP PIPING	1B
81416	PG TEST MATERIAL	1.79	HP PIPING	1B
81415	Guages	0.73	HP PIPING	1B
81417	Guages	0.30	HP PIPING	1B
80363	EXHAUST STEAM FROM PRIME MOVERS-TG SCOPE	30.95	LP PIPING	1C
80370	HP Flash Drain Tank to Condenser	77.22	HP PIPING	1B
80371	DRAIN FLASH TANK VENT TO CONDENSER	4.10	LP PIPING	1C
80373	AUX STEAM HEADER SV EXHAUST	2.70	LP PIPING	1C
80375	UNLISTED SC EXHAUST-TG EXHAUST	0.51	LP PIPING	1C
80379	HP SV EXHAUST TO FLASH TANK	6.11	LP PIPING	1C
80381	HP HEATER VENTS	4.40	LP PIPING	1C
80382	LP HEATER VENTS	1.76	LP PIPING	1C
80385	VENT FROM UNLISTED PPG/EQPT TO CONDENSER	7.13	LP PIPING	1C

80388	CONDENSER AIR EVACUATION PIPING	7.95	LP PIPING	1C
80400	CONDENSATE SUCTION PIPING	9.03	LP PIPING	1C
80401	CD FROM PUMP TO LPH1/DC INLET TEE AND RECIRCULATION	32.40	LP PIPING	1C
80402	CD FROM LPH1/DC INLET TEE TO TG TP	11.33	LP PIPING	1C
80403	CD FROM TG TP TO DEAERATOR	17.98	LP PIPING	1C
80407	CONDENSATE FOR SEALING OF VACCUM	2.80	LP PIPING	1C
80408	CONDENSATE DUMP FROM HEADER	1.23	LP PIPING	1C
80419	DEAERATOR SV EXHAUST TO ATMOSPHERE	4.71	LP PIPING	1C
80435	UNLISTED SPRAY WATER-TG SCOPE	1.97	LP PIPING	1C
80436	SPRAY WATER TO LP HEATER DESUPERHEATER	4.92	LP PIPING	1C
80439	TURBINE FLASH TANK DRAIN TO CONDENSER	0.20	LP PIPING	1C
80442	GLAND STEAM COOLER DRAINS	0.33	LP PIPING	1C
80443	LP HEATER 1 TO CONDENSER	7.01	LP PIPING	1C
80444	LP HEATER DRIPS AND DRAINS	7.06	LP PIPING	1C
80446	DEAERATOR HEATER OVERFLOW AND DRAINS	3.53	LP PIPING	1C
80447	HP HEATER DRAINS	33.22	LP PIPING	1C
80448	DRAINS FROM UNLISTED EQUIPMENTS	10.53	LP PIPING	1C
80449	TG CYCLE PIPING DRAINS	10.17	LP PIPING	1C
80451	BOILER INTEGRAL PIPING DRAINS	25.22	LP PIPING	1C
80452	HP PIPING DRAINS	28.68	LP PIPING	1C
80453	LP PIPING DRAINS	16.30	LP PIPING	1C
80454	SCAPH DRAINS	1.98	LP PIPING	1C
80455	DRAINS FROM UNLISTED EQUIPMENTS	33.44	LP PIPING	1C
80457	MANIFOLS FOR HP FLASH BOX AND CONDENSER	1.56	LP PIPING	1C
80459	HP FLASH TANK DRAIN TO CONDENSER	0.84	LP PIPING	1C
80473	DM WATER SYSTEM	1.33	LP PIPING	1C
80493	HP FLASH TANK VENT TO CONDENSER	2.41	LP PIPING	1C
80494	LP FLASH TANK VENT TO CONDENSER	3.49	LP PIPING	1C
80495	LP FLASH TANK DRAIN TO CONDENSER	2.77	LP PIPING	1C
80545	LP CONDENSATE PIPING WITHIN TG HALL	9.08	LP PIPING	1C
80673	LUBE OIL PIPING SYSTEM	17.06	LP PIPING	1C
80601	LP DOSING	3.41	SS PIPING	1D
80412	HOTWELL MAKE UP	1.98	SS PIPING	1D
80830	H&S FOR CRITICAL PIPING	194.37	H&S	1E
80920	H&S FOR HYDRO TEST	3.48	H&S	1E
80921	H&S FOR LIGH UP STEAM LINE	55.58	H&S	1E
80928	H&S FOR BOILER LIGHT UP	19.83	H&S	1E
80930	H&S FOR SYSCHRONISATION	52.85	H&S	1E
80933	H&S FOR LP PIPING	49.10	H&S	1E
80935	ALH AND CLD FOR MS PIPING	2.80	H&S	1E
80936	VLH AND CLH FOR SG PIPING	6.16	H&S	1E
80937	VLH AND CLH FOR CRITICAL PIPING	48.30	H&S	1E
80940	Aux Structure for Critical Piping and CD bay	205.42	H&S	1E

80941	VLH AND CLH FOR BFD PIPING	11.65	H&S	1E
80942	VLH AND CLH FOR TG CYCLE PIPING	5.85	H&S	1E
81036	CW STORAGE TANK	7.49	H&S	1E
81100	CONDENSATE PUMP	4.50	H&S	1E
81417	INSTRUMENTATION FOR STARTUP SYSTEM	0.30	H&S	1E
81110	Cooling water Pump With Motor	0.38	H&S	1E
81318	FIXING COMPONENT FOR MISCELLANEOUS PPG INSULATION	7.70	INS-IRON	3A
81325	MINERAL WOOL MATTRESS	58.67	INS-WOOL	3B
81341	SEALING COMPOUND FOR INSULATION	0.27	INS-ALU	3C
81350	ALUMINIUM CLADDING FOR INSULATION	19.27	INS-ALU	3C
80399	STEAM BLOWING PIPING TEMPORARY	181.32	TEMP	TP1
80604	ACID CLEANING PIPING	93.33	TEMP	TP1
80926	H&S FOR LIGH UP NON STEAM LINE	12.31	TEMP	TP1
80927	H&S ACID CLEANING PIPING	9.91	TEMP	TP1
TRICHY VALVES				
XXXX	PIPING VALVES	287.02	HP PIPING	1B
HYDERABAD				
xxxx	Recirculation valves/Strainers of BFP,BOOSTER PUMP.	15.00	HP PIPING	1B
xxxx	Drive Turbine Insulation	5.00	INS-WOOL	3B
PEM BOI				
xxxx	ALUMINIUM SHEETS-INSULATION	100.00	INS-ALU	3C
xxxx	MINERAL WOOL MATTRESS	530.00	INS-WOOL	3B
xxxx	ANCILLARY MATERIALS	30.00	INS-ALU	3C
xxxx	VALVES	25.00	HP PIPING	1B
xxxx	ME BELLOWS, STEAM AND AIR TRAPS, BUTTERFLY VALVES ETC.	50.00	HP PIPING	1B

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 to the contractor for the tonnage actually erected at the respective category as per the quoted / accepted rate. Quantity Variation will be dealt as per clause 2.14 of General Conditions of Contract (Volume I Book II).
2	There may be variation or addition of PGMAs, description, weights etc., and any additional scope of work supplied under the above package shall be erected by the contractor and payment will be made as per the quoted/accepted rate in the respective category.
3	The temporary piping for Chemical Cleaning & steam Blowing will be issued as and where conditions in cut pieces. The scope includes cutting and edge preparation and erection as per the site condition & dismantling after the process is over and return to store with identification mark as instructed by the BHEL/Engineer. The quoted rate shall be inclusive of all this.

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 as a part of work. There will not be any separate payment for this works.
5	Also refer Field/ Erection welding schedule in Chapter 2 of part II of Technical Conditions of Contract (Volume-I Book-I)

VOLUME-IA PART-I CHAPTER -X GENERAL

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

(All the works mentioned hereunder shall be carried out within the accepted rate unless otherwise specified.)

1.10.1 Contractors are requested to furnish the following at PSSR-HQ, Chennai immediately after release of Letter of Intent (LOI)

i) Security Deposit and additional Security Deposit.
ii) Unqualified Acceptance for Detailed LOI/ Work Order.
iii) Rs.100/- Stamp Paper for preparation of Contract Agreement.

1.10.2 Contractors are requested to furnish the proof of documents for the following at PSSR- Site

i) PF Regn No.
ii) Labour License No.
iii) Workmen Insurance Policy No.

1.10.3 In addition to the clause 2.8 of General Conditions of Contract (Volume-1C of Book-II) the contractor shall comply with the following.

1.10.3.1 BOCW Act & BOCW Welfare Cess Act

1.10.3.1.1 The Contractor should Register their Establishment under BOCW Act 1996 read with rules 1998 by submitting Form I (Application for Registration of Establishment) and Form IV (Notice Of Commencement / Completion of Building other Construction Work) to the respective Labour Authorities i.e.,

a) Assistant Labour Commissioner (Central) in respect of the project premises which is under the purview of Central Govt.–NTPC, NTPL etc.

b) Appropriate State Authorities in respect of the project premises which is under the purview of State Govt.

1.10.3.1.2 The Contractor should comply with the provisions of BOCW Welfare Cess Act 1996 in respect of the work awarded to them by BHEL.

1.10.3.1.3 The contractor should ensure compliance regarding Registration of Building Workers as Beneficiaries, Hours of work, welfare measures and other conditions of service with particular reference to Safety and Health

measures like Safety Officers, safety committee, issue of Personal protective equipments, canteen, rest room, drinking water, Toilets, ambulance, first aid centre etc.

1.10.3.1.4 The contractor irrespective of their nature of work and manpower (Civil, Mechanical, Electrical works etc) should register their establishment under BOCW Act 1996 and comply with BOCW Welfare Cess Act 1996.

1.10.3.1.5 Contractor shall make remittance of the BOCW cess as per the Act in consultation with BHEL as per the rates in force (presently 1%). BHEL shall reimburse the same upon production of documentary evidence. However, BHEL shall not reimburse the fee paid towards the registration of establishment, fees paid towards registration of Beneficiaries and contribution of Beneficiaries remitted.

1.10.3.1.6 Non-compliance to Provisions of the BOCW Act & BOCW Welfare Cess Act is not acceptable. In case of any non-compliance, BHEL reserves the right to withhold any sum as it deems fit. Only upon total compliance to the BOCW Act and also discharge of total payment of Cess under the BOCW Cess Act by the Contractor, BHEL shall consider refund of the Amounts.

1.10.3.2 PROVIDENT FUND

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

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

1.10.3.3 OTHER STATUTORY REQUIREMENTS

1.10.3.3.1 The Contractor shall submit a copy of Labour License obtained from the Licensing Officer (Form VI) u/r 25 read with u/s 12 of Contract Labour (R&A) Act 1970 & rules and Valid WC Insurance copy or ESI Code (if applicable) and PF code no. along with the first running bill.

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

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

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

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

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

1.10.3.4 DEPLOYMENT OF SKILLED / SEMI-SKILLED TRADESMEN

The following clause is applicable in case the contract value / contract price is Rs. Five crores and above.

The contractor shall, at all stages of work deploy skilled / semi-skilled tradesmen who are qualified and possess certificate in particular trade from CPWD Training Institute / Industrial Training Institute / National Institute of Construction Management and Research (NICMAR), National Academy of Construction, CIDC or any similar reputed and recognized Institute managed / certified by State / Central Government. The number of such qualified tradesmen shall not be less than 20%

of total skilled / semi-skilled workers required in each trade at any stage of work. The contractor shall submit number of man days required in respect of each trade, its scheduling and the list of qualified tradesmen along with requisite certificate from recognized Institute to Engineer-in-Charge for approval. Notwithstanding such approval, if the tradesmen are found to have inadequate skill to execute the work of respective trade, the contractor shall substitute such tradesmen within two days of written notice from Engineer-in-Charge. Failure on the part of contractor to obtain approval of Engineer-in-Charge or failure to deploy qualified tradesmen will attract a compensation to be paid by contractor at the rate of Rs. 100 per such tradesman per day. Decision of Engineer-in-Charge as to whether particular tradesman possesses requisite skill and amount of compensation in case of default shall be final and binding.

1.10.3.5 RECOVERY OF COMPENSATION PAID TO VICTIMS BY BHEL IN CASES OF DEATH/ PERMANENT INCAPACITATION OF PERSON DUE TO AN ACCIDENT DURING THE WORKS

BHEL shall recover the amount of compensation paid to victim(s) by BHEL towards loss of life / permanent disability due to an accident which is attributable to the negligence of contractor, agency or firm or any of its employees as detailed below.

a) Victim: Any person who suffers permanent disablement or dies in an accident as defined below.

b) Accident: Any death or permanent disability resulting solely and directly from any unintended and unforeseen injurious occurrence caused during the manufacturing / operation and works incidental thereto at BHEL factories/ offices and precincts thereof, project execution, erection and commissioning, services, repairs and maintenance, trouble shooting, serving, overhaul, renovation and retrofitting, trial operation, performance guarantee testing undertaken by the company or during any works /during working at BHEL Units/ Offices/ townships and premises/ Project Sites.

c) Compensation in respect of each of the victims:

In the event of death or permanent disability resulting from Loss of both limbs: Rs. 10,00,000/- (Rs. Ten Lakh)

In the event of other permanent disability: Rs. 7,00,000/- (Rs. Seven Lakh)

d) Permanent Disablement: A disablement that is classified as a permanent total disablement under the proviso to Section 2 (I) of the Employee's Compensation Act, 1923."

1.10.4 GENERAL

1.10.4.1 Site Visit by the Bidder

The bidder prior to submitting his tender for the work, shall visit, examine and acquire full knowledge & information of necessary conditions prevailing at the site and its surroundings of the plant premises together with all statutory, obligatory, mandatory requirements of various authorities about the site of works at his own expense, and obtain and ascertain for himself on his own responsibility that may be for preparing his tender and entering into a contract, and take the same into account in the quoted contract price for the work.

1.10.4.2 The bidder shall satisfy themselves about the following factors:

i) Site conditions including access to the site, existing and required roads and other means of transport/communication for use by him in connection with the work including diverting and re-routing of services.

ii) Requirement and availability of land and other facilities of his enabling works, establishment of his nursery, office, stores etc.

iii) Ground conditions including those bearing upon transportation, disposal, handling and storage of materials required for the work or obtained there-from.

iv) Source and extent of availability of suitable materials, including water etc., and labour (skilled and unskilled) required for work, and laws and regulations governing their use and employment.

v) Geological, meteorological, topographical and other general features of the site and its surroundings as are pertaining to and needed for the performance of the work.

vi) The limit and extent of surface and subsurface water to be encountered during the performance of the work, and the requirement of drainage and pumping.

vii) The type of equipment and facilities needed, for and in the performance of the work;

viii) The extent of lead and lift required for the work in complete form over the entire duration of the contract, and

ix) All other information pertaining to and needed for the work including information as to the risks, contingencies and other circumstances which may influence or affect the work or the cost thereof under this contract.

1.10.4.3 The bidder should note that information, if any, in regard to the local conditions, as contained in these tender documents, has been given to tenderer merely for guidance and is not warranted to be complete.

1.10.4.4 A bidder shall be deemed to have full knowledge of the site, whether he inspects it or not, and no extra charges consequent on any misunderstanding or otherwise shall be allowed.

1.10.4.5 The bidder and any of his personnel or agents will be granted permission by the Site-In-Charge or his authorized nominee, on receipt of formal application in respect thereof a week in advance of the proposed date of inspection of site, to enter upon his premises and lands for purpose of such inspection, but only on the express condition that the tenderer (and his personnel and agents) will relieve and indemnify the Employer (and his personnel and agents) from and against all liability in respect thereof and will be responsible for personal injury (whether fatal or otherwise), loss of or damage to property and any other loss, damage, costs and expenses however caused which, but for the exercise of such permission, would not have arisen.

1.10.4.6 Scope of work covered under this specification requires quality workmanship, engineering and green belt management along with the supply of all consumables, tools and tackles and testing instruments. The contractor shall ensure timely completion of work. The contractor shall have adequate tools, measuring instruments etc. in his possession. He shall also have adequate trained, qualified and experienced engineers, supervisory staff and skilled personnel. The manpower deployment identified by contractor shall match with above scope of works.

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

1.10.4.8 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.

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

1.10.4.10 The contractor shall carryout additional tests, if any, which the Engineer feels necessary because of site conditions and also to meet system specification.

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

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

1.10.4.13 Wherever Construction sequences are furnished by BHEL, the contractor shall follow the same sequence.

1.10.4.14 Contractor shall execute the supply and works as per sequence prescribed by BHEL at site engineer. No claims for extra payment from the contractor will be entertained on the grounds of deviation from the methods of execution of similar job in any other site or for any reasons whatsoever.

1.10.4.15 If required by BHEL, the contractor shall change the sequence of his operation so that work on priority sectors can be completed within the projects schedule. The contractor shall afford maximum assistance to BHEL in this connection without causing delay to agreed completion date.

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

1.10.4.17 Contractor shall retain all T&P / Testing instrument / Material handling equipment’s etc. at site as per advice of BHEL engineer and same shall be taken out from site only after getting the clearances from engineer in charge.

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

1.10.4.19 The Contractor may have to execute work in such a place and condition where other agencies also will be under such circumstances. However, completion time for construction, agreed will be subject to the condition that contractor’s work is not hampered by the agencies.

1.10.4.20 Contractor has to work in close co-ordination with other 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 Construction 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.

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

1.10.4.22 Contractor shall remove all scrap materials periodically generated from his working area and collect the same at one place earmarked for the same. Load of scraps is to be shifted to a place earmarked by BHEL. Failure to collect the scrap is likely to lead to accidents and as such BHEL reserves the right to collect and remove the scrap at contractor's risk and cost if there is any failure on the part of contractor in this respect.

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

1.10.4.24 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.

1.10.4.25 No member of the already erected structure / buildings, other component and auxiliaries should be removed / modified without specific approval of BHEL engineer.

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

1.10.4.27 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 overall project schedule.

1.10.4.28 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.

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

1.10.4.30 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.

1.10.4.31 It is the responsibility of the contractor to do the checking, testing etc. if necessary, repeatedly to satisfy BHEL Engineer with all the necessary tools and tackles, manpower etc. without any extra cost. The testing will be completed only when jointly certified so, by the BHEL Engineer.

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

1.10.4.33 The contractor's work shall not hinder other work, either underground or over ground, such as electrical, phone lines, water or sewage lines, etc. In areas of overlap, the contractor shall work in coordination with other related contractors. Any damage by the landscape contractor's team to such utilities will be penalized and contractor shall be responsible for cost for such damages.

1.10.4.34 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.

1.10.4.35 Contractor has to clear the front, expeditiously and promptly as instructed by BHEL Engineer for other agencies, like Boiler, piping, Turbine, Generator erection, Cabling, instrumentation, insulation etc., to commence their work from / on the equipments coming under this scope.

1.10.4.36 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.

1.10.5 SITE INSPECTION

1.10.5.1 BHEL 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.

1.10.5.2 BHEL / Customer will have full power and authority to inspect the works at any time, either on the site or at the contractor's premises. The contractor shall arrange every facility and assistance to carry out such inspection. On no account will the contractor be allowed to proceed with work of any type unless such work has been inspected and entries are made in the site inspection register by customer / BHEL.

1.10.5.3 The contractor shall maintain at site a joint protocol for recording actual measurement of work carried out at site, inspection and witnessing of various tests conducted by the contractor.

1.10.5.4 Field Quality Assurance (FQA) Formats: -

It is the responsibility of the contractor to collect and fill up the relevant FQA log sheets of BHEL and present the same to BHEL after carrying out the necessary checks as per the log sheets and obtaining the signature of BHEL and Owner as token of their acceptance. Payment to the contractor will be inked with the submission of these FQA log sheets.

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

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

1.10.6 AS BUILT DRAWINGS:

1.10.6.1 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.

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

1.10.7 DOCUMENTATION

1.10.7.1 Record of Quantity of FREE / Chargeable items issued by BHEL must be maintained during contract execution. Also reconciliation statement to be prepared at regular intervals.

1.10.7.2 The under mentioned Records/ Log-books/ Registers applicable to be maintained.

a) Hindrance Register.

b) Site Order Book.

c) Test Check of measurements.

d) Steel & Cement Supply and Consumption Daily Register

e) Records of Test reports of Field tests.

f) Records of manufacture's test certificates.

g) Records of disposal of scraps generated during and after the work completion.

h) List of T&Ps and MMEs

1.10.7.3 Other documents / records as specified in chapter -Progress of work in PART- I of Technical conditions of Contract Volume IA (Volume I Book I).

1.10.7.4 Schedule as specified in chapters of Technical conditions of Contract Volume IA (Volume I Book I).

VOLUME-IA PART-I CHAPTER - XI
PROGRESS OF WORK

(All the works mentioned hereunder shall be carried out within the accepted rate unless otherwise specified.)

1.11.1 Refer forms F -14 to F-18 of volume I D (Forms & Procedure) of volume -I Book-II. Plan and review will be done as per the formats. Please note that Form F-14 and F-15 are revised and published in this booklet (Volume IA Part-II)

1.11.2 The progress reports shall indicate the progress achieved against plan, indicating reasons for delays, if any. The report shall also give remedial actions which the contractor intends to make good the slippage or lost time so that further works can proceed as per the original plan the slippages do not accumulate and affect the overall programme.

1.11.3 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.

1.11.4 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.

1.11.5 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. The periodicity of the reports will be decided by BHEL Engineer at site.

1.11.6 The monthly report as a booklet shall be submitted at the end of every month and shall contain the following details: -

a. Progress photographs in color.

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 the last day 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 shall be split up under the work areas like Piping, Insulation etc.

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.

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

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

1.11.9 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.

VOLUME-IA PART-I CHAPTER -XII FOUNDATIONS AND GROUTING

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

(All the works mentioned hereunder shall be carried out within the accepted rate unless otherwise specified.)

1.12.1 Foundation for the equipments to be erected shall be provided by BHEL / clients of BHEL. The dimensions of the foundations 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.

1.12.2 Cleaning of foundation surfaces, pocket holes and anchor bolt pits etc., dewatering, 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.

1.12.3 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

1.12.4 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 / equipments based on the foundations including shear lug provisions / openings.

1.12.5 Foundation pockets are to be cleaned thoroughly before placing the supports / 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.

1.12.6 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.

1.12.7 Non shrink cementitious flow able grout shall be used for grouting of pockets and under pinning work below base plate of columns. Nominal thickness of

grout shall be 50 mm. Non shrink cum plasticizer admixture shall be added in the grout. Crushing strength of the grout shall be generally being one grade higher than that of the base concrete. Minimum grade of grout shall be M30.

1.12.8 However, for Equipment Foundations, high strength (Minimum Characteristic Compressive Strength of 60 N/mm^2 at 28 days) ready mixed non-shrink, Chloride free, Cement based, free flowing, non-metallic grout as recommended by Equipment manufacturer shall be used. The ready mix grout shall be of reputed make as approved by the customer. 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. The quoted rate shall inclusive of the same.

1.12.9 The contractor shall arrange for grouting of foundation bolt holes of equipment and final grouting of equipment as per the drawings / specification as advise d by the Engineer or BHEL after preparing the foundation surface for grouting. The contractor has to arrange, a representative from the supplier of special cement for witnessing the grouting and other works at their cost including any miscellaneous expenditure for this activity. BHEL will not pay any service and incidental charges for arranging the supplier representative. The contractor to take note of this aspect and quote accordingly.

1.12.10 All equipment bases and structural steel bases and foundations pockets shall be grouted and finished as per the specifications after surface preparation unless otherwise recommended by the equipment manufacturers. The surface preparation includes soda washing of the foundations to remove oil, grease etc. to ensure proper grouting.

1.12.11 The certificates of the grout are 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.

1.12.12 All the materials required for grouting including special cements as approved by BHEL and other materials like Portland cement, sand, chips, gravel, 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.

1.12.13 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.

1.12.14 Providing & grouting of pocket holes, pipe sleeves and under base plate of structural steel work/ machinery/ pipe supporting structures including roughening of surface, cleaning, ramming, curing etc. all complete with non-shrink cementitious flow able grout as per specification using non-shrink cum plasticizer admixture. Crushing Strength of the grout shall be one grade higher than that of the base concrete (however grade of grout shall be minimum M30 to max M35 grade).

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

1.12.16 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 Piping should be carried out by non-shrink cement like Conbextra GPI / Conbextra GP II of 'FOSROC' make / Shrinkkomp or its equivalent etc. This special non-shrink cement shall be arranged by the contractor at his cost. Premixed grout of above-mentioned non-shrink cement of crushing strength 650kg/sq cm for major equipment foundation and 450 kg/sq cm for other foundation where concrete grade M30 or higher is provided. The quoted rate shall be inclusive of the same.

1.12.17 **PROCEDURE FOR GROUTING:**

Contractor has to carry out the grouting as per the work instructions for grouting available at site or the grouting is to be carried out as per the supplier's recommendation / IS standard. Copy of those recommendations is to be submitted to BHEL for records.

VOLUME-IA PART-I CHAPTER -XIII

MATERIAL HANDLING, TRANSPORTATION AND SITE STORAGE

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

(All the works mentioned hereunder shall be carried out within the accepted rate unless otherwise specified.)

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

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

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

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

1.13.5 All welding filler wires / electrodes is issued to contractor shall be preserved by him carefully to prevent deterioration of their properties. Special care shall be taken to preserve alloy steel and other special electrodes / filler wires. Contractors shall exercise maximum care in using these electrodes, filler wires to minimize wastage by maintaining a record of all usages.

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

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

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

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

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

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

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

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

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

1.13.15 Loading at BHEL / Customer stores and storage yard, transport to site, unloading at site / pre-assembly area / 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.

1.13.16 The contractor shall provide any fixtures, concrete blocks & wooden sleepers, sandbags which are required for temporary supporting of the components at their stores at site.

1.13.17 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.

1.13.18 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.

1.13.19 The contractor shall take necessary measures to see that all the machined surfaces are preserved and covered.

1.13.20 Contractor has to arrange required fire retardant covering materials (tarpaulins) to protect the machined components / assembled parts drawn from BHEL before and after erection at their cost.

1.13.21 Any fittings such as thermos-well plugs, radiography plugs which has been assembled and dispatched as a single Dispatch Able Unit (DU) shall be checked before drawing materials from BHEL Stores. If any such attachments / fittings are found missing the same shall be intimated to concern BHEL Officials and recorded before drawing materials. It shall be the contractor responsibility to safeguard such attachments / fittings. If lost at contractor custody, the same shall be arranged by the contractor else BHEL shall arrange at the cost of contractor.

1.13.22 Contractor shall plan and transport equipments, components from storage yard to erection site in such a manner and sequence that material accumulation at site does not lead to congestion at site of work.

1.13.23 It is the responsibility of the contractor to ensure that the insulation and refractory materials and sheet metal covering issued to him for application are well protected against loss or damage or weather conditions tending to affect its quality by the provision of close / semi closed sheds at his cost. If any damage occurs to the materials due to improper storage or due to any causes attributable to the contractor except for normal breakage or damaged material shall be to the cost of the contractor.

VOLUME-IA PART-I CHAPTER- XIV ERECTION

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

(All the works mentioned hereunder shall be carried out within the accepted rate unless otherwise specified.)

1.14.1 COMMON TO PIPING AND INSULATION

1.14.1.1 The contractor will have to follow the instructions provided in the technical manuals, drawings, and specifications provided by BHEL, to the contractor from time to time. In case of ambiguity or deviation the decision / clarification of BHEL Engineer will have to be followed.

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

1.14.1.3 In case of any class of work for which there is no such specifications as laid down in the contract such as blue matching, welding of stainless steel parts etc., the work shall be carried out in accordance with instructions and requirements of the BHEL engineer at the quoted rates only.

1.14.1.4 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.

1.14.1.5 Contractor has to arrange required fire retardant covering materials (tarpaulins) to protect the machined components / assembled parts drawn from BHEL before and after erection at their cost.

1.14.1.6 Any fixtures, scaffolding materials, approach ladders, concrete block supports, steel structures required for temporary supporting, pre assembly, checking, welding, lifting & handling during pre assembly and erection and during application of insulations shall be arranged by the contractor at his cost.

1.14.1.7 The contractor shall erect scaffolding / temporary platforms for erection as per the guidelines of relevant IS codes. These should be of adequate capacity and shall never be over loaded. These should be replaced when not found suitable during erection work and dismantled on work completion

and removed from work site. Only steel scaffolding materials with proper clamps should be used. Use of bamboo / casuarinas shall not be permitted.

1.14.1.8 Contractor shall remove all scrap materials periodically generated from his working area and collect the same at one place earmarked for the same. Load of scraps is to be shifted to a place earmarked by BHEL. BHEL reserves the right to collect and remove the scrap at contractor's risk and cost if there is any failure on the part of contractor in this respect. All the packaging materials, including special transporting frames, etc. shall be returned to the BHEL stores / customer's stores by the contractor and maintain records.

1.14.1.9 Contractor shall engage separate gangs throughout the contract period, exclusively for proper housekeeping of the site. The contractor has to make necessary arrangements for collection and for bringing down the scrap from, all locations and taking them away from the erection areas to various locations as indicated by BHEL Engineer. The house keeping must be a routine and continuous activity.

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

1.14.1.11 Prior to erection of any components, inspection to be done for any foreign materials and damages and they are to be removed / attended as per instructions of BHEL engineer.

1.14.1.12 The contractor is strictly prohibited in using any of the BHEL's materials / components like angles, channels, hand-rails for any temporary supporting or scaffolding work or for using as bed for pre-assembly works etc.. In case of such misuse, a sum as determined by BHEL shall be recovered from contractor's bills.

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

1.14.1.14 Upon completion of daily work, the contractor shall remove from the vicinity of work all scrap packing materials rubbish, unused and other materials and deposit them in places to be specified by BHEL Engineer.

1.14.1.15 Delay in clearance of mechanical equipment and piping for insulations is unlikely to happen. However, if any delay occurs, the contractor shall not claim anything extra, like idle charges.

1.14.2 **ERECTION OF PIPING**

1.14.2.1 Handling at site stores / storage yard, transporting to site, inspection, pre-assembly, erection, alignment, welding, NDT, fixing of hangers & supports, chemical cleaning / pickling, oil flushing, water flushing, hydro testing &

steam blowing, surface finish, supply & application of primer & finish paints including labeling & flow direction on the piping over insulation & hangers and supports, pre-commissioning, commissioning, trial operation & handing over to customer of Power cycle piping and its associated items / systems, hangers and supports, valves and other miscellaneous equipment.

1.14.2.2 Brief list of system / sub system, approximate weight of pipes and accessories to be erected by the contractor mentioned in the Bill of Quantity and numbers of joints mentioned in Erection Welding Schedule of this tender specification are meant for giving general idea to the tender only about magnitude of the work involved. The piping components are sent in parts for convenient transportation / layout requirements. They are to be cleaned, pre-assembled in stage by stage, welded, erected and aligned as per the drawing dimensions / tolerance and instructions of BHEL Engineers.

1.14.2.3 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, inspection, edge preparation if required, 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 within the quoted rate. Major machining work, which is only to be carried out in workshops, will be arranged by BHEL.

1.14.2.4 All the works such as cleaning, inspection, edge preparation if required, 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 within the quoted rate. Major machining work, which is only to be carried out in workshops, will be arranged by BHEL.

1.14.2.5 Erection of all items comprising piping systems such as valves, filters / strainers, expansion bellows, flow elements, hangers and supports, tanks, level instruments, pumps, associated skids are also a part of the scope.

1.14.2.6 All Operating / Approach platforms, cross over, canopies, ladders etc. along with their supporting structures, for the equipments / valves / filters etc shall be erected by the contractor as per instruction of BHEL and shall be paid as per accepted Tonnage rate for "Hangers and Supports".

1.14.2.7 Additional platforms, Cross over, Canopies, Ladders, etc. for approaching different equipments as per the site requirement, which may not be

indicated in drawings, shall be fabricated and erected by contractor. However, the contractor shall be paid for this work on accepted tonnage rate for “Hangers and Supports”. 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.

1.14.2.8 If the provision of creep measurement is envisaged in the drawings, stubs erection and welding as per drawing shall be done by the contractor within the quoted rate.

1.14.2.9 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, NDE, 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.

1.14.2.10 Contractor should obtain the formal clearance from Director of Boilers to carry out erection & Welding of piping under IBR purview (Power Cycle Piping, Special tanks, Flash tanks and any other tanks as applicable). Arrangement for the visit of Boiler inspector for field inspection etc. is in the scope of contractor, and necessary drawing / details only will be given by BHEL. Inspection fee, if any shall be paid by BHEL.

1.14.2.11 Contractor shall arrange the necessary clearance from any other statutory authorities as required for installation of the plant and equipment and render all assistance, service required in this regard. Inspection fee, if any will be paid by BHEL.

1.14.2.12 Fittings like bends, tees, elbow / bends, reducers, flanges etc., will be supplied as loose items.

1.14.2.13 Fittings shall be supplied with standard dimensions. Edge preparation, matching inner diameter of pipes for welding as per the drawing dimensions shall be part of erection works. No separate payment will be made for the correction of pipes, edge preparation of standard fittings such as bends, Tees etc.,

1.14.2.14 Normally weld neck valves will have prepared edges for welding. It may be occasionally necessary to prepare new edges or recondition the edges by grinding or chamfering to match the corresponding tubes and pipes. All fittings like tees, weld neck flanges, reducers, elbows, flanges, inserts etc., shall be suitably edge prepared and matched with pipes for welding. No extra cost shall be paid for this.

1.14.2.15 In case 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.

1.14.2.16 During connection & floating of any decks, etc., before and after pipe connections, adding tentative loads, readjusting of spring to the required level is covered in this scope of work.

1.14.2.17 Carrying out erection of piping as per the specification between equipments constituting terminal points, whether the terminal equipments fall within the scope of work / specification, contractor shall carry out the terminal joints at either end. Also where the piping connection to the terminal points involve flanged joints, matching of flanges, fixing gaskets, bolting and tightening as per BHEL Engineers instructions is in the scope of work. In case piping connected to equipment, matching of flanges for achieving the parallelism and alignment at the equipment end by suitably resorting to heat correction or other method as instructed by BHEL Engineer, with in the quoted rate.

1.14.2.18 Erection of 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 to the equipments erected by the contractor is completely covered in the scope of work.

1.14.2.19 Contractor 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 within the quoted / accepted rate.

1.14.2.20 Attachment, welding of necessary instrumentation tapping points, thermocouple pads, root valves, condensing vessels, flow nozzles and control valves etc., shall be the responsibility of the contractor and the same shall 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.

1.14.2.21 All the valves will have to be checked, cleaned, lapped or overhauled in full or in parts before erection, after chemical cleaning and during commissioning. The contractor, at his own cost, shall arrange experienced technicians for the above work, including required consumables.

1.14.2.22 The valves, actuators etc., will have to be checked, cleaned or overhauled in full or in part before erection, after chemical cleaning, steam blowing and during commissioning as may be necessary.

1.14.2.23 Contractor shall study the layout of LP piping and other site routed piping well before the start of work. Final routing shall be decided after approval

from Site erection Engineer for site routed pipe in such a way that it does not foul with critical piping.

1.14.2.24 For thermo-well welding with Carbon steel / alloy steel welding applicable combination electrodes shall be arranged by the contractor within the quoted rate.

1.14.2.25 During floating of critical lines insulation weights has to be added at hanger locations. Suitable weights like plates, structural members, etc shall be arranged by BHEL on returnable basis. Handling of the items shall be done by the contractor within the quoted rate.

1.14.2.26 Immediately after erecting electrically operated valves, Valve Tag Nos shall be painted or stickering shall be done for ease of identification.

1.14.2.27 All the valve packing has to be lubricated as per BHEL Engineer instruction till handing over. Necessary gland packing will be supplied by BHEL.

1.14.2.28 All the lifting equipments, actuators / power cylinders, valves / dampers, etc., shall be serviced and lubricated to the satisfaction of BHEL engineer before erecting the same and also during pre commissioning. The required cleaning, servicing and lubrication of bearings to be carried out before commissioning at no extra cost.

1.14.2.29 In the case of structural members, pipes, plates, ducts etc, 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 within the quoted rates / prices.

1.14.2.30 All the tubes and pipes shall be cleaned and blown with compressed air and shown to the Engineer before lifting. Pipes above 2" diameter have to be cleaned by means of wire brush as per the instruction of BHEL Engineer and subsequently flushed with air before lifting them into position. Pipes below 2" diameter, shall be sponge cleaned with air flushing. 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.

1.14.2.31 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 assembly and other components as per instruction of BHEL Engineer during erection at the quoted rate. The necessary compressor for air cleaning is to be arranged by contractor at his cost.

1.14.2.32 Fine fittings and other small bore piping have to be routed according to site conditions and hence shall be done only in position as per the site requirement. Necessary sketch for routing these lines should be got approved from BHEL by the contractor. In case any minor modifications are required in these pipelines after completion to meet the system requirements, the same shall be carried out by the contractor within the quoted rate. The contractor should absorb this cost in his quoted rate.

1.14.2.33 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.

1.14.2.34 Assistance for calibrating / testing the power cylinders/ actuators / valves, gauges, instruments, etc. and setting to actuators shall be provided by contractor within the quoted rates.

1.14.2.35 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.

1.14.2.36 All the drain lines should have sufficient slope towards drain. Slope of 1:500 shall be maintained towards drain point unless otherwise specified. Expansion loops shall be provided in all the vents and drains as per the drawings.

1.14.2.37 Wherever pipes / bends / 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.

1.14.2.38 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.

1.14.2.39 Wherever drawings indicate site routing and site fabrication, such pipes (in general equal to and less than 2" Dia) will be issued in running meters as straight length. These are to be cut to required at site length to suit layout as given in the erection drawing and edge prepared as per the standards / drawings and as per the instruction of BHEL Engineer. In some cases 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. The contractor shall weld the joints of site routing piping as per site requirement.

1.14.2.40 Certain extra lengths of portions / parts of various site fabricated components / parts / bellows / piping etc. are provided as erection allowance and they shall have to be cut to suit site conditions and layout.

Certain small length of portions / components / bellows / piping casing etc., may have to be added to suit conditions and layouts. Preparing edges afresh and adopting specified heat treatment procedure, are in the scope of work. No extra payment will be admitted for such works.

1.14.2.41 Some extra lengths in various fabricated pipes given as erection allowance shall have to be cut and edges prepared to suit the site conditions at no extra cost. 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. Prepared edges to be preserved / applied with weldable primer.

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

1.14.2.43 For pipes nominal bore size 2” and below routing shall not be shown in piping layouts or in isometrics and the same to be routed / connected as shown in schematics. For the above sizes if the routing is shown in layouts it is only for guidance and the same shall be routed and supported as per site requirement / convenience as per site engineer’s advice.

1.14.2.44 For Piping of nominal bore size 2” and below, 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.

1.14.2.45 Contractor should fabricate bends of </=2” diameter size at site from running meters of piping for the above and cut, edge prepare and lay the piping as per BHEL Engineer’s instructions.

1.14.2.46 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., by grinding / gouging and not by hammering. 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.

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

1.14.2.48 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.,

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

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

1.14.2.51 Erection of Flow nozzles, flow orifices, flow switches, steam traps, filters, flow meters, flow indicators, other metering elements, spray nozzles, steam traps, flow orifices, flow indicators, control valves, aux. control valves, filters, suction strainers, CRH NRV and other NRVs, HPBP Valve and suction strainers of pumps, servomotors etc. forming part of the system (under this scope of work) irrespective of the suppliers is also to be carried out by the agency without any extra cost after chemical and / or steam blowing / oil flushing at site. This will include collecting from BHEL / Customer stores, transport to site, suitably cutting the erected piping, cleaning, erection, welding, radiography, NDE and stress relieving and commissioning.

1.14.2.52 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 dismount such instruments and re-erect whenever required prior to commissioning. Sometime this may have to be handed over to store or instrumentation contractor.

1.14.2.53 Fixing, fitting, welding of thermowells, 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 in the scope of this specification.

1.14.2.54 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.

1.14.2.55 Welding of all thermowells, draft, pressure and temperature instrumentation points and all other instrumentation points on piping and auxiliaries and welding of thermocouple pads for permanent system as well as for performance guarantee test is in the scope of work.

1.14.2.56 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 prefabricated clamping type ladders. No temporary welding on any structural member is permitted except under special circumstances with the approval of BHEL.

1.14.2.57 All thermowells (released under applicable PGMAs and loose received along with instruments) are to be fixed into the equipment and piping erected by PIPING agency as per drawing and same to be welded as per FQP within the quoted rates.

1.14.2.58 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.

1.14.2.59 The contractor shall take all reasonable care to protect the materials and equipment during erection. Touch up painting required to be done on any equipment or part during the course of erection will have to be done by the contractor.

1.14.2.60 The contractor shall also weld all thermowells, 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. Thermowells 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 thermowells and flow elements with branch pipes be installed and welded.

1.14.2.61 The hangers and supports for pipelines and pressure parts may be supplied in dismantled / knocked down condition. It is the responsibility of the contractor to assemble them as per approved drawings and install them in position as per site engineer instructions.

1.14.2.62 For hangers and supports the instruction given in the drawings and documents must be followed for handling, erection and setting of cold / hot values and locking etc.

1.14.2.63 Where the flange comes welded to the equipment, erection of counter flange, Hydrotesting and Normalisation of the line is under the scope of this contract. Where both the flange and counter flange come as loose items and need to be welded, the entire welding of flange and counter flange, Hydrotesting and Normalisation of the line are under the scope of this contract.

1.14.2.64 Wherever hangers 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 within quoted rate. 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.

1.14.2.65 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.

1.14.2.66 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.

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

1.14.2.68 Welding, non-destructive testing and heat-treatment as prescribed in BHEL Welding / Heat treatment manual is to be carried out by the contractor. The contractor shall conduct nondestructive 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 within the quoted rate.

1.14.2.69 The Matching Pieces / Nozzles / Reducers (including the reducers to be connected with HP Heaters) supplied for connecting BFP discharge piping to Boiler forming part of the systems are also in the scope of work including issue, transportation, suitably cutting the erected piping, cleaning, erection, welding, NDE and stress relieving and commissioning.

1.14.2.70 Cutting and removal of dummies for all the shop welded stubs (irrespective of the equipments supplier for the above) for all the terminal points and preparation of edge where the piping is to be terminated is also in the scope of the contractor without any extra payment.

1.14.2.71 The contractor shall fabricate piping, install lube oil systems, if any and carry out the acid cleaning of fabricated piping. The contractor shall also service the lube oil system, carry out the hydraulic test of oil coolers. etc.,

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

1.14.2.73 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.

1.14.2.74 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.

1.14.2.75 All the bearings, gearboxes etc., of the equipment / actuators 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. Lubricants will however be supplied by BHEL at free of cost.

1.14.2.76 The actuators / motors of valves may be supplied in loose parts, contractor shall have to match / assemble and align at site as per instructions of BHEL Engineer including placement on foundation.

1.14.2.77 All dimensions / elevations refers to centerline of pipe unless otherwise specified, the pipe routing shall be carried out as per the drawing. Wherever the dimensions are not specified / shown as approximate the same may be routed as per site requirement / convenience as per site engineer's advice.

1.14.2.78 Pipelines shall be cleaned off welding slag and burrs by hand files, wire brushes and flexible grinders wherever required and using cloth.

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

1.14.2.80 Please refer the "FIELD / ERECTION WELDING SCHEDULES" published under Chapter-2 of volume IA part II of this booklet.

1.14.2.81 Also refer "GUIDELINES FOR HEAT TREATMENT" and "GUIDELINES FOR WELDING" published under Chapter-3 and Chapter-4 respectively of Volume IA Part II of this booklet.

1.14.3 **INSTALLATION OF INSULATION**

1.14.3.1 Handling at site stores / storage yard, Transportation to site of work, Application of refractory & Insulation materials and connected works for Power cycle, LP and Turbine Piping, Gland Steam Piping, Vessels, equipments like Feed Pumps, Flash Tanks, HP and LP Heaters, Deaerator, FST, TDBFP and MDBFP Pumps etc., and binding and cladding with sheets etc., using their own tools plants, tackles, all

consumables, supervisor and men as enumerated in the scope of contract.

1.14.3.2 Application of refractory, wool insulation, sheet metal cladding, welding of hooks / supports to hold insulation and refractories under this contract including but are not limited to the following. Insulation of HP & LP piping, temporary acid cleaning and steam blowing piping connected tubes, all drain lines, traps, flanges, fine fittings, sampling lines etc.

1.14.3.3 Bidders to note that application of Insulation of Main Turbine, Turbine Integral Piping under Hardwar scope of supply, TDBFP Drive Turbine, Boiler and ESP are excluded from the scope of this contract.

1.14.3.4 All insulations and refractory materials including iron components and other sheets casing materials, etc., required as per drawing will be supplied by BHEL and the same have to be erected / applied as per the drawings and specifications of BHEL by the contractor.

1.14.3.5 Clean the Surface to be insulated from Rust, Dust, Grease, Loose scale, Oil, Moisture, etc. Care shall be taken that flexible insulation is not unduly compressed. After insulating the equipment, the gaps / joints shall be filled with loose wool / molded insulation as applicable.

1.14.3.6 Painting of inner side of sheet metal covering over the insulation walls with two coats of anti-corrosive paint (IS-158) to be applied to the entire satisfaction of BHEL Engineer and application of bituminous sealing compound on cladding / sheet metal joints shall also be carried out by the contractor. Retainer type 'A' must be coated with Aluminium paint. For which the required amount of paint, thinner and other accessories for painting, cleaning the surfaces etc., shall be SUPPLIED by the contractor within the quoted rate.

1.14.3.7 Bituminous sealing compound will be provided by BHEL free of cost which is supplied by the respective Manufacturing Units. However, supply and application of bituminous coating inside aluminium sheet is within the scope of the Contractor at no extra cost.

1.14.3.8 All the insulation, refractory materials and sheet metal covering etc., issued to the contractor shall be properly stored and handled before application of the same. If any damage occurs to the materials due to improper storage or due to any causes attributable to the contractor except for normal breakage or damaged material shall be to the cost of the contractor.

1.14.3.9 Contractor is liable for the exact accounting of the materials issued to him and any unaccountable losses shall be made good by him. The necessary accounting of the material issued will have to be furnished by the contractor periodically.

1.14.3.10 The contractor shall provide the required quantity of wire, nails and other materials for centering works at their cost.

1.14.3.11 Wherever iron components are to be welded on non-pressure parts, the contractor shall employ only approved structural welders. It shall also be the responsibility of the contractor to weld hooks, flats, plates, supports and other fixtures also. All consumables tools and plants etc., required for the work shall be arranged by the contractor at their cost.

1.14.3.12 Wool insulations are received at site as bonded and unbonded mattresses in standard sizes. These has to be dressed / cut to suit equipment / site work by the contractor.

1.14.3.13 Removal type of insulation to be provided for valves fittings, expansion joints etc., as per the drawings or as directed by BHEL Engineer.

1.14.3.14 All piping insulations shall be carried out in such a manner as to facilitate removal of bolts nuts and washers from the flanges.

1.14.3.15 Fabrication of covering sheets may be necessary like preparing the sheets to the sizes and shapes specified in drawings, beading, swaging, beveling of sheets crowning of the sheets if necessary the same to supports over wool insulation with screws as specified in BHEL drawings or as instructed by BHEL engineer.

1.14.3.16 Fixing or welding of hooks / supports to equipments, piping and other connected equipments to support wool insulation applying of primer paint to welded portion parts welding certain supports, by engaging approved welders on parts other than pressure parts to hold refractory's as per the drawings or as instructed by BHEL Engineer will have to be carried out by the contractor.

1.14.3.17 Fabrication, fixing or welding of hooks / supports to equipment piping and other connected equipments to support wool insulation applying of primer paint to welded portion parts welding certain supports on parts as per the drawings or as instructed by BHEL Engineer will have to be carried out by the contractor.

1.14.3.18 The contractor shall leave certain gap and opening while doing the work as per the instructions of BHEL Engineer to facilitate inspection by Boiler Inspector or doing commissioning to fix gauges, fittings, instruments. Those gaps will have to be finished as per drawings at a later date by the contractor at his cost, as required by BHEL .

1.14.3.19 Cladding sheets shall be suitably pressed along with diagonals to form diamond shape so as to improve the strength of the sheets, to avoid bumpiness and to give aesthetic look.

1.14.3.20 Plates, bars, rods and other materials that are to be cut, and re-welded from the fabricated places to suit erection requirements for which no extra

payment will be made to the contractor.

1.14.3.21 A log book shall be maintained by the contractor for the clearance of the area for application of refractory and insulation. If the contractor does the work on his own accord without prior permission the area should be redone at his cost.

1.14.3.22 The contractor shall draw only one week's requirement of material for their work from BHEL stores and keep them in their semi-closed shed near to the work area. The materials required for a particular space of work only shall be taken to the work spot. At the end of the day's work the leftover or unused materials shall be taken back to their semi-closed shed for keeping the materials safe. Necessary records shall have to be maintained by the contractor in respect of the above drawls / deposits, on daily basis as instructed by BHEL.

1.14.3.23 Welding of hooks as per pitch, non-pressure parts, applying primer paint to the welded portion as directed as per drawings before application of mineral wool mattresses will have to be done by the contractor.

1.14.3.24 Applying different layers of mineral wool as directed and as per drawings and specifications for pipelines valves and other vessels and after fixing require holdings materials, suitably if necessary, fabrication of rings etc., and fixing as directed and as per drawings and specifications shall also form part of this work.

1.14.3.25 If necessary the hooks may have to be made from the rods, raw materials supplied in running lengths. The contractor may have to carry out this work also and use the same hooks.

1.14.3.26 In case the contractor is required (which is not attributable to contractor) to dismantle and re-erect certain area as and when required for pre-commissioning / commissioning activities the rate as indicated in the rate schedule shall be paid by BHEL for erection. However, for dismantling no extra charge will be paid under any circumstances.

1.14.3.27 Wherever additional / clamps, frame works, etc., are required to be fabricated and installed even though not indicated in the drawings shall be fabricated and installed at their cost. Only steel materials shall be given by BHEL free of cost, consumables like electrodes, gases etc., are to arranged by the contractor at his cost.

1.14.3.28 The contractor shall provide any fixtures, concrete blocks / wooden sleepers, etc., which are required for temporary supporting of the insulation materials at site.

1.14.3.29 Welding of iron components directly on pressure parts and HP piping are to be carried out by certified IBR High Pressure welders.

1.14.3.30 Welding of iron components directly on pressure parts and HP piping **is** in the scope of this contract and are to be carried out by certified IBR high pressure welders. Bidder to arrange for the same within the quoted rates.

1.14.3.31 Application of insulation and removal of the same for temporary piping under scope of erection of this contract is also included in the scope of the work. However, BHEL will supply the insulation materials free of cost.

1.14.3.32 Dressing of insulation to suit site conditions, sheet cladding over insulations, form the part of this work.

1.14.3.33 Fabrication, fixing or welding of hooks / supports to equipment of piping and other connected equipments to support wool insulation applying of primer paint to welded portion parts welding certain supports on parts other than pressure parts to hold refractory's (by engaging approved welders) as per the drawings or as instructed by BHEL Engineer will have to be carried out by the contractor.

1.14.3.34 Wastages allowance for the materials issued are envisaged as follows:

a) Wool mattresses 2%
b) Cladding sheets 5%

1.14.3.35 In case the contractor is required to dismantle and re-erect certain area as and when required for pre-commissioning / commissioning activities the rate as indicated in the rate schedule shall be paid by BHEL for erection. However, for dismantling no extra charge will be paid under any circumstances.

1.14.3.36 Also refer 'General Guidelines for Insulation Works' published under Chapter-7 of Volume IA Part II of this booklet.

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:

(All the works mentioned hereunder shall be carried out within the accepted rate unless otherwise specified.)

1.15.1 The pressure parts, equipments and piping shall be erected in conformity with the provisions of Indian Boiler Regulations and as may be directed, as per other standard / specification in practice in BHEL. The method of welding (viz) ARC, TIG or other methods as indicated in the detailed drawing or as instructed by BHEL Engineer shall be followed. BHEL Engineer will have the option to change the method to suit site conditions.

1.15.2 The contractor has to establish the WPS (Welding Procedure Specification) and PQR (Procedure Qualification Requirement) applicable for the scope of work for all the materials involved at his own cost. However, Test Materials for the same will be given by BHEL free of cost.

1.15.3 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.

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

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

1.15.6 Erection of equipment involves good quality of Welding, Heat treatment and Non Destructive Testing. Wherever required, 100% dye penetrant tests have to be carried out as per instructions of BHEL Engineer. Contractor's Engineers, Supervisors, Technicians and workers engaged should have adequate knowledge on the above works.

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

1.15.8 Welding electrodes for welding shall be procured from Customer / BHEL approved vendors only.

1.15.9 For Stainless Steel pipe, welding procedure will be as per BHEL site Engineer's directive. During the root runs of stainless-steel joints, if required, the contractor shall carry out purging the pipes with inert gas before and during welding.

1.15.10 Welding of pressure parts, piping & fittings (under IBR code), high tensile structural steel 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 and who are approved by BHEL Engineer. The High-pressure welder who possesses necessary certificate shall ensure re-validation as per relevant provisions of IBR and keep the certificate valid till the completion of work. The services of such welders, the validity of whose certificates have expired shall not be utilized for high pressure works.

1.15.11 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.

1.15.12 BHEL Engineer is entitled to stop any Welder from the work if his performance is unsatisfactory for any technical reasons or if there is a high percentage of rejection of joints welded by him, which in opinion of the BHEL Engineer, will adversely affect the quality of the welding though the Welder has earlier passed the tests prescribed by BHEL Engineers. The welders having passed qualification tests do not absolve the contractor of contractual obligation to check the welder’s performance.

1.15.13 The contractor shall carry out the root run welding of all HP / LP piping, valves by TIG welding method as specified in the drawings / EWS (Erection welding Schedule). Contractor to note that the EWS forms the part of this booklet (Volume-IA) of this tender specification. The contractor shall have to carry out full TIG welding of butt weld joints of tubes / pipes of lesser thickness if required.

1.15.14 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.

1.15.15 All butt Joints shall be carried out by TIG root run and subsequent runs by Arc welding. Full TIG welding, wherever necessary shall be carried out within the quoted rates. For oil system piping root run of all the butt joints shall be carried out by TIG welding only.

1.15.16 For approval of contractor's welders for engaging in the erection work, all

expenses for testing of welders including destructive and non-destructive tests conducted by BHEL or by the inspecting authority 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 and all testing facility shall be made available by the contractor.

1.15.17 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.

1.15.18 The electrodes brought to the site will have valid manufacturing test certificate. The test certificate should have a co-relation with the lot number / batch number given on electrode packets. No electrodes will be used in the absence of above requirement. The thermostat and thermometer of electrode drying oven will be also calibrated and test certificate from Govt. approved / accredited test house traceable to National / International standards will be submitted to BHEL before putting the oven in use. The contractor shall also arrange periodical calibration for the same. Separate ovens shall be used for baking and holding.

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

1.15.20 The contractor shall deploy required number of High-pressure welders to carry out the high-pressure weld joints. The welding works should not be held up due to shortage / want of I.B.R./ High pressure welders.

1.15.21 The contractor shall maintain a record in the format as prescribed by BHEL of all operations carried out on each weld and 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 otherwise of the welds shall be final. All site welds shall be subject to acceptance of BHEL / Customer Engineers.

1.15.22 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.

1.15.23 Faulty welds caused by the poor workmanship shall be cut and re-welded at the contractor's expense. Prior to any repair, approval shall be obtained

from BHEL Engineer for the procedure for the repair of defective welds. After the repair has been carried out, the compliance document shall be submitted to the quality engineer.

1.15.24 All necessary preheating, post heating of welds and stress relieving operation of welds are part of the erection work and shall be performed by the contractor in accordance with the relevant regulations and standards of BHEL practice and to the satisfaction of BHEL Engineer and in accordance with the drawings and specifications.

1.15.25 Pre-heating, radiography and other NDE, post weld heating and stress relieving after welding of tubes, pipes 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 and as specified in Erection Welding Schedule, Welding, Heat Treatment & NDT manuals and FQP. Contractor at his cost shall arrange all equipment and consumables essential for carrying out the above process.

1.15.26 Contractor shall arrange all necessary Preheating, post weld heating, 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.

1.15.27 **P 91 WELDING**

The induction heating equipments and other accessories shall be drawn from BHEL stores, transported and installed & commissioned wherever required. For routine maintenance & attending all type of break- down maintenance contractor shall deploy sufficient manpower, tools, and plant with in quoted price. The contractor shall provide electrical cables & switches required. All the equipments shall be protected by providing

covers and sheds at site by the contractor with in quoted rate.

Also refer clauses in Chapter IV and chapter V of Part I of Technical Conditions of Contract (Volume-I Book-I) regarding P91 welding.

1.15.28 Welding of Hangers, supports, stubs and impulse piping to be carried out by the contractor as per drawing specification and as per BHEL engineer's instructions. According to drawing specifications and as per BHEL Engineers instructions pre heating, post heating, stress reliving, etc. have to be carried out by the contractor wherever necessary.

1.15.29 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 Piping & other equipments has to be carried out by the Contractor within quoted rates.

1.15.30 All the prepared / patched edges will have to be suitably protected to prevent rusting or foreign material ingression.

1.15.31 For thermowell welding with carbon steel / alloy steel welding applicable combination of electrodes shall be arranged by contractor with in quoted rate.

1.15.32 The regulators used on welding machines shall be calibrated before putting these into use for work. The Contractor at his cost shall also arrange periodic calibration for the same.

1.15.33 The thermostat and thermometer of electrode drying oven shall be also calibrated. All welders shall have electrodes drying portable oven at the work spot.

1.15.34 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.

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

1.15.36 The contractor for radiography work shall use iridium-192 / Cobalt 60; the geometric un-sharpness shall not exceed 1.5 mm. The contractor should take adequate safety precautions while carrying out radiography. Contractor at his cost shall arrange necessary safe guards required for radiography (including personnel from BARC).

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

1.15.38 All radiographs shall be free from mechanical / chemical process marks to the extent they shall not confuse the radiographic image and defect finding. Penetrometer, as per ASME or ISO or IS must be used for each exposure.

1.15.39 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.

1.15.40 Lead intensifying screens for front and back of the film shall be used as per ASME specification or as per the instructions of BHEL Engineer.

1.15.41 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 downstream side of the weld. For multiple exposures on pipes, an overlap of about 25 mm of film shall be provided.

1.15.42 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.

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

1.15.44 In case of radiography of less than 100%, the joints identified by BHEL at random shall be radiographed.

1.15.45 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.

1.15.46 All the radiographs shall be properly preserved in air-conditioned rooms and shall become the property of BHEL. They are to be reconciled with the work done, joints radiographed and submitted to BHEL / customer.

1.15.47 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 welder is unsatisfactory, he is to be replaced immediately.

1.15.48 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.

1.15.49 All arrangements for carrying out radiography work including radiography source & equipments and consumables, 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 shall be submitted and got approved by BHEL Engineer before the actual deployment of agency for radiography work.

1.15.50 The contractor shall arrange air conditioned dark room, radiography equipments, films, chemicals and other dark room facilities. The air conditioned dark room shall be 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. There must be sufficient 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.

1.15.51 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.

1.15.52 Contractor shall provide all skilled, unskilled work men required for the job, which will include Engineers, supervisors, operators, as required for timely and satisfactory execution of radiography work. 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 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.

1.15.53 All welds shall be painted with primer as specified in the painting schedule, once radiography and stress relieving works are over. Necessary consumables and scaffolding etc including paints shall be provided by contractor at his own cost.

1.15.54 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.

1.15.55 Wherever radiographs are not accepted on account of poor exposure / bad

shot, joints shall be re-radiographed and the film of the same shall be submitted for evaluation. Radiographs shall be taken again on joints after carrying out repairs. 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.

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

1.15.57 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 includes such preparation and no extra charges are payable for this.

1.15.58 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.

1.15.59 The welded surface irrespective of place of welding shall be cleaned of slag and painted with primer paint to prevent corrosion at no extra cost towards this including supply of Paint for this purpose.

1.15.60 All welders shall be tested and approved by BHEL Engineer before they are actually engaged on work though they may possess the IBR certificate. BHEL reserves the right to reject any welders without assigning any reason. The welder Identification code as approved by the BHEL Engineer shall be stamped by the welder on each joint done by them. The contractor will be responsible for the periodic renewal, retesting of the welders as demanded by BHEL.

1.15.61 The welding process, weld joint details, joint configuration and material specification may change to suit the design requirements. The contractors 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.

1.15.62 Heat treatment details of welds indicating minimum, Temperature recorded, Heating rate, cooling rate, soaking time etc. shall also be recorded and documented by the contractor as per BHEL Engineers instructions. Welder’s performance record shall be furnished every month. The performance report of welders shall be indicating the percentage of repair for each welder.

1.15.63 All the data such as heating temperatures, heating rate, soaking time, maximum temperature reached during heat treatment shall be properly recorded and documented which will be property of BHEL.

1.15.64 All stress reliving 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 starting of SR operations.

1.15.65 For higher thickness joints for which radiography plugs are not provided, alternate NDE methods such as ultra sound examination as instructed by BHEL engineer shall be conducted with in the quoted rate.

1.15.66 Quantum of radiography (percentage of joints) shall be enforced as per specifications and as per the drawings. BHEL Engineer reserves the right to alter the quantum of radiography of joints. The decision of the BHEL Engineer in this regard is fixed and final and binding on the contractor. Any defects as pointed out by BHEL Engineer shall have to be rectified by the contractor at his cost.

1.15.67 If the contractor does not carry out radiography work in time due to non-availability of film, chemical etc. BHEL shall get the work done through some other agency at the risk and cost of the contractor.

1.15.68 Radiography work of the 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 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.

1.15.69 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 BHEL drawings / IBR Regulations. At the discretion of BHEL Engineer / Boiler inspection authority, they may however be increased depending upon the performance of the individual welder. It is the responsibility of the contractor to get the IBR clearance, wherever required including arranging for IBR Inspection.

1.15.70 All field joints shall be subjected to dye penetrant examination as specified

in the respective drawings and shall have to be accepted by BHEL Engineer. Any rectifications required shall have to be done by the contractor at his cost.

1.15.71 Oxy-acetylene flame heating or exo-thermic chemical heating for stress relieving is not permitted. Heating shall be by means of Electric Induction coil or Electric resistance coil. Potentiometric type recorders shall only be used for temperature recording purposes.

1.15.72 Please refer the “FIELD / ERECTION WELDING SCHEDULES” published under Chapter-9 of volume IA part II of this booklet.

1.15.73 Also refer “GUIDELINES FOR HEAT TREATMENT” and “GUIDELINES FOR WELDING” published under Chapter 6 and Chapter 7 respectively of Volume IA Part II of this booklet.

1.15.74 Also refer the clauses on FACILITY TO BE PROVIDED BY THE CONTRACTOR FOR P91 WELDING in Chapter-IV of Technical Conditions of Contract (Volume-I Book-I).

1.15.75 For Extra Works, refer GCC Rev 02 clause no 2.15.

VOLUME-IA PART-I CHAPTER – XVI HYDRAULIC TEST, PRE-COMMISSIONING AND POST COMMISSIONING

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

(All the works mentioned hereunder shall be carried out within the accepted rate unless otherwise specified.)

1.16.1 All required tests 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. The contractor shall carryout all tests 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.

1.16.2 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, commissioning of piping and the other equipments, even though the delay reasons are not attributable to the contractor.

1.16.3 The contractor shall carryout the required tests on the equipments & pipelines, such as gas tightness test / air tightness test, kerosene test, hydrostatic test 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. of equipments and the same shall be carried out by contractor as per requirement. Compressed air for pneumatic testing is to be arranged by contractor. 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 dry out to be done by the contractor to improve the IR value at no extra cost.

1.16.4 During the initial stages of work, trenches for draining water may not be available after Leak test, Hydro test, Flushing or mass flushing. For discharging / emptying the equipment, system and piping, necessary low point drains and temporary piping up to safe location are be erected by the contractor at his cost. The materials will be provided by BHEL.

1.16.5 In case any erection defect and / or malfunctioning is detected during various tests / operations, trial runs as detailed above, such as loose components, undue noises, vibration, strain on connected equipment, steam / oil / water

leakage, etc. the contractor shall immediately attend these defects and take necessary corrective measures. If any readjustment and re-alignments are necessary, the same shall be done as per BHEL Engineer's instructions. If any part needs repairs rectification and replacement the same shall be done by the contractor at no extra cost. The parts to be replaced shall be provided by BHEL free of cost. If 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.

1.16.6 For conducting Hydro test / steam blowing of MSL, CRH & HRH internals of valves and NRVs (LP BP, ESV, IV & LP BP Valves & NRVs) are to be removed, Hydro Test devices are to be fixed and after Hydro Test the internals are to be re-assembled by the contractor as instructed by BHEL without any additional cost.

1.16.7 Temporary blinds / lugs / caps of piping and associated equipments like tanks, pumps etc. required for oil flushing / alkali cleaning / acid cleaning of piping & other equipments during erection & pre-commissioning shall be erected by contractor within the quoted rate.

1.16.8 During Commissioning, opening / closing of valves, changing of gaskets, attending to leakage and adjustments of erected equipment may arise. Contractor may have to replace old / damaged gaskets / packing etc. for equipments and the same shall be carried out by contractor as per requirement. The finally accepted price / rates shall also include all such work.

1.16.9 Replacing / cleaning of filters of the erected equipments and piping system etc., during pre-commissioning / commissioning stage is within the scope of work.

1.16.10 During steam blowing operations the required manpower for fixing the target plates shall be arranged by the contractor as per the instructions of BHEL Engineer within the quoted rates. The manpower for the above operation may be required round the clock if necessary. The contractor shall carry out the above operation as per the instructions of BHEL Engineer within the quoted rates.

1.16.11 Main Steam Line Strainers bodies are erected first before steam blowing of the lines. After Hydraulic Test, the strainer elements are fixed. During trial operation, if required the strainers are removed for inspection of debris & cleaning. Contractor has to carry out the work as part of his work without any extra cost.

1.16.12 Cleaning of strainers erected is the responsibility of the contractor during pre-commissioning and commissioning activities.

1.16.13 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, transporting & adding of chemicals / consumables and attending any problem in the equipment erected by the contractor till handing over. The contractor will provide necessary consumables in his scope, 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.

1.16.14 **After synchronization, the commissioning activities and trial operations will continue up to handing over. 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 consumables, hand tools, supervision etc. as part commissioning assistance for equipment erected by the contractor till handing over of sets to customer**. The rate quoted shall include 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. Mill Wright Fitters
c. HP / Structural welders
d. Riggers
e. Unskilled workers
f. Supervisors
g. Electricians
h. Any other category of workers as may be required

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

1. One supervisor per shift for three shifts
2. Two fitters per shift for three shifts
3. Two helpers per shift for three shifts.

It shall be specifically noted that the contractor may have to work round the clock during the pre-commissioning, commissioning and post-commissioning period along with BHEL Engineers and hence considerable overtime payment is involved. The contractor's quoted rates shall be inclusive of all these factors.

1.16.15 Steam blowing of system piping if required will involve laying of temporary pipe lines, valves, etc. and dismantling & restoration of piping. The required steam shall be provided at a central point by BHEL.

1.16.16 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 supply necessary labour and other services and make necessary arrangements to carry out the required tests as per the instructions and directions of the BHEL Engineers.

1.16.17 Contractor has to arrange Hydraulic Test pump / Hand Pump at his cost for Hydraulic testing of LP lines.

1.16.18 Hydraulic testing pumps for High Pressure lines 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.

1.16.19 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.

1.16.20 Contractor at his cost shall lay all necessary temporary piping, install the pumps, blanks, valves required for the test, pressure gauges etc. Required pipes, valves, plates etc., will be given by BHEL. Temporary piping, pumps, valves, flanges, blanks etc. shall be removed by him and returned to BHEL. All thermowell 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.

1.16.21 All welded joints for temporary piping required for alkali flushing, acid cleaning and steam blowing should be got done by High Pressure welders only. The root run should be done by TIG welding. All arrangements required for the above shall be the responsibility of the contractor at no additional cost.

1.16.22 Welding and stress relieving of temporary blanks or suitably fixing temporary blank flanges with gaskets and fasteners and welding and providing suitable de-aeration / 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 without charging extra. 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.

1.16.23 The contractor shall make all necessary arrangements including making of temporary closures / dummy on piping / equipment for carrying out the

hydro-static testing on all piping, equipment covered in the specification at no extra cost. Necessary blanks will be provided by BHEL.

1.16.24 Providing dummy / plugs for the thermowell points during hydro test / steam blowing shall be done by the contractor within the quoted rate. During hydro test, pipe end dummy if required shall be supplied by BHEL, plates shall be cut for the requirement and shall be returned back to BHEL Stores.

1.16.25 After hydro test / steam blowing during the restoration works, it is the responsibility of the contactor to ensure the removal of dummy/plugs and edge preparation for the thermowell stubs if required within the quoted rate.

1.16.26 Hanger adjustment / readjustment 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.

1.16.27 In general, Hydraulic testing of piping shall be performed after all eventual pipe branches have been completed and valves installed. Should it be required to hasten erection work, pressure tests may be performed by sections. For this scope of work, the erected pipe lines shall be hydraulically tested as per site requirement in segments. For conducting hydraulic test, both ends of pipe lines shall be blanked by welding of plates. Only one or two set of plates and structural materials for blanking required for one segment will be provided by BHEL free of charge. After completion of hydraulic test in one segment, the same plates are to be cut and removed and utilized / welded on the other segment of the pipe lines, to carry out the hydraulic test for the respective segments. No separate plates for blanking for each segment will be provided. After completion of Hydraulic test, the required edge preparations shall be carried out on the end of pipe lines and to be welded with the respective pipe lines. In such cases joint connection shall be checked during a final and additional test, if required. The contractor shall note this aspect and quote accordingly.

1.16.28 During hydraulic test, the pipes being tested shall be isolated from the equipments to which they are connected.

1.16.29 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.

1.16.30 The contractor shall carry out all the required tests and pre-commissioning and commissioning activities required for successful and reliable operation. These would include hydraulic test of piping, pre-boiler system detergent flushing / chemical cleaning, steam blowing, water washing etc. as instructed by BHEL using contractors own labour and scaffoldings etc.,

1.16.31 All the tests shall be repeated till all the pipelines / equipments satisfy the requirements / obligation of BHEL to their customer. As far as the hydraulic pressure test is concerned, the same shall be conducted at various stages to the satisfaction of BHEL / Boiler Inspector / Customer Engineers. Any rectifications required shall have to be done / redone by the contractor at his cost.

1.16.32 Test records shall be made for pressure testing of above piping system. These records shall contain the following information:

a) Date of test
b) Identification of piping tested
c) Test fluid
d) Test pressure
e) Approval of the Engineer.

1.16.33 The scope of pre-commissioning activities covers installation of all necessary equipment including temporary piping, supports, valves, blanking, pumps, tanks, with access platforms valves, dummy plates & other miscellaneous equipment etc. along with accessories required for hydro test, pre-boiler system detergent flushing / chemical cleaning, steam blowing or for any other tests on piping. The scope also covers the offsite disposal of effluents.

1.16.34 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 as a part of work. The quoted rate shall be inclusive of all this.

1.16.35 Temporary lines for chemical cleaning shall be erected as per the instructions of BHEL Engineer. Necessary pipes and other items will be supplied by BHEL free of cost. 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.

1.16.36 Temporary lines for Steam blowing / chemical cleaning of Power Cycle piping shall be erected as per the instructions of BHEL Engineer. Necessary pipes, valves 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 chemical cleaning, all the temporary lines to be dismantled and restoration of piping to be carried out, within quoted rate. The required steam shall be provided at a central point by BHEL.

1.16.37 Contractor shall lay the temporary pipelines with fittings, accessories and erection & commissioning of 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 are within the scope of work. Necessary materials for this will be provided by BHEL. Overhauling / cleaning / revisioning / servicing of valves, fittings in temporary system and acid cleaning tanks for re-commissioning activities / operation like water flushing / steam blowing / washing / flushing / passivation / chemical cleaning etc., and also over hauling / revisioning of the pumps & equipments and also to carry out the repairs to attend leaks etc., in the temporary piping & equipments, prior & while carrying out the above operations / activities. All the above works are within the scope of work. All the chemicals will be supplied by BHEL free of cost.

1.16.38 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, 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 carried out by the contractor. Required materials will be provided by BHEL free of cost. Chemicals for chemical Cleaning will be provided by BHEL. All other consumables are to be provided by the contractor.

1.16.39 All items / materials (Including Chemicals) required for conducting hydraulic test, pre-Boiler system detergent flushing / chemical cleaning, steam blowing etc., will be supplied by BHEL. However, fabrication, servicing, erection, dismantling and returning of the same to stores are 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.

Dismantling of the temporary equipment and piping will be done by the agency that has erected the equipment. He will also return the equipment to the stores. The quoted rate shall be inclusive of all this.

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

1.16.40 During commissioning opening of valves changing of gaskets attending to leakages, minor modification, and rectification works may arise. The contractor has to carry out these works at his cost by providing required manpower with T & Ps in all the three shifts.

1.16.41 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.

1.16.42 Contractor shall cut open the 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.

1.16.43 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.

1.16.44 All the valves, Actuators will have to be checked, cleaned, lapped or overhauled / serviced in full or in parts before erection, prior to pre – commissioning, during commissioning and Trial operation. 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. The contractor, at his own cost, shall arrange experienced technicians for the above work, including required consumables.

1.16.45 Necessary scaffolding and approaches for conducting the above shall also be within the scope of the contract.

1.16.46 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.

1.16.47 During this period, though BHEL's and customer's staff also be associated in the work, it is the contractor's responsibility to make available the resources in his scope till such time the commissioned units are taken over by the customer / BHEL.

VOLUME-IA PART- I CHAPTER-XVII

PAINTING

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

(All the works mentioned hereunder shall be carried out within the accepted rate unless otherwise specified.)

1.17 FINAL PAINTING

1.17.1 The scope of work shall also include supply and application of final painting of all the erected equipments as required and specified in the BHEL / Customer / Customer Consultant's painting specification / scheme that forms the part of this tender for the components of all piping & its auxiliaries and other equipments erected under the scope of this tender. Supply & application of primer & finish paints are included in the scope of work.

1.17.2 Required paints, thinner other consumable such as wire brush, brush etc. shall have to be arranged by the contractor at their own cost. The required manpower, other required consumables, T & P etc. shall be provided by the contractor within the quoted rate. The arrangement of primer/paint will be in contractor's scope.

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

1.17.4 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.

1.17.5 Normally Paint shall be applied by brushing as per the instruction of BHEL Engineer. It shall be ensured that brush marks are minimum. If needed and insisted either by BHEL engineer or the BHEL client, in certain cases, spray painting has to be done wherever brush painting is not accessible, by the contractor, within the quoted rates. Contractor has to carryout painting as per the procedure lay down by the customer.

1.17.6 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.

1.17.7 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 manufacturer's instructions shall be followed in method of application, handling, drying time etc.,

1.17.8 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.

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

1.17.10 Finish coat paint, Number 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 mentioned in Volume-IA part-II Chapter-3 of this booklet which is forming part of this tender shall be used as guidelines to be followed.

1.17.11 The scope of painting includes application of color 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.

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

1.17.13 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. The batch certificates of paints to be submitted to BHEL Engineer before using the same.

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

1.17.15 Primer painting after proper surface cleaning wherever required to be done as per site requirement over all surfaces to be insulated prior to the application of the insulation. This is to be done as a part of contract without any additional charges.

1.17.16 Painting of inner side of sheet metal covering over the insulation walls with two coats of anti-corrosive paint (IS-158) to be applied to the entire satisfaction of BHEL Engineer and application of bituminous sealing compound on cladding / sheet metal joints shall also be carried out by the contractor. Retainer type 'A' must be coated with Aluminium paint. For which the required amount of paint, thinner and other accessories for painting, cleaning the surfaces etc., shall be arranged by the contractor within the quoted rate.

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

VOLUME-IA PART – II CHAPTER 1

CORRECTIONS / REVISIONS IN SPECIAL CONDITIONS OF CONTRACT, GENERAL CONDITIONS OF CONTRACT AND FORMS & PROCEDURES

Sl. No: 1

Clause 4.1.11 of SCC is deleted.

Sl. No: 2

OCCUPATIONAL HEALTH, SAFETY & ENVIRONMENT MANAGEMENT/ QUALITY ASSURANCE PROGRAMME

The following clauses in Occupational Health, Safety & Environment Management / Quality Assurance Programme published in Chapter-IX of Special Conditions of Contract (Volume I Book-II) is revised as under.

Chapter IX Clause 9.1 is modified as below:

Contractor will comply with HSE (Health, Safety & Environment) requirements of BHEL as per the "HSE Plan for Site Operations by Subcontractor" (Document No. HSEP: 14 Rev01) enclosed.

Chapter IX Clause 9.1.1 to 9.1.25 stands deleted.

Chapter IX Clause 9.2 to 9.62 stands deleted.

Sl. No: 3

Clause No. 10.5 on RA Bill Payments, in Special Conditions of Contract (SCC), Volume- IB, Book- II, is revised as under:

The payment for running bills will normally be released within 30 days of submission of running bill complete in all respects with all documents. It is the responsibility of the contractor to make his own arrangements for making timely payments towards labour wages, statutory payments, outstanding dues etc., and other dues in the meanwhile.

Sl. No: 4

The following clause is added under clause 1.10 Security Deposit in General Conditions of Contract (Volume I Book II):

"1.10.8 Bidder agrees to submit Security Deposit required for execution of the contract within the time period mentioned. In case of delay in submission of Security Deposit, enhanced Security Deposit which would include interest (Base rate of SBI +6%) for the delayed period, shall be submitted by the bidder. Further, if Security Deposit is not submitted till such time the first bill becomes due, the amount of Security Deposit due shall be

recovered as per terms defined in NIT/contract, from the bills along with due interest."

Sl. No: 5

In addition to clause 2.7.9 of General Conditions of Contract (GCC), a New clause 2.7.9.1 is added as below.

2.7.9.1 Penalty for Intermediate Milestones

2.7.9.1.1 M1 and M2 shall be intermediate Milestones for this work.

2.7.9.1.2 In case of slippage of these identified Intermediate Milestones, Delay Analysis shall be carried out on achievement of each of these two Intermediate Milestones in reference to Form 14.

2.7.9.1.3 Incase delay in achieving M1 milestone is solely attributable to the contractor,0.5% per week of executable contract value* limited to Maximum 2% of executable contract value will be withheld.

2.7.9.1.4 Incase delay in achieving M2 milestone is solely attributable to the contractor,0.5% per week of executable contract value* limited to maximum 3% of executable contract value will be withheld.

2.7.9.1.5 Amount already withheld, if any, against slippage of M1 milestone, shall be released only if there is no delay attributable to contractor in achievement of M2 milestone.

2.7.9.1.6 Amount required to be withheld on account of slippage of identified intermediate milestone(s) shall be withheld out of respective milestone payment and balance amount (if any) shall be withheld @10% of RA Bill amount from subsequent RA bills.

2.7.9.1.7 Final deduction towards LD (if applicable), on account of delay attributable to contractor shall be based on final delay analysis on completion / closure of contract. Withheld amount, if any due to slippage of intermediate milestones shall be adjusted against LD or released as the case may be.

2.7.9.1.8 In case of termination of contract due to any reason attributable to contractor before completion of work, the amount already withheld against slippage of intermediate milestones shall not be released and be converted in to recovery.

Note: *Executable contract value-value of work for which inputs/fronts were made available to contractor and were scheduled for execution till the date of achievement of that milestone.

Sl. No.: 6

Procedure 2.3 that forms the part of the "Forms and Procedures (Volume 1 Book 2)" is published as chapter 14 in Volume 1A Part II of this booklet (Volume-I Book-I).

Sl. No: 7

Reverse Auction

The chapter Reverse auction procedure published in 'Forms and Procedures' of Volume I Book-II stands deleted. (Explanation: Reverse Auction is not applicable for this tender).

Sl. No: 8

Existing format on BANK GUARANTEE FOR SECURITY DEPOSIT as available in Form No F-11 (Rev 00) of Volume ID Forms and Procedure stands deleted. Refer proforma of Bank Guarantee (in lieu of Security Deposit)- Form WAM 22 provided in Volume IA Part II Chapter 13.

Sl. No: 9

Existing format on Monthly Plan Review of Contractor, as available in Form No F-14 of Volume ID Forms and procedure stands Deleted. Form No.- F-14 (Rev 01) is enclosed as Volume IA Part II Chapter 9.

Sl. No: 10

Existing format on Monthly Performance Evaluation of Contractor, as available in Form No F-15 of Volume ID Forms and procedure stands Deleted. Form No.- F-15 (Rev 02) is enclosed as Volume IA Part II Chapter 10.

Sl. No: 11

Existing format for Integrity Pact, as available in Volume ID Forms and procedure stands Deleted. Revised Format is enclosed in NIT.

VOLUME-IA PART – II

CHAPTER 2 to 14

In next 417 pages as below

Description	Chapter	No. of pages
Field/ Erection Welding Schedule	Chapter-2	95
Painting Scheme	Chapter-3	18
Guidelines for Heat treatment	Chapter-4	18
Guidelines for welding including erection welding practice for SA335P91 materials	Chapter-5	98
Guidelines for NDE and Heat Treatment Agency	Chapter-6	13
General Guidelines for Insulation Works	Chapter-7	54
"HSE Plan for Site Operations by Subcontractor" (Document No. HSEP: 14 Rev00)	Chapter-8	82
Format for Form no.: F-14 (Rev 01); Monthly Plan & Review with Contractor	Chapter-9	06
Format for Form no.: F-15 (Rev 02); Monthly Performance-Evaluation of Contractor	Chapter-10	06
Hire charges on issue of capital tools & Plants (Only corresponding charges)	Chapter-11	10
Proforma of Bank Guarantee (in lieu of Earnest Money)- Form WAM 23	Chapter-12	03
Proforma of Bank Guarantee (in lieu of Security Deposit)- Form WAM 22	Chapter-13	03
Procedure 2.3 for conduct of conciliation proceedings	Chapter-14	11

ERECTION / FIELD WELDING SCHEDULE

PROJECT : KOTHAGUDAM 1X800MW
CONTRACTOR : M/S BHEL

CUST. NO : 7268
PGMA : 80-303
SYSTEM : MS PIPING TO AUX PRDS

REV. NO. : 00
WELDING CODE : IBR / ASME
PAGE NO : 01 OF 02

SL. NO.	DRG NO. FOR WELD LOCATION IDENTIFICATION MARK	DESCRIPTION OF PARTS TO BE WELDED	MATL.SPEC. (ATT)	DIMENSIONS SIZE OD mm	DIMENSIONS THICK mm	PROCESS OF WELDING	TYPE OF WELD	ELECTRODE FILLER SPEC. (ATT) TIG QTY(gms)	ARC SPEC. QTY(NOS.) ø2.5	ø3.2	ø4.0	W.P.S NO.	MIN. PRE HEAT TEMP. °C	HEAT TREATMENT TEMP. °C	HEAT TREATMENT HOLD TIME	NDT METHOD/ QUANTUM	REF. SPEC. NO.	ACC. NORM REF.	REMARKS
		PART-1	PART-1																
		PART-2	PART-2				QTY	ø2.4											
01	1-80-303-21119	PIPE FITTING	SA335P91 SA234WP91	219.1	34	TIG & ARC	34 V	ER90SB9	E9015B9			1050 REV 05	220	755 ±15	2.5 Mts PER mm min 60 min	100% UT & 100% MPI	*	*	100% HARDNESS
		PIPE FITTING/VALVE	SA335P91 SA234WP91/F91				17	1020	306	425	901								
02	1-80-303-21119	PIPE	SA335P22	457.2	9.53	TIG & ARC	9.53 V	ER90SB3	E9018-B3			1038 REV 04	220	750 ±20	2.5mtS PER mm minimum 60 min	RT 100%	*	*	100% HARDNESS
		VALVE	F91				1	150	34	53	–								
03	1-80-303-21119	PIPE	SA335P11	457.2	20	TIG & ARC	9.53 V	ER80SB2	E8018B2			1012 REV 04	150	680 TO 720	2.5mtS PER mm minimum 60 min	RT 100%	*	*	3% HARDNESS
		FITTING	SA234WP22				1	158	34	53	–								
04	1-80-303-21119	PIPE	SA335P11	457.2	20	TIG & ARC	9.53 V	ER70SA1	E7018-1			1033 REV 03	150	660±10	2.5mtS PER mm minimum 60 min	RT 100%	*	*	3% HARDNESS
		FITTING	SA105				1	150	34	53	41								
05	1-80-303-21119	PIPE FITTING	SA106GRB SA234WPB	457.2	9.53	TIG & ARC	9.53 V	ER70SA1	E7018-1			1003 REV 03	10	–	–	RT 10%	*	*	
		PIPE FITTING/VALVE	SA106GRB SA234WPB/WCB				7	1050	238	371	–								
06	1-80-303-21119	PIPE	SA106GRB	219.1	6.35	TIG & ARC	6.35 V	ER70SA1	E7018-1			1003 REV 03	10	–	–	RT 100%	*	*	
		FITTING PLATE	SA234WPB SA515GR70				2	142	74	–	–								

NOTES: 01. * REFER NDE MANUAL DOC NO. AA/CQ/GL/011 REV 00 dtd 24.10.16

PREPARED	DESIGN/CHD.	DESIGN/APPD.	CHD./APPD. – QA	DATE	DRAWING NO.	REV.
RAJESH KUMAR	DHINESH	S.RAMAMURTHY	C.HARITHA	10.03.17	4-80-303-79794	00

ERECTION / FIELD WELDING SCHEDULE

PROJECT : KOTHAGUDAM 1X800MW
CONTRACTOR : M/S BHEL

CUST. NO : 7268
PGMA : 80-303
SYSTEM : MS PIPING TO AUX PRDS

REV. NO. : 00
WELDING CODE : IBR / ASME
PAGE NO : 02 OF 02

SL. NO.	DRG NO. FOR WELD LOCATION IDENTIFICATION MARK	DESCRIPTION OF PARTS TO BE WELDED	MATL.SPEC. (ATT)	DIMENSIONS SIZE OD mm	DIMENSIONS THICK mm	PROCESS OF WELDING	TYPE OF WELD	ELECTRODE FILLER SPEC. (ATT) TIG QTY(gms) ø2.4	ELECTRODE FILLER SPEC. (ATT) ARC SPEC. QTY(NOS.) ø2.5	ø3.2	ø4.0	W.P.S NO.	MIN. PRE HEAT TEMP. °C	HEAT TREATMENT TEMP. °C	HEAT TREATMENT HOLD TIME	NDT METHOD/ QUANTUM	REF. SPEC. NO.	ACC. NORM REF.	REMARKS
		PART-1	PART-1				QTY												
		PART-2	PART-2																
07	1-80-303-21119	PIPE	SA335P22	457.2	9.53	TIG & ARC	9.53V	ER90SB3	E9018B3			1014 REV 03	150	700 ±20	2.5 Mts PER mm min 60 min	100% RT	*	*	3% HARDNESS
		FITTING	SA234WP22				1	150	34	53	–								

NOTES: 01. * REFER NDE MANUAL DOC NO. AA/CQ/GL/011 REV 00 dtd 24.10.16

PREPARED	DESIGN/CHD.	DESIGN/APPD.	CHD./APPD. – QA	DATE	DRAWING NO.	REV .
RAJESH KUMAR	DHINESH	S.RAMAMURTHY	C.HARITHA	10.03.17	4-80-303-79794	00

ERECTION / FIELD WELDING SCHEDULE

PROJECT : KOTHAGUDAM 1X800MW
CONTRACTOR : M/S BHEL

CUST. NO : 7268
PGMA : 80-307
SYSTEM : HP & LP BYPASS WARMUP

DOC.NO. : NA
REV. NO. : 00
WELDING CODE : IBR / ASME
PAGE NO : 01

SL. NO.	DRG NO. FOR WELD LOCATION IDENTIFICATION MARK	DESCRIPTION OF PARTS TO BE WELDED	MATL.SPEC. (ATT)	DIMENSIONS SIZE OD mm	DIMENSIONS THICK mm	PROCESS OF WELDING	TYPE OF WELD	ELECTRODE FILLER SPEC. (ATT) TIG	ARC SPEC.			W.P.S NO.	MIN. PRE HEAT TEMP. °C	HEAT TREATMENT TEMP. °C	HEAT TREATMENT HOLD TIME	NDT METHOD/ QUANTUM	REF. SPEC. NO.	ACC. NORM REF.	REMARKS
								QTY(gms)	QTY(NOS.)										
		PART-1	PART-1					TIG	ARC SPEC.										
		PART-2	PART-2				QTY	ø2.4	ø2.5	ø3.2	ø4.0								
01	1-80-307-21345	PIPE	SA335P91	60.3	12.5	TIG & ARC	12.5√	ER90SB9	E9015B9			1036 REV 07	220	745 ±15	2.5 Mts PER mm min 30 min	100% RT	*	*	100% HARDNESS
		PIPE/BEND VALVE	SA335P91 C12A				48	480	624	336	–								
02	1-80-307-21345	PIPE	SA335P91	60.3	5.54	TIG & ARC	5.54√	ER90SB9	E9015B9			1036 REV 07	220	745 ±15	2.5 Mts PER mm min 30 min	100% RT	*	*	100% HARDNESS
		PIPE/BEND VALVE	SA335P91 C12A				~40	520	400	–	–								
03	1-80-307-21345	PIPE	SA335P22	33.4	4.55	ARC	5◺	–	E9018B3			1023 REV 00	10	745 ±35	1 HOUR PER 25 MM min 60 min	LPI/ MPI 100%	*	*	HARDNESS 3%
		FITTING	F22				~20	–	40										

NOTES: 01. * REFER NDE MANUAL DOC NO. AA/CQ/GL/011 REV 00 dtd 24.10.16

PREPARED	DESIGN/CHD.	DESIGN/APPD.	CHD./APPD. – QA	DATE	DRAWING NO.	REV .
RAJESH KUMAR	DHINESH	S.RAMAMURTHY	C.HARITHA	10.03.17	4-80-307-80268	00

ERECTION / FIELD WELDING SCHEDULE

PROJECT : KOTHAGUDAM 1X800MW
CONTRACTOR : M/S BHEL

CUST. NO : 7268
PGMA : 80–322
SYSTEM : COLD REHEAT PIPING TO DEAERATOR PEGGING

REV. NO. : 00
WELDING CODE : IBR / ASME
PAGE NO : 01 OF 02

SL. NO.	DRG NO. FOR WELD LOCATION IDENTIFICATION MARK	DESCRIPTION OF PARTS TO BE WELDED	MATL.SPEC. (ATT)	DIMENSIONS SIZE OD mm	DIMENSIONS THICK mm	PROCESS OF WELDING	TYPE OF WELD	ELECTRODE FILLER SPEC. (ATT) TIG	ELECTRODE FILLER SPEC. (ATT) ARC SPEC.			W.P.S NO.	MIN. PRE HEAT TEMP. °C	HEAT TREATMENT TEMP. °C	HEAT TREATMENT HOLD TIME	NDT METHOD/ QUANTUM	REF. SPEC. NO.	ACC. NORM REF.	REMARKS
		PART–1	PART–1					QTY(gms)	QTY(NOS.)										
		PART–2	PART–2				QTY	ø2.4	ø2.5	ø3.2	ø4.0								
01	1–80–322–21214	FITTING PIPE	SA106GRC SA234WPC	406.4	16	TIG& ARC	16 V	ER70SA1	E7018–1			1003 REV 03	10	–	–	RT 100%	*	*	
		FITTING PIPE/VALVE	SA234WPC SA106GRC/WCC				32	4544	960	1610	576								
02	1–80–322–21214	FITTING PIPE	SA106GRC SA234WPC	965	34	TIG& ARC	34 V	ER70SA1	E7018–1			1005 REV 05	100	635±15	2.5mtS PER mm minimum 30 min	RT 100%	*	*	
		FITTING PIPE/VALVE	SA234WPC SA106GRC/WCC				2	670	152	249	572								
03	1–80–322–21214	FITTING PIPE	SA106GRC SA234WPC	965	10	TIG& ARC	10 V	ER70SA1	E7018–1			1003 REV 03	10	–	–	RT 10%	*	*	
		FITTING PIPE/VALVE	SA234WPC SA106GRC/WCC				9	2981	681	1070	–								
04	1–80–322–21214	FITTING PIPE	SA106GRB SA234WPB	323.9	12.7	TIG& ARC	12.7 V	ER70SA1	E7018–1			1003 REV 03	10	–	–	RT 10%	*	*	
		FITTING PIPE	SA106GRB SA234WPB				2	224	48	102	–								
05	1–80–322–21214	FITTING PIPE	SA106GRC SA234WPC	219.1	8.18	TIG& ARC	8.18 V	ER70SA1	E7018–1			1003 REV 03	10	–	–	RT 100%	*	*	
		FITTING PIPE	SA106GRC SA234WPC				2	140	34	36	–								
06	1–80–322–21214	THERMOWELL	ANSI321	63.5	13	TIG & ARC	13 V	ERNiCr3	ENiCrFe3			1025 REV 01	10	610±15	2.5mtS PER mm min 30mts	RT 100% LPT 100%	*	*	
		TEMP STUB	SA 105				1	25	14	10	2								

NOTES: 01. * REFER NDE MANUAL DOC NO. AA/CQ/GL/011 REV 00 dtd 24.10.16

PREPARED	DESIGN/CHD.	DESIGN/APPD.	CHD./APPD. – QA	DATE	DRAWING NO.	REV.
RAJESH KUMAR	DHINESH	S.RAMAMURTHY	HARITHA.C	10.03.17	4-80-322-80017	00

ERECTION / FIELD WELDING SCHEDULE

PROJECT : KOTHAGUDAM 1X800MW
CONTRACTOR : M/S BHEL

CUST. NO : 7268
PGMA : 80–322
SYSTEM : COLD REHEAT PIPING TO DEAERATOR PEGGING

REV. NO. : 00
WELDING CODE : IBR / ASME
PAGE NO : 02 OF 02

SL. NO.	DRG NO. FOR WELD LOCATION IDENTIFICATION MARK	DESCRIPTION OF PARTS TO BE WELDED	MATL.SPEC. (ATT)	DIMENSIONS SIZE OD mm	DIMENSIONS THICK mm	PROCESS OF WELDING	TYPE OF WELD	ELECTRODE FILLER SPEC. (ATT) TIG	ARC SPEC.			W.P.S NO.	MIN. PRE HEAT TEMP. °C	HEAT TREATMENT TEMP. °C	HEAT TREATMENT HOLD TIME	NDT METHOD/ QUANTUM	REF. SPEC. NO.	ACC. NORM REF.	REMARKS
		PART–1	PART–1					QTY(gms)	QTY(NOS.)										
		PART–2	PART–2				QTY	ø2.4	ø2.5	ø3.2	ø4.0								
07	1–80–322–21214	FITTING	SA234WPB	273	12.7	TIG& ARC	12.7 V	ER70SA1	E7018–1			WT412 REV–00				RT 100%	*	*	
		VALVE	WC9				1	87	20	30	–								
08	1–80–322–21214	FITTING	SA105	508	20	TIG& ARC	20 V	ER70SA1	E7018–1			WT412 REV–00				RT 100%	*	*	
		VALVE	WC9				1	177	38	63	46								
09	1–80–322–21214	FITTING	SA234WPB	660	22	TIG& ARC	22 V	ER70SA1	E7018–1			1004 REV 03	10	610 ±15	2.5mtS PER mm minimum 30 min	RT 100%	*	*	
		FITTING	SA234WPB				1	233	50	83	162								
10	1–80–322–21214	FITTING	SA234WPB	762	9.53	TIG& ARC	9.53 V	ER70SA1	E7018–1			1003 REV 03	10	–	–	RT 10%	*	*	
		FITTING	SA234WPB				1	258	63	99	–								

NOTES: 01. * REFER NDE MANUAL DOC NO. AA/CQ/GL/011 REV 00 dtd 24.10.16

PREPARED	DESIGN/CHD.	DESIGN/APPD.	CHD./APPD. – QA	DATE	DRAWING NO.	REV.
RAJESH KUMAR	DHINESH	S.RAMAMURTHY	HARITHA.C	10.03.17	4-80-322-80017	00

ERECTION / FIELD WELDING SCHEDULE

PROJECT : KOTHAGUDAM 1X800MW
CONTRACTOR : M/S BHEL

CUST. NO : 7268
PGMA : 80–323
SYSTEM : EXTRACTION STEAM PPG TO BFPT A&B

REV. NO. : 00
WELDING CODE : IBR / ASME
PAGE NO : 01 OF 01

SL. NO.	DRG NO. FOR WELD LOCATION IDENTIFICATION MARK	DESCRIPTION OF PARTS TO BE WELDED	MATL.SPEC. (ATT)	DIMENSIONS SIZE OD mm	DIMENSIONS THICK mm	PROCESS OF WELDING	TYPE OF WELD	ELECTRODE FILLER SPEC. (ATT) TIG QTY(gms) ø2.4	ARC SPEC. QTY(NOS.) ø2.5	ø3.2	ø4.0	W.P.S NO.	MIN. PRE HEAT TEMP. °C	HEAT TREATMENT TEMP. °C	HEAT TREATMENT HOLD TIME	NDT METHOD/ QUANTUM	REF. SPEC. NO.	ACC. NORM REF.	REMARKS
		PART–1	PART–1																
		PART–2	PART–2				QTY												
01	1–80–323–21220	FITTING PIPE	SA234WPC SA106GRC	OD273	12.7	TIG& ARC	12.7V	ER70SA1	E7018–1			1003 REV 03	10	–	–	RT 10%	*	*	
		FITTING PIPE	SA234WPC SA106GRC				33	3441	740	1221	222								
02	1–80–323–21220	VALVE	SA216WCC	OD273	12.7	TIG& ARC	12.7V	ER70SA1	E7018–1			1003 REV 03	10	–	–	RT 10%	*	*	
		FITTING PIPE	SA234WPC SA106GRC				8	744	160	264	48								
03	1–80–323–21220	WN FLANGE	SA515GR70	OD273	12.7	TIG& ARC	12.7V	ER70SA1	E7018–1			1003 REV 03	10	–	–	RT 10%	*	*	
		FITTING PIPE	SA234WPC SA106GRC				4	372	80	132	24								
04	1–80–323–21220	FITTING PIPE	SA234WPB SA106GRB	OD323.9	9.53/36	TIG& ARC	9.53V	ER70SA1	E7018–1			1003 REV 03	10	–	–	RT 10%	*	*	
		FITTING PIPE	SA234WPB SA106GRB				16	1664	384	592	–								
05	1–80–323–21220	PIPE	SA106GRC	OD114.3	6.02	TIG& ARC	6.02V	ER70SA1	E7018–1			1003 REV 03	10	–	–	RT 10%	*	*	
		FITTING	SA234WPB				8	216	168	–	–								
06	1–80–323–21220	BRANCH PIPE	SA106GRC	OD168.3	14.27	ARC	12◺	–	E7018–1			1021 REV 01	–	–	–	LPI/MPI 10%			
		FLANGE	SA515GR70				2	–	–	30	–								

NOTES:
01. * REFER NDE MANUAL DOC NO. AA/CQ/GL/011 REV 00 dtd 24.10.16

PREPARED	DESIGN/CHD.	DESIGN/APPD.	CHD./APPD. – QA	DATE	DRAWING NO.	REV.
RAJESH KUMAR	DHINESH	S.RAMAMURTHY	HARITHA.C	10.03.17	4-80-323-80024	00

ERECTION / FIELD WELDING SCHEDULE

PROJECT : KOTHAGUDAM 1X800MW
CONTRACTOR : M/S BHEL

CUST. NO : 7268
PGMA : 80-324
SYSTEM : CRH PIPING TO AUX PRDS

REV. NO. : 00
WELDING CODE : IBR / ASME
PAGE NO : 01 OF 02

SL. NO.	DRG NO. FOR WELD LOCATION IDENTIFICATION MARK	DESCRIPTION OF PARTS TO BE WELDED	MATL.SPEC. (ATT)	DIMENSIONS SIZE OD mm	DIMENSIONS THICK mm	PROCESS OF WELDING	TYPE OF WELD	ELECTRODE FILLER SPEC. (ATT) TIG QTY(gms)	ARC SPEC. QTY(NOS.) ø2.5	ø3.2	ø4.0	W.P.S NO.	MIN. PRE HEAT TEMP. °C	HEAT TREATMENT TEMP. °C	HEAT TREATMENT HOLD TIME	NDT METHOD/ QUANTUM	REF. SPEC. NO.	ACC. NORM REF.	REMARKS
		PART-1	PART-1																
		PART-2	PART-2				QTY	ø2.4											
01	1-80-324-21295	PIPE FITTING	SA106GRB SA234WPB	114.3	6.02	TIG & ARC	6.02 V	ER70SA1	E7018-1			1003 REV 03	10	–	–	RT 10%	*	*	
		PIPE FITTING/VALVE	SA106GRB SA234WPB/WCB				27	719	567	--	--								
02	1-80-324-21295	PIPE	SA335P11	114.3	6.02	TIG & ARC	6.02 V	ER70SA1	E7018-1			1017 REV 03	125	–	–	RT 100%	*	*	3% HARDNESS
		VALVE	WCB				1	27	21	--	--								
03	1-80-324-21295	PIPE	SA335P11	114.3	6.02	TIG & ARC	6.02 V	ER80SB2	E8018B2			1011 REV 01	150	–	–	RT 100%	*	*	3% HARDNESS
		VALVE	WC9				1	27	21	--	--								
04	1-80-324-21295	VALVE	WC9	114.3	6.02	TIG & ARC	6.02 V	ER90SB3	E9018B3			1013 REV 02	150	–	–	RT 100%	*	*	3% HARDNESS
		FITTING	SA234WP22				1	27	21	--	--								
05	1-80-324-21295	PIPE	SA335P11	219.1	12.7	TIG & ARC	12.7 V	ER80SB2	E8018B2			1012 REV 04	150	680 TO 720	2.5mtS PER mm minimum 60 min	RT 100%	*	*	3% HARDNESS
		FITTING	SA234WP22				1	73	17	25	8								
06	1-80-324-21295	PIPE	SA335P11	219.1	12.7	TIG & ARC	12.7 V	ER70SA1	E7018-1			1033 REV 03	150	610±10	2.5mtS PER mm minimum 60 min	RT 100%	*	*	3% HARDNESS
		VALVE	WCB				1	67	17	25	8								

NOTES:
01. * REFER NDE MANUAL DOC NO. AA/CQ/GL/011 REV 00 dtd 24.10.16

PREPARED	DESIGN/CHD.	DESIGN/APPD.	CHD./APPD. – QA	DATE	DRAWING NO.	REV.
RAJESH KUMAR	DHINESH	S.RAMAMURTHY	C.HARITHA	10.03.17	4-80-324-80176	00

ERECTION / FIELD WELDING SCHEDULE

PROJECT : KOTHAGUDAM 1X800MW
CONTRACTOR : M/S BHEL

CUST. NO : 7268
PGMA : 80-324
SYSTEM : CRH PIPING TO AUX PRDS

REV. NO. : 00
WELDING CODE : IBR / ASME
PAGE NO : 02 OF 02

SL. NO.	DRG NO. FOR WELD LOCATION IDENTIFICATION MARK	DESCRIPTION OF PARTS TO BE WELDED	MATL.SPEC. (ATT)	DIMENSIONS SIZE OD mm	DIMENSIONS THICK mm	PROCESS OF WELDING	TYPE OF WELD	ELECTRODE FILLER SPEC. (ATT) TIG	ARC SPEC.			W.P.S NO.	MIN. PRE HEAT TEMP. °C	HEAT TREATMENT TEMP. °C	HEAT TREATMENT HOLD TIME	NDT METHOD/ QUANTUM	REF. SPEC. NO.	ACC. NORM REF.	REMARKS
		PART-1	PART-1					QTY(gms)	QTY(NOS.)										
		PART-2	PART-2				QTY	ø2.4	ø2.5	ø3.2	ø4.0								
07	1-80-324-21295	PIPE	SA106GRB	219.1	12.7	TIG & ARC	12.7 V	ER70SA1	E7018-1			1003 REV 03	10	-	-	RT 10%	*	*	
		VALVE FITTING	WCB SA234WPC				2	146	34	50	16								
08	1-80-324-21295	PIPE FITTING	SA106GRB SA234WPB	219.1	6.35	TIG & ARC	6.35 V	ER70SA1	E7018-1			1003 REV 03	10	-	-	RT 10%	*	*	
		PIPE FITTING/VALVE	SA106GRB SA234WPB/WCB				19	1349	703	--	--								

NOTES: 01. * REFER NDE MANUAL DOC NO. AA/CQ/GL/011 REV 00 dtd 24.10.16

PREPARED	DESIGN/CHD.	DESIGN/APPD.	CHD./APPD. - QA	DATE	DRAWING NO.	REV.
RAJESH KUMAR	DHINESH	S.RAMAMURTHY	C.HARITHA	10.03.17	4-80-324-80176	00

ERECTION / FIELD WELDING SCHEDULE

PROJECT : KOTHAGUDAM 1X800MW
CONTRACTOR : M/S BHEL

CUST. NO : 7268
PGMA : 80–329
SYSTEM : EXTRACTION STEAM PPG TO BFPT A&B

REV. NO. : 00
WELDING CODE : IBR / ASME
PAGE NO : 01 OF 01

SL. NO.	DRG NO. FOR WELD LOCATION IDENTIFICATION MARK	DESCRIPTION OF PARTS TO BE WELDED	MATL.SPEC. (ATT)	DIMENSIONS SIZE OD mm	DIMENSIONS THICK mm	PROCESS OF WELDING	TYPE OF WELD	ELECTRODE FILLER SPEC. (ATT) TIG QTY(gms)	ARC SPEC. QTY(NOS.) ø2.5	ø3.2	ø4.0	W.P.S NO.	MIN. PRE HEAT TEMP. °C	HEAT TREATMENT TEMP. °C	HEAT TREATMENT HOLD TIME	NDT METHOD/ QUANTUM	REF. SPEC. NO.	ACC. NORM REF.	REMARKS
		PART–1	PART–1																
		PART–2	PART–2				QTY	ø2.4											
01	1–80–329–21266	FITTING PIPE/VALVE	SA234WPB SA106GRB/WCB	508	12.7	TIG& ARC	12.7V̂	ER70SA1	E7018–1			1003 REV 03	10	–	–	RT 10%	*	*	
		FITTING PIPE	SA234WPB SA106GRB				14	2534	532	882	196								
02	1–80–329–21266	FITTING PIPE/VALVE	SA234WPB SA106GRB/WCB	406.4	9.53	TIG& ARC	9.53V̂	ER70SA1	E7018–1			1003 REV 03	10	–	–	RT 10%	*	*	
		FITTING PIPE	SA234WPB SA106GRB				45	5940	1350	2115									
03	1–80–329–21266	FITTING PIPE	SA234WPB SA106GRB	273	9.27	TIG& ARC	9.27V̂	ER70SA1	E7018–1			1003 REV 03	10	–	–	RT 10%	*	*	
		FITTING PIPE	SA234WPB SA106GRB				28	2436	560	840	–								
04	1–80–329–21266	NOZLLE	GRB EQUIVALENT	273	9.27	TIG& ARC	9.27V̂	ER70SA1	E7018–1			1003 REV 03	10	–	–	RT 10%	*	*	
		PIPE	SA106GRB				4	348	80	120	–								
05	1–80–329–21266	PLATE PIPE	SA515GR70 SA106GRC	219.1	6.35	TIG& ARC	6.35V̂	ER70SA1	E7018–1			1003 REV 03	10	–	–	RT 10%	*	*	
		PIPE	SA106GRB				6	426	222	–	–								
06	1–80–329–21266	THERMOWELL	ANSI321	63.5	13	TIG & ARC	13.0 V̂	ERNiCr3	ERNiCrFe3			1025 REV 01	10	610 ±15	2.5mtS PER mm minimum 30 min	RT100% LPI100%	*	*	
		TEMP STUB	SA 105				2	50	28	20	4								

NOTES: 01. * REFER NDE MANUAL DOC NO. AA/CQ/GL/011 REV 00 dtd 24.10.16

PREPARED	DESIGN/CHD.	DESIGN/APPD.	CHD./APPD. – QA	DATE	DRAWING NO.	REV.
RAJESH KUMAR	DHINESH	S.RAMAMURTHY	HARITHA.C	10.03.17	4-80-329-80105	00

ERECTION / FIELD WELDING SCHEDULE

PROJECT : KOTHAGUDAM 1X800MW
CONTRACTOR : M/S BHEL

CUST. NO : 7268
PGMA : 80–332
SYSTEM : EXTRACTION STEAM PIPING TO LOW PRESSURE HEATER–3

REV. NO. : 00
WELDING CODE : IBR / ASME
PAGE NO : 01 OF 01

SL. NO.	DRG NO. FOR WELD LOCATION IDENTIFICATION MARK	DESCRIPTION OF PARTS TO BE WELDED	MATL.SPEC. (ATT)	DIMENSIONS SIZE OD mm	DIMENSIONS THICK mm	PROCESS OF WELDING	TYPE OF WELD	ELECTRODE FILLER SPEC. (ATT) TIG QTY(gms)	ARC SPEC. QTY(NOS.) ø2.5	ø3.2	ø4.0	W.P.S NO.	MIN. PRE HEAT TEMP. °C	HEAT TREATMENT TEMP. °C	HEAT TREATMENT HOLD TIME	NDT METHOD/ QUANTUM	REF. SPEC. NO.	ACC. NORM REF.	REMARKS
		PART–1	PART–1																
		PART–2	PART–2				QTY	ø2.4											
01	1–80–332–21255	FITTING PIPE	SA672GRB70 SA234WPC	610	10	TIG& ARC	10 V	ER70SA1	E7018–1			1003 REV 03	10	–	–	RT 10%	*	*	
		FITTING PIPE/VALVE	SA672GRB70 SA234WPC/WCC				22	4502	1020	1600	–								
02	1–80–332–21255	FITTING PIPE	SA672GRB70 SA234WPC	813	10	TIG& ARC	10 V	ER70SA1	E7018–1			1003 REV 03	10	–	–	RT 10%	*	*	
		FITTING PIPE/VALVE	SA672GRB70 SA234WPC/WCC				12	3312	756	1188	–								
03	1–80–332–21255	PIPE	SA106GRB	273	6.35	TIG& ARC	6.35 V	ER70SA1	E7018–1			1003 REV 03	10	–	–	RT 10%	*	*	
		PIPE SA515GR70	SA106GRB SA515GR70				2	223	44	22	–								
04	1–80–332–21255	PIPE	SA106GRB	219.1	6.35	TIG& ARC	6.35 V	ER70SA1	E7018–1			1003 REV 03	10	–	–	RT 10%	*	*	
		PIPE SA515GR70	SA106GRB SA515GR70				4	355	163	–	–								
05	1–80–332–21255	THERMOWELL	ANSI321	30	13	TIG & ARC	10 +6	ERNiCr3	ENiCrFe3			1025 REV 01	10	610 ±15	2.5mtS PER mm minimum 30 min	RT100% LPI100%	*	*	
		TEMP STUB	SA 105				2	20	28	14									
06	1–80–332–21255	FITTING	SA234WPB	914	10	TIG& ARC	10 V	ER70SA1	E7018–1			1003 REV 03	10	–	–	RT 10%	*	*	
		NOZZLE	SA515GR70				1	313	84	132	–								

NOTES: 01. * REFER NDE MANUAL DOC NO. AA/CQ/GL/011 REV 00 dtd 24.10.16

PREPARED	DESIGN/CHD.	DESIGN/APPD.	CHD./APPD. – QA	DATE	DRAWING NO.	REV.
RAJESH KUMAR	DHINESH	S.RAMAMURTHY	HARITHA.C	07.02.17	4-80-332-80085	00

ERECTION / FIELD WELDING SCHEDULE

PROJECT : KOTHAGUDAM 1X800MW
CONTRACTOR : M/S BHEL

CUST. NO : 7268
PGMA : 80-334
SYSTEM : EXTRACTION PPG TO LPH#04

REV. NO. : 00
WELDING CODE : IBR / ASME
PAGE NO : 01 OF 02

SL. NO.	DRG NO. FOR WELD LOCATION IDENTIFICATION MARK	DESCRIPTION OF PARTS TO BE WELDED	MATL.SPEC. (ATT)	DIMENSIONS SIZE OD mm	DIMENSIONS THICK mm	PROCESS OF WELDING	TYPE OF WELD	ELECTRODE FILLER SPEC. (ATT) TIG	ARC SPEC.			W.P.S NO.	MIN. PRE HEAT TEMP. °C	HEAT TREATMENT TEMP. °C	HEAT TREATMENT HOLD TIME	NDT METHOD/ QUANTUM	REF. SPEC. NO.	ACC. NORM REF.	REMARKS
		PART-1	PART-1				QTY(gms)		QTY(NOS.)										
		PART-2	PART-2				QTY	ø2.4	ø2.5	ø3.2	ø4.0								
01	1-80-334-21256	PIPE FITTING	SA106GRB SA234WPB	508	12.7	TIG & ARC	12.7 V	ER70SA1	E7018-1			1003 REV 03	10	–	–	RT 10%	*	*	
		PIPE FITTING/VALVE	SA106GRB SA234WPB/WCB				33	5973	1254	2079	462								
02	1-80-334-21256	FITTING	SA234WPB	610	12.7	TIG & ARC	12.7 V	ER70SA1	E7018-1			1003 REV 03	10	–	–	RT 10%	*	*	
		TURBINE NOZZ	SA106GRB				1	270	47	76	17								
03	1-80-334-21256	FITTING	SA234WPB	559	16	TIG & ARC	16.0 V	ER70SA1	E7018-1			1003 REV 03	10	–	–	RT 10%	*		
		LPH NOZZLE	SA106GRB				1	270	47	76	26								
04	1-80-334-21256	PIPE	SA106GRB	219.1	6.35	TIG & ARC	6.35 V	ER70SA1	E7018-1			1003 REV 03	10	–	–	RT 10%	*	*	
		PLATE FITTING	SA515GR70 SA234WPB				4	284	148	--	--								
05	1-80-334-21256	THERMOWELL	AISI 321	63.5	13	TIG & ARC	13.0 V	ERNiCr3	ENiCrFe3			1025 REV 01	10	610 ±15	2.5mtS PER mm minimum 30 min	RT100% LPI100%	*	*	
		TEMP STUB	SA 105				3	75	42	30	6								
06	1-80-334-21256	THERMOWELL	AISI 321	24	17	TIG & ARC	17Y+6Δ	ERNI Cr3	ENI Cr Fe3			1025 REV 01	10	610 ±15	2.5mtS PER mm minimum 30 min	RT100% LPI100%	*	*	
		STUB	SA 105				1	5	7	–	–								

NOTES: 01. * REFER NDE MANUAL DOC NO. AA/CQ/GL/011 REV 00 dtd 24.10.16

PREPARED	DESIGN/CHD.	DESIGN/APPD.	CHD./APPD. – QA	DATE	DRAWING NO.	REV .
RAJESH KUMAR	DHINESH	S.RAMAMURTHY	C.HARITHA	07.02.17	4-80-334-80086	00

ERECTION / FIELD WELDING SCHEDULE

PROJECT : KOTHAGUDAM 1X800MW
CONTRACTOR : M/S BHEL

CUST. NO : 7268
PGMA : 80-334
SYSTEM : EXTRACTION PPG TO LPH#04

REV. NO. : 00
WELDING CODE : IBR / ASME
PAGE NO : 02 OF 02

SL. NO.	DRG NO. FOR WELD LOCATION IDENTIFICATION MARK	DESCRIPTION OF PARTS TO BE WELDED	MATL.SPEC. (ATT)	DIMENSIONS		PROCESS OF WELDING	TYPE OF WELD	ELECTRODE FILLER SPEC. (ATT)				W.P.S NO.	MIN. PRE HEAT TEMP. °C	HEAT TREATMENT		NDT METHOD/ QUANTUM	REF. SPEC. NO.	ACC. NORM REF.	REMARKS
				SIZE OD mm	THICK mm			TIG	ARC SPEC.					TEMP. °C	HOLD TIME				
								QTY(gms)	QTY(NOS.)										
		PART-1	PART-1				QTY	ø2.4	ø2.5	ø3.2	ø4.0								
		PART-2	PART-2																
07	1-80-334-21256	PIPE FITTING	SA106GRB SA234WPB	508	16	TIG & ARC	16.0 V	ER70SA1	E7018-1			1003 REV 03	10	–	–	RT 10%	*	*	
		PIPE FITTING/VALVE	SA106GRB SA234WPB/WCB				1	180	38	63	24								

NOTES: 01. * REFER NDE MANUAL DOC NO. AA/CQ/GL/011 REV 00 dtd 24.10.16

PREPARED	DESIGN/CHD.	DESIGN/APPD.	CHD./APPD. – QA	DATE	DRAWING NO.	REV .
RAJESH KUMAR	DHINESH	S.RAMAMURTHY	C.HARITHA	07.02.17	4-80-334-80086	00

ERECTION / FIELD WELDING SCHEDULE

PROJECT : KOTHAGUDAM 1X800MW
CONTRACTOR : M/S BHEL

CUST. NO : 7268
PGMA : 80–335
SYSTEM : EXTRACTION STEAM PPG TO DEAERATOR

REV. NO. : 00
WELDING CODE : IBR / ASME
PAGE NO : 01 OF 02

SL. NO.	DRG NO. FOR WELD LOCATION IDENTIFICATION MARK	DESCRIPTION OF PARTS TO BE WELDED	MATL.SPEC. (ATT)	DIMENSIONS SIZE OD mm	DIMENSIONS THICK mm	PROCESS OF WELDING	TYPE OF WELD	ELECTRODE FILLER SPEC. (ATT) TIG	ARC SPEC. ø2.5	ARC SPEC. ø3.2	ARC SPEC. ø4.0	W.P.S NO.	MIN. PRE HEAT TEMP. °C	HEAT TREATMENT TEMP. °C	HEAT TREATMENT HOLD TIME	NDT METHOD/ QUANTUM	REF. SPEC. NO.	ACC. NORM REF.	REMARKS
		PART–1	PART–1					QTY(gms)	QTY(NOS.)										
		PART–2	PART–2				QTY	ø2.4											
01	1–80–335–21215	TURBINE NOZZLE	16Mo3	610	10	TIG& ARC	10 V	ER70SA1	E7018–1			1003 REV 03	10	–	–	RT 10%	*	*	
		PIPE	SA672GRB70				1	203	47	73	–								
02	1–80–335–21215	PIPE FITTING	SA672GRB70 SA234WPB	610	10	TIG& ARC	10 V	ER70SA1	E7018–1			1003 REV 03	10	–	–	RT 10%	*	*	
		PIPE FITTING	SA672GRB70 SA234WPB				8	1620	370	581	–								
03	1–80–335–21215	PIPE FITTING	SA106GRB SA234WPB	508	12.7	TIG& ARC	10 V	ER70SA1	E7018–1			1003 REV 03	10	–	–	RT 10%	*	*	
		PIPE FITTING	SA106GRB SA234WPB				32	5792	1216	2016	576								
04	1–80–335–21215	PIPE FITTING	SA672GRB70 SA234WPB	660	10	TIG& ARC	10 V	ER70SA1	E7018–1			1003 REV 03	10	–	–	RT 10%	*	*	
		PIPE FITTING	SA672GRB70 SA234WPB				6	1326	300	500	–								
05	1–80–335–21215	BRANCH PIPE FITTING	SA672GRB70 SA234WPB	219.1	6.35	TIG& ARC	6.35 V	ER70SA1	E7018–1			1003 REV 03	10	–	–	RT 10%	*	*	
		PIPE	SA106GRB				4	284	148	–	–								
06	1–80–335–21215	FITTING	SA234WPB	762	10	TIG& ARC	10 V	ER70SA1	E7018–1			1003 REV 03	10	–	–	RT 10%	*	*	
		FITTING	SA234WPB				1	258	59	93	–								

NOTES: 01. * REFER NDE MANUAL DOC NO. AA/CQ/GL/011 REV 00 dtd 24.10.16

PREPARED	DESIGN/CHD.	DESIGN/APPD.	CHD./APPD. – QA	DATE	DRAWING NO.	REV.
RAJESH KUMAR	DHINESH	S.RAMAMURTHY	HARITHA.C	03.08.16	4-80-335-80019	00

ERECTION / FIELD WELDING SCHEDULE

PROJECT : KOTHAGUDAM 1X800MW
CONTRACTOR : M/S BHEL

CUST. NO : 7268
PGMA : 80–335
SYSTEM : EXTRACTION STEAM PPG TO DEAERATOR

REV. NO. : 00
WELDING CODE : IBR / ASME
PAGE NO : 02 OF 02

SL. NO.	DRG NO. FOR WELD LOCATION IDENTIFICATION MARK	DESCRIPTION OF PARTS TO BE WELDED	MATL.SPEC. (ATT)	DIMENSIONS SIZE OD mm	DIMENSIONS THICK mm	PROCESS OF WELDING	TYPE OF WELD	ELECTRODE FILLER SPEC. (ATT) TIG	ELECTRODE FILLER SPEC. (ATT) ARC SPEC.			W.P.S NO.	MIN. PRE HEAT TEMP. °C	HEAT TREATMENT TEMP. °C	HEAT TREATMENT HOLD TIME	NDT METHOD/ QUANTUM	REF. SPEC. NO.	ACC. NORM REF.	REMARKS
								QTY(gms)	QTY(NOS.)										
		PART–2	PART–2				QTY	ø2.4	ø2.5	ø3.2	ø4.0								
07	1–80–335–21215	PIPE FITTING/NOZZ	SA672GRB70 SA234WPB/SA106GrB	965	10	TIG& ARC	10 V	ER70SA1	E7018–1			1003 REV 03	10	–	–	RT 10%	*	*	
		PIPE FITTING	SA672GRB70 SA234WPB				5	1656	378	594	–								
08	1–80–335–21215	THERMOWELL	ANSI 321	63.5	13	TIG & ARC	13.0 V	ERNiCr3	ENiCrFe3			1025 REV 01	10	610 ±15	2.5mtS PER mm minimum 30 min	RT100% LPI100%	*	*	
		TEMP STUB	SA 105				4	100	42	40	8								
09	1–80–335–21215	THERMOWELL	AISI 321	30	10	TIG & ARC	6U + 6Δ	ERNiCr3	ENi Cr Fe3			1025 REV 01	10	610 ±15	2.5mtS PER mm minimum 30 min	RT100% LPI100%	*	*	
		STUB	SA 105				1	5	7	–	–								

NOTES: 01. * REFER NDE MANUAL DOC NO. AA/CQ/GL/011 REV 00 dtd 24.10.16

PREPARED	DESIGN/CHD.	DESIGN/APPD.	CHD./APPD. – QA	DATE	DRAWING NO.	REV.
RAJESH KUMAR	DHINESH	S.RAMAMURTHY	HARITHA.C	03.08.16	4-80-335-80019	00

ERECTION / FIELD WELDING SCHEDULE

PROJECT : KOTHAGUDAM 1X800MW
CONTRACTOR : M/S BHEL

CUST. NO : 7268
PGMA : 80–336
SYSTEM : EXTRACTION STEAM PPG TO HIGH PRESSURE HEATER 6A & 6B

REV. NO. : 00
WELDING CODE : IBR / ASME
PAGE NO : 01 OF 02

SL. NO.	DRG NO. FOR WELD LOCATION IDENTIFICATION MARK	DESCRIPTION OF PARTS TO BE WELDED	MATL.SPEC. (ATT)	DIMENSIONS SIZE OD mm	DIMENSIONS THICK mm	PROCESS OF WELDING	TYPE OF WELD	ELECTRODE FILLER SPEC. (ATT) TIG QTY(gms)	ELECTRODE FILLER SPEC. (ATT) ARC SPEC. QTY(NOS.) ø2.5	ø3.2	ø4.0	W.P.S NO.	MIN. PRE HEAT TEMP. °C	HEAT TREATMENT TEMP. °C	HEAT TREATMENT HOLD TIME	NDT METHOD/ QUANTUM	REF. SPEC. NO.	ACC. NORM REF.	REMARKS
		PART–1	PART–1																
		PART–2	PART–2				QTY	ø2.4											
01	1–80–336–21238	NOZZLE	13CRMo4–5	406.4	16.0	TIG& ARC	16.0 V	ER80S–B2	E8018–B2			1012 REV 04	150	680 – 720°	2.5 Mts PER mm 60 min	RT 100%	*	*	3% HARDNESS
		FITTING	SA234WP22				1	150	34	53	18								
02	1–80–336–21238	FITTING PIPE	SA234WP22 SA335P22	323.9	9.53	TIG& ARC	9.53 V	ER90SB3	E9018–B3			1014 REV 03	150	680 –720	2.5 Mts PER mm 60 min	RT 100%	*	*	3% HARDNESS
		FITTING PIPE/VALVE	SA234WP22 SA335P22/WC9				32	3328	768	1184	–								
03	1–80–336–21238	FITTING PIPE	SA234WP22 SA335P22	273	9.27	TIG& ARC	9.27 V	ER90SB3	E9018–B3			1014 REV 03	150	680 –720	2.5 Mts PER mm 60 min	RT 100%	*	*	3% HARDNESS
		FITTING PIPE	SA234WP22 SA335P22				20	1740	400	600	–								
04	1–80–336–21238	NOZZLE	SA182F11	273	9.27	TIG & ARC	9.27 V	ER80S–B2	E8018–B2			1012 REV 04	150	680 – 720°	2.5 Mts PER mm 60 min	RT 100%	*	*	3% HARDNESS
		FITTING	SA234WP22				2	180	40	60	–								
05	1–80–336–21238	PIPE	SA335P22	168.3	7.11	TIG& ARC	7.11 V	ER90SB3	E9018B3			1013 REV 02	150	–	–	RT 100%	*	*	3% HARDNESS
		FITTING PLATE	SA234WP22 SA387GR22				4	212	60	44	–								
06	1–80–336–21238	THERMOWELL	AISI321	63.5	13	TIG & ARC	13 V	ERNi Cr3	ENi Cr Fe3			1024 REV 01	150 ON P5 SIDE	680 TO 720	1 HOUR PER 25mm 60 min	RT100% LPI100%	*	*	
		STUB	SA182F22CL3				1	25	14	10	2								

NOTES: 01. * REFER NDE MANUAL DOC NO. AA/CQ/GL/011 REV 00 dtd 24.10.16

PREPARED	DESIGN/CHD.	DESIGN/APPD.	CHD./APPD. – QA	DATE	DRAWING NO.	REV.
RAJESH KUMAR	DHINESH	S.RAMAMURTHY	HARITHA.C	07.02.17	4-80-335-80066	00

ERECTION / FIELD WELDING SCHEDULE

PROJECT : KOTHAGUDAM 1X800MW
CONTRACTOR : M/S BHEL

CUST. NO : 7268
PGMA : 80–336
SYSTEM : EXTRACTION STEAM PPG TO HIGH PRESSURE HEATER 6A & 6B

REV. NO. : 00
WELDING CODE : IBR / ASME
PAGE NO : 02 OF 02

SL. NO.	DRG NO. FOR WELD LOCATION IDENTIFICATION MARK	DESCRIPTION OF PARTS TO BE WELDED	MATL.SPEC. (ATT)	DIMENSIONS SIZE OD mm	DIMENSIONS THICK mm	PROCESS OF WELDING	TYPE OF WELD	ELECTRODE FILLER SPEC. (ATT) TIG	ELECTRODE FILLER SPEC. (ATT) ARC SPEC.			W.P.S NO.	MIN. PRE HEAT TEMP. °C	HEAT TREATMENT TEMP. °C	HEAT TREATMENT HOLD TIME	NDT METHOD/ QUANTUM	REF. SPEC. NO.	ACC. NORM REF.	REMARKS
		PART–1	PART–1					QTY(gms)	QTY(NOS.)										
		PART–2	PART–2				QTY	ø2.4	ø2.5	ø3.2	ø4.0								
07	1–80–336–21238	THERMOWELL	AISI321	30	7	TIG & ARC	7 ▽	ERNi Cr3	ENi Cr Fe3			1024 REV 01	150 ON P5 SIDE	680 TO 720	1 HOUR PER 25mm 60 min	RT100% LPI100%	*	*	
		STUB	SA182F22CL3				1	10	14	7	–								
08	1–80–336–21238	PIPE	SA106GRB	273	6.35	TIG& ARC	6.35▽	ER70SA1	E7018–1			1003 REV 03	10	–	–	RT 10%	*	*	
		FITTING PIPE	SA234WPB SA106GRB				40	3600	800	440	–								
09	1–80–336–21238	THERMOWELL	ANSI321	63.5	13	TIG & ARC	13.0 ▽	ERNiCr3	ENiCrFe3			1025 REV 01	10	610 ±15	2.5mtS PER mm minimum 30 min	RT100% LPI100%	*	*	
		TEMP STUB	SA 105				4	100	42	40	8								

NOTES: 01.* REFER NDE MANUAL DOC NO. AA/CQ/GL/011 REV 00 dtd 24.10.16

PREPARED	DESIGN/CHD.	DESIGN/APPD.	CHD./APPD. – QA	DATE	DRAWING NO.	REV.
RAJESH KUMAR	DHINESH	S.RAMAMURTHY	HARITHA.C	07.02.17	4-80-335-80066	00

ERECTION / FIELD WELDING SCHEDULE

PROJECT : KOTHAGUDAM 1X800MW
CONTRACTOR : M/S BHEL

CUST. NO : 7268
PGMA : 80–337
SYSTEM : EXTRACTION STEAM PPG FROM CRH TO HPH 7A & 7B

REV. NO. : 00
WELDING CODE : IBR / ASME
PAGE NO : 01 OF 01

SL. NO.	DRG NO. FOR WELD LOCATION IDENTIFICATION MARK	DESCRIPTION OF PARTS TO BE WELDED	MATL.SPEC. (ATT)	DIMENSIONS SIZE OD mm	DIMENSIONS THICK mm	PROCESS OF WELDING	TYPE OF WELD	ELECTRODE FILLER SPEC. (ATT) TIG	ARC SPEC.			W.P.S NO.	MIN. PRE HEAT TEMP. °C	HEAT TREATMENT TEMP. °C	HEAT TREATMENT HOLD TIME	NDT METHOD / QUANTUM	REF. SPEC. NO.	ACC. NORM REF.	REMARKS
		PART–1	PART–1					QTY(gms)	QTY(NOS.)										
		PART–2	PART–2				QTY	ø2.4	ø2.5	ø3.2	ø4.0								
01	1–80–337–21239	FITTING PIPE	SA234WPC SA106GRC	406	16	TIG& ARC	16 V̂	ER70SA1	E7018–1			1003 REV 03	10	–	–	RT 100%	*	*	
		FITTING PIPE	SA234WPC SA106GRC				6	850	180	300	108								
02	1–80–337–21239	FITTING PIPE	SA234WPC SA106GRC	323.9	12.7	TIG& ARC	12.7V̂	ER70SA1	E7018–1			1003 REV 03	10	–	–	RT 100%	*	*	
		FITTING PIPE	SA234WPC SA106GRC				38	4256	912	2090	–								
03	1–80–337–21239	HPH NOZZLE	SA350LF2CL1	273	12.7	TIG& ARC	12.7V̂	ER70SA1	E7018–1			1003 REV 03	10	–	–	RT 100%	*	*	
		FITTING	SA234WPC				2	206	48	110	–								
04	1–80–337–21239	PIPE	SA106GRC	114.3	6.02	TIG& ARC	6.02V̂	ER70SA1	E7018–1			1003 REV 03	10	–	–	RT 100%	*	*	
		FITTING	SA234WPC				4	107	84	–	–								
05	1–80–337–21239	THERMOWELL	ANSI321	63.5	13	TIG & ARC	13 V̂	ERNiCr3	ENiCrFe3			1025 REV 01	10	610±15	2.5mtS PER mm min 30mts	RT 100% LPT 100%	*	*	
		TEMP STUB	SA 105				4	100	56	40	8								

NOTES: 01. * REFER NDE MANUAL DOC NO. AA/CQ/GL/011 REV 00 dtd 24.10.16

PREPARED	DESIGN/CHD.	DESIGN/APPD.	CHD./APPD. – QA	DATE	DRAWING NO.	REV.
RAJESH KUMAR	DHINESH	S.RAMAMURHTY	HARITHA.C	07.02.17	4-80-337-80067	00

ERECTION / FIELD WELDING SCHEDULE

PROJECT : KOTHAGUDAM 1X800MW
CONTRACTOR : M/S BHEL

CUST. NO : 7268
PGMA : 80–338
SYSTEM : EXTRACTION STEAM PPG FROM TO HIGH PRESSURE HEATER 8A & 8B

REV. NO. : 00
WELDING CODE : IBR / ASME
PAGE NO : 01 OF 02

SL. NO.	DRG NO. FOR WELD LOCATION IDENTIFICATION MARK	DESCRIPTION OF PARTS TO BE WELDED	MATL.SPEC. (ATT)	DIMENSIONS SIZE OD mm	DIMENSIONS THICK mm	PROCESS OF WELDING	TYPE OF WELD	ELECTRODE FILLER SPEC. (ATT) TIG QTY(gms) ø2.4	ARC SPEC. QTY(NOS.) ø2.5	ø3.2	ø4.0	W.P.S NO.	MIN. PRE HEAT TEMP. °C	HEAT TREATMENT TEMP. °C	HEAT TREATMENT HOLD TIME	NDT METHOD/ QUANTUM	REF. SPEC. NO.	ACC. NORM REF.	REMARKS
		PART–1	PART–1																
		PART–2	PART–2				QTY												
01	1–80–338–21240	NOZZLE (HPH–8)	SA182F11	168.3	10.97	TIG& ARC	10.97 ▽	ER80S–B2	E8018–B2			1010 REV 06	150°C	655°C ±15°	2.5mtS PER mm minimum 60 min	RT 100%	*	*	3% HARDNESS
		ELBOW	SA234WP11				2	102	30	46	–								
02	1–80–338–21240	FITTING PIPE	SA234WPC SA106GRC	168.3	10.97	TIG& ARC	10.97 ▽	ER70SA1	E7018–1			1003 REV 03	10	–	–	RT 100%	*	*	
		FITTING PIPE/VALVE	SA234WPC SA106GRC/WCC				36	1836	540	828	–								
03	1–80–338–21240	FITTING PIPE	SA234WPC SA106GRC	219.1	12.7	TIG& ARC	12.7 ▽	ER70SA1	E7018–1			1003 REV 03	10	–	–	RT 100%	*	*	
		FITTING PIPE/VALVE	SA234WPC SA106GRC/WCC				32	2144	544	800	256								
04	1–80–338–21240	PIPE	SA106GRC	114.3	13.49	TIG& ARC	13.49▽	ER70SA1	E7018–1			1003 REV 03	10	–	–	RT 100%	*	*	
		FITTING	SA234WPC				8	272	88	120	–								
05	1–80–338–21240	ELBOW	SA234WP11	168.3	10.97	TIG& ARC	10.97 ▽	ER80SB2	E8018–B2			1012 REV04	150	700 ±20	2.5mtS PER mm minimum 60 min	RT 100%	*	*	
		NOZZLE	SA182F22				2	102	30	46	–								
06	1–80–338–21240	THERMOWELL	ANSI321	63.5	13	TIG & ARC	13.0 ▽	ERNiCr3	ENiCrFe3			1025 REV 01	–	610 ±15	2.5mtS PER mm minimum 30 min	RT100% LPI100%	*	*	
		TEMP STUB	SA 105				6	150	84	60	12								

NOTES: 01. * REFER NDE MANUAL DOC NO. AA/CQ/GL/011 REV 00 dtd 24.10.16

PREPARED	DESIGN/CHD.	DESIGN/APPD.	CHD./APPD. – QA	DATE	DRAWING NO.	REV.
RAJESH KUMAR	DHINESH	S.RAMAMURTHY	HARITHA.C	07.02.17	4-80-338-80136	00

ERECTION / FIELD WELDING SCHEDULE

PROJECT : KOTHAGUDAM 1X800MW
CONTRACTOR : M/S BHEL

CUST. NO : 7268
PGMA : 80–338
SYSTEM : EXTRACTION STEAM PPG FROM TO HIGH PRESSURE HEATER 8A & 8B

REV. NO. : 00
WELDING CODE : IBR / ASME
PAGE NO : 02 OF 02

SL. NO.	DRG NO. FOR WELD LOCATION IDENTIFICATION MARK	DESCRIPTION OF PARTS TO BE WELDED	MATL.SPEC. (ATT)	DIMENSIONS SIZE OD mm	DIMENSIONS THICK mm	PROCESS OF WELDING	TYPE OF WELD	ELECTRODE FILLER SPEC. (ATT) TIG	ELECTRODE FILLER SPEC. (ATT) ARC SPEC.			W.P.S NO.	MIN. PRE HEAT TEMP. °C	HEAT TREATMENT TEMP. °C	HEAT TREATMENT HOLD TIME	NDT METHOD/ QUANTUM	REF. SPEC. NO.	ACC. NORM REF.	REMARKS
								QTY(gms)	QTY(NOS.)										
		PART–2	PART–2				QTY	ø2.4	ø2.5	ø3.2	ø4.0								
07	1–80–338–21240	THERMOWELL	AISI 321	30	10	TIG & ARC	6U + 6△	ERNi Cr3	ENi Cr Fe3			1025 REV 01	10	610±15	2.5mtS PER mm min 30mts	RT 100% LPT 100%	*	*	
		STUB	SA 105				1	5	7	–	–								
08	1–80–338–21240	FITTING	SA234WP11	168.3	14.27	TIG & ARC	14.27▽	ER70S–A1	E7018–1			1033 REV 04	150	660±10	2.5mtS PER mm min 30mts	RT 100%	*	*	3% HARDNESS
		PIPE	SA106GRB				2	106	30	46	8								

NOTES: 01. * REFER NDE MANUAL DOC NO. AA/CQ/GL/011 REV 00 dtd 24.10.16

PREPARED	DESIGN/CHD.	DESIGN/APPD.	CHD./APPD. – QA	DATE	DRAWING NO.	REV.
RAJESH KUMAR	DHINESH	S.RAMAMURTHY	HARITHA.C	07.02.17	4-80-338-80136	00

ERECTION / FIELD WELDING SCHEDULE

PROJECT : KOTHAGUDAM (1X800MW)
CONTRACTOR : M/S BHEL

CUST. NO : 7268
PGMA : 80–339
SYSTEM : AUX. STEAM TO TURBO DRIVEN BOILER FEED PUMP

REV. NO. : 00
WELDING CODE : IBR / ASME
PAGE NO : 01 OF 01

SL. NO.	DRG NO. FOR WELD LOCATION IDENTIFICATION MARK	DESCRIPTION OF PARTS TO BE WELDED	MATL.SPEC. (ATT)	DIMENSIONS SIZE OD mm	DIMENSIONS THICK mm	PROCESS OF WELDING	TYPE OF WELD	ELECTRODE FILLER SPEC. (ATT) TIG	ARC SPEC.			W.P.S NO.	MIN. PRE HEAT TEMP. °C	HEAT TREATMENT TEMP. °C	HEAT TREATMENT HOLD TIME	NDT METHOD / QUANTUM	REF. SPEC. NO.	ACC. NORM REF.	REMARKS
								QTY(gms)	QTY(NOS.)										
		PART–1	PART–1																
		PART–2	PART–2				QTY	ø2.4	ø2.5	ø3.2	ø4.0								
01	2–80–339–14065	FITTING PIPE	SA234WPB SA106GRB	219.1	6.35	TIG& ARC	6.35◊	ER70SA1	E7018–1			1003 REV 03	10	–	–	10% RT	*	*	
		FITTING PIPE/VALVE	SA234WPB SA106GRB/WCB				32	2272	1184	–	–								
02	2–80–339–14065	PIPE	SA106GRC	219.1	12.7	TIG& ARC	12.7 ◊	ER70SA1	E7018–1			1003 REV 03	10	–	–	100% RT	*	*	
		FITTING/ VALVE	SA234WPC/ WCC				4	292	68	100	32								
03	2–80–339–14065	PIPE	SA106GRB	114.3	6.02	TIG& ARC	6.02◊	ER70SA1	E7018–1			1003 REV 03	10	–	–	10% RT	*	*	
		FITTING	SA234WPB				2	54	42	–	–								

NOTES: 01. * REFER NDE MANUAL DOC NO. AA/CQ/GL/011 REV 00 dtd 24.10.16

PREPARED	DESIGN/CHD.	DESIGN/APPD.	CHD./APPD. – QA	DATE	DRAWING NO.	REV.
RAJESH KUMAR	DHINESH	S.RAAMURTHY	HARITHA.C	07.02.17	4-80-339-80069	00

ERECTION / FIELD WELDING SCHEDULE

PROJECT : KOTHAGUDAM 1X800MW
CONTRACTOR : M/S BHEL

CUST. NO : 7268
PGMA : 80-340
SYSTEM : AUX STEAM HEADER

REV. NO. : 00
WELDING CODE : IBR / ASME
PAGE NO : 01 OF 01

SL. NO.	DRG NO. FOR WELD LOCATION IDENTIFICATION MARK	DESCRIPTION OF PARTS TO BE WELDED	MATL.SPEC. (ATT)	DIMENSIONS SIZE OD mm	DIMENSIONS THICK mm	PROCESS OF WELDING	TYPE OF WELD	ELECTRODE FILLER SPEC. (ATT) TIG	ARC SPEC.			W.P.S NO.	MIN. PRE HEAT TEMP. °C	HEAT TREATMENT TEMP. °C	HEAT TREATMENT HOLD TIME	NDT METHOD / QUANTUM	REF. SPEC. NO.	ACC. NORM REF.	REMARKS
		PART-1	PART-1					QTY(gms)	QTY(NOS.)										
		PART-2	PART-2				QTY	ø2.4	ø2.5	ø3.2	ø4.0								
01	1-80-340-21246	PIPE FITTING	SA106GRB SA234WPB	457.2	9.53	TIG & ARC	9.53 V	ER70SA1	E7018-1			1003 REV 03	10	–	–	RT 10%	*	*	
		PIPE FITTING/VALVE	SA106GRB SA234WPB/WCB				25	3800	850	1325	0								
02	1-80-340-21246	PIPE FITTING	SA106GRB SA234WPB	273	6.35	TIG & ARC	6.35 V	ER70SA1	E7018-1			1003 REV 03	10	–	–	RT 10%	*	*	
		PIPE FITTING	SA106GRB SA234WPB				3	270	60	33	--								
03	1-80-340-21246	PIPE	SA106GRB	219.1	6.35	TIG & ARC	6.35 V	ER70SA1	E7018-1			1003 REV 03	10	–	–	RT 10%	*	*	
		PLATE FITTING	SA515GR70 SA234WPB				4	284	148	--	--								
04	1-80-340-21246	PIPE	SA106GRB	114.3	6.02	TIG & ARC	6.02 V	ER70SA1	E7018-1			1003 REV 03	10	–	–	RT 10%	*	*	
		PIPE FITTING/VALVE	SA106GRB SA234WPB/WCB				8	213	168	--	--								

NOTES: 01. * REFER NDE MANUAL DOC NO. AA/CQ/GL/011 REV 00 dtd 24.10.16

PREPARED	DESIGN/CHD.	DESIGN/APPD.	CHD./APPD. – QA	DATE	DRAWING NO.	REV .
RAJESH KUMAR	DHINESH	S.RAMAMURTHY	C.HARITHA	07.02.17	4-80-340-80102	00

ERECTION / FIELD WELDING SCHEDULE

PROJECT : KOTHAGUDAM 1X800MW
CONTRACTOR : M/S BHEL

CUST. NO : 7268
PGMA : 80–345
SYSTEM : AUXILIARY STEAM TO DEAERATOR

REV. NO. : 00
WELDING CODE : IBR / ASME
PAGE NO : 01 OF 02

SL. NO.	DRG NO. FOR WELD LOCATION IDENTIFICATION MARK	DESCRIPTION OF PARTS TO BE WELDED	MATL.SPEC. (ATT)	DIMENSIONS		PROCESS OF WELDING	TYPE OF WELD	ELECTRODE FILLER SPEC. (ATT)				W.P.S NO.	MIN. PRE HEAT TEMP. °C	HEAT TREATMENT		NDT METHOD/ QUANTUM	REF. SPEC. NO.	ACC. NORM REF.	REMARKS
				SIZE OD mm	THICK mm			TIG	ARC SPEC.					TEMP. °C	HOLD TIME				
		PART–1	PART–1					QTY(gms)	QTY(NOS.)										
		PART–2	PART–2				QTY	ø2.4	ø2.5	ø3.2	ø4.0								
01	1–80–345–21216	FITTING PIPE	SA234WPB SA106GRB	273	6.35	TIG& ARC	6.35◊	ER70SA1	E7018–1			1003 REV 03	10	–	–	10% RT	*	*	
		FITTING PIPE/VALVE	SA234WPB SA106GRB/WCB				35	3150	700	385	–								
02	1–80–345–21216	PIPE FITTING	SA672GRB70 SA234WPB	508	12.7	TIG& ARC	12.7◊	ER70SA1	E7018–1			1003 REV 03	10	–	–	10% RT	*	*	
		PIPE FITTING/VALVE	SA672GRB70 SA234WPB/WCB				18	3258	684	1134	324								
03	1–80–345–21216	PIPE FITTING	SA106GRB SA234WPB	168.3	7.11	TIG& ARC	7.11◊	ER70SA1	E7018–1			1003 REV 03	10	–	–	10% RT	*	*	
		PIPE FITTING/VALVE	SA106GRB SA234WPB/WCB				18	954	270	198	–								
04	1–80–345–21216	PIPE FITTING	SA106GRB SA234WPB	406.4	9.53	TIG& ARC	9.53◊	ER70SA1	E7018–1			1003 REV 03	10	–	–	10% RT	*	*	
		PIPE/NOZZLE FITTING	SA106GRB SA234WPB				2	264	60	94	–								
05	1–80–345–21216	PIPE	SA106GRB	219.1	6.35	TIG& ARC	6.35◊	ER70SA1	E7018–1			1003 REV 03	10	–	–	10% RT	*	*	
		BRANCH/ PLATE	SA106GRC SA515GR70				2	180	74	–	–								
06	1–80–345–21216	PIPE	SA106GRB	114.3	6.02	TIG& ARC	6.02◊	ER70SA1	E7018–1			1003 REV 03	10	–	–	10% RT	*	*	
		FITTING	SA234WPB				2	54	42	–	–								

NOTES: 01. * REFER NDE MANUAL DOC NO. AA/CQ/GL/011 REV 00 dtd 24.10.16

PREPARED	DESIGN/CHD.	DESIGN/APPD.	CHD./APPD. – QA	DATE	DRAWING NO.	REV.
RAJESH KUMAR	DHINESH	S. RAMAMURTHY	HARITHA.C	07.02.17	4-80-345-80021	00

ERECTION / FIELD WELDING SCHEDULE

PROJECT : KOTHAGUDAM 1X800MW
CONTRACTOR : M/S BHEL

CUST. NO : 7268
PGMA : 80-345
SYSTEM : AUXILIARY STEAM TO DEAERATOR

REV. NO. : 00
WELDING CODE : IBR / ASME
PAGE NO : 02 OF 02

SL. NO.	DRG NO. FOR WELD LOCATION IDENTIFICATION MARK	DESCRIPTION OF PARTS TO BE WELDED	MATL.SPEC. (ATT)	DIMENSIONS		PROCESS OF WELDING	TYPE OF WELD	ELECTRODE FILLER SPEC. (ATT)				W.P.S NO.	MIN. PRE HEAT TEMP. °C	HEAT TREATMENT		NDT METHOD/ QUANTUM	REF. SPEC. NO.	ACC. NORM REF.	REMARKS
				SIZE OD mm	THICK mm			TIG	ARC SPEC.					TEMP. °C	HOLD TIME				
								QTY(gms)	QTY(NOS.)										
		PART-1	PART-1																
		PART-2	PART-2				QTY	ø2.4	ø2.5	ø3.2	ø4.0								
07	1-80-345-21216	VALVE(ASV-8)	WC9	273	6.35	TIG& ARC	12.7 V	ER80S-B2	E8018-B2			1012 R04	150	700±20	2.5mtS PER mm min 60mts	100% RT 3% HARDNESS	*	*	
		PIPE	SA335P11				2	186	40	22	-								

NOTES: 01. * REFER NDE MANUAL DOC NO. AA/CQ/GL/011 REV 00 dtd 24.10.16

PREPARED	DESIGN/CHD.	DESIGN/APPD.	CHD./APPD. - QA	DATE	DRAWING NO.	REV.
RAJESH KUMAR	DHINESH	S. RAMAMURTHY	HARITHA.C	07.02.17	4-80-345-80021	00

ERECTION / FIELD WELDING SCHEDULE

PROJECT : KOTHAGUDAM 1X800MW
CONTRACTOR : M/S BHEL

CUST. NO : 7268
PGMA : 80–349
SYSTEM : AUX STEAM TO TURBINE GLAND SEALING

REV. NO. : 00
WELDING CODE : IBR / ASME
PAGE NO : 01 OF 01

SL. NO.	DRG NO. FOR WELD LOCATION IDENTIFICATION MARK	DESCRIPTION OF PARTS TO BE WELDED	MATL.SPEC. (ATT)	DIMENSIONS SIZE OD mm	DIMENSIONS THICK mm	PROCESS OF WELDING	TYPE OF WELD	ELECTRODE FILLER SPEC. (ATT) TIG	ARC SPEC.			W.P.S NO.	MIN. PRE HEAT TEMP. °C	HEAT TREATMENT TEMP. °C	HEAT TREATMENT HOLD TIME	NDT METHOD/ QUANTUM	REF. SPEC. NO.	ACC. NORM REF.	REMARKS
		PART–1	PART–1				QTY(gms)		QTY(NOS.)										
		PART–2	PART–2				QTY	ø2.4	ø2.5	ø3.2	ø4.0								
01	1–80–349–21296	PIPE FITTING	SA106GRB SA234WPB	OD88.9	5.49	TIG& ARC	5.49V	ER70SA1	E7018–1			1003 REV 03	10	–	–	10% RT	*	*	
		PIPE FITTING/VALVE	SA106GRB SA234WPB/WCB				30	600	450	–	–								
02	1–80–349–21296	PIPE	SA106GRB	OD48.3	5.08	TIG& ARC	5.08V	ER70SA1	E7018–1			1003 REV 03	10	–	–	10% RT	*	*	
		PIPE	SA106GRB				~12	120	96	–	–								
03	1–80–349–21296	PIPE	SA106GRB	OD48.3	5.08	ARC	5△	ER70SA1	E7018–1			1003 REV 03	10	–	–	10% RT	*	*	
		FITTING	SA105				~30	–	100	–	–								
04	1–80–349–21296	PIPE	SA106GRB	OD33.4	4.55	TIG& ARC	4.55V	ER70SA1	E7018–1			1003 REV 03	10	–	–	10% RT	*	*	
		PIPE	SA106GRB				~12	84	60	–	–								
05	1–80–349–21296	PIPE	SA106GRB	OD33.4	4.55	ARC	5△	–	E7018–1			1003 REV 03	10	–	–	10% RT	*	*	
		FITTING	SA105				~30	–	35	–	–								

NOTES: 01. * REFER NDE MANUAL DOC NO. AA/CQ/GL/011 REV 00 dtd 24.10.16

PREPARED	DESIGN/CHD.	DESIGN/APPD.	CHD./APPD. – QA	DATE	DRAWING NO.	REV.
RAJESH KUMAR	DHINESH	S.RAMAMURTHY	HARITHA.C	10.03.17	4-80-349-80180	00

ERECTION / FIELD WELDING SCHEDULE

PROJECT : KOTHAGUDAM 1X800MW
CONTRACTOR : M/S BHEL

CUST. NO : 7268
PGMA : 80–400
SYSTEM : CONDENSATE SUCTION PIPING

REV. NO. : 00
WELDING CODE : – / ASME
PAGE NO : 01 OF 01

SL. NO.	DRG NO. FOR WELD LOCATION IDENTIFICATION MARK	DESCRIPTION OF PARTS TO BE WELDED	MATL.SPEC. (ATT)	DIMENSIONS SIZE OD mm	DIMENSIONS THICK mm	PROCESS OF WELDING	TYPE OF WELD	ELECTRODE FILLER SPEC. (ATT) TIG QTY(gms)	ELECTRODE FILLER SPEC. (ATT) ARC SPEC. QTY(NOS.) ø2.5	ø3.2	ø4.0	W.P.S NO.	MIN. PRE HEAT TEMP. °C	HEAT TREATMENT TEMP. °C	HEAT TREATMENT HOLD TIME	NDT METHOD/ QUANTUM	REF. SPEC. NO.	ACC. NORM REF.	REMARKS
		PART–1	PART–1				QTY	ø2.4											
		PART–2	PART–2																
01	1–80–400–21237	FITTING PIPE	SA106GRB SA234WPB	355.6	9.53	TIG& ARC	9.53▽	ER70SA1	E7018–1			1003 REV 03	10	–	–	10% RT	*	*	
		FITTING PIPE	SA106GRB SA234WPB				20	2875	594	902	–								
02	1–80–400–21237	FITTING PIPE	SA672GRB70 SA234WPB	660	10	TIG& ARC	10▽	ER70SA1	E7018–1			1003 REV 03	10	–	–	10% RT	*	*	
		FITTING PIPE	SA672GRB70 SA234WPB				23	5079	1160	1822	–								
03	1–80–400–21237	FITTING PIPE	SA672GRB70 SA234WPB	559	10	TIG& ARC	10▽	ER70SA1	E7018–1			1003 REV 03	10	–	–	10% RT	*	*	
		FITTING PIPE/WCC	SA234WPB SA672GR70/WCB				12	2070	416	654	–								
04	1–80–400–21237	FITTING PIPE	SA234WPB SA672GRB70	610	10	TIG& ARC	10▽	ER70SA1	E7018–1			1003 REV 03	10	–	–	10% RT	*	*	
		FITTING PIPE	SA234WPB SA672GRB70				9	1822	416	654	–								
05	1–80–400–21237	PIPE	SA106GRB	60.3	5.54	TIG & ARC	5.54▽	ER70SA1	E7018–1			1003 REV 03	10	–	–	10% RT	*	*	
		PIPE	SA106GRB				36	454	360	–	–								
06	1–80–400–21237	PIPES	SA106GRB	60.3 & 33.4	5.54 & 4.55	ARC	6◺ 5◺	–	E7018–1			1003 REV 03	10	–	–	LPI/MPI 10%	*	*	
		FLANGE	SA515GR70				45	–	163	–	–								

NOTES: 01. * REFER NDE MANUAL DOC NO. AA/CQ/GL/011 REV 00 dtd 24.10.16

PREPARED	DESIGN/CHD.	DESIGN/APPD.	CHD./APPD. – QA	DATE	DRAWING NO.	REV.
RAJESH KUMAR	DHINESH	S.RAMAMURTHY	HARITHA.C	10.03.17	4-80-400-79999	00

ERECTION / FIELD WELDING SCHEDULE

PROJECT : KOTHAGUDAM 1X800MW
CONTRACTOR : M/S BHEL

CUST. NO : 7268
PGMA : 80–401
SYSTEM : CEP DISCHARGE TO DEAERATOR

REV. NO. : 00
WELDING CODE : – / ASME
PAGE NO : 01 OF 02

SL. NO.	DRG NO. FOR WELD LOCATION IDENTIFICATION MARK	DESCRIPTION OF PARTS TO BE WELDED	MATL.SPEC. (ATT)	DIMENSIONS SIZE OD mm	DIMENSIONS THICK mm	PROCESS OF WELDING	TYPE OF WELD	ELECTRODE FILLER SPEC. (ATT) TIG	ARC SPEC.			W.P.S NO.	MIN. PRE HEAT TEMP. °C	HEAT TREATMENT TEMP. °C	HEAT TREATMENT HOLD TIME	NDT METHOD/ QUANTUM	REF. SPEC. NO.	ACC. NORM REF.	REMARKS
		PART–1	PART–1				QTY(gms)		QTY(NOS.)										
		PART–2	PART–2				QTY	ø2.4	ø2.5	ø3.2	ø4.0								
01	0–80–401–07009 0–80–401–07010 0–80–401–07011	FITTING PIPE/VALVE	SA234WPB SA106GRB/WCC	457.2	12.7	TIG& ARC	12.7◇	ER70SA1	E7018–1			1003 REV 03	10	–	–	10% RT	*	*	
		FITTING PIPE	SA234WPB SA106GRB				141	22842	4794	7896	2256								
02	0–80–401–07009 0–80–401–07011	FITTING PIPE/VALVE	SA234WPB SA106GRB/WCC	323.9	9.53	TIG& ARC	9.53◇	ER70SA1	E7018–1			1003 REV 03	10	–	–	10% RT	*	*	
		FITTING PIPE	SA234WPB SA106GRB				48	4992	1152	1776	–								
03	0–80–401–07009	FITTING PIPE	SA234WPB SA106GRB	406.4	12.7	TIG& ARC	12.7◇	ER70SA1	E7018–1			1003 REV 03	10	–	–	10% RT	*	*	
		FITTING PIPE	SA234WPB SA106GRB				17	2431	510	850	204								
04	0–80–401–07009	FITTING PIPE/VALVE	SA234WPB SA106GRB/WCC	88.9	5.49	TIG& ARC	5.49◇	ER70SA1	E7018–1			1003 REV 03	10	–	–	10% RT	*	*	
		FITTING PIPE	SA234WPB SA106GRB				32	640	480	–	–								
05	0–80–401–07010 0–80–401–07011	FITTING PIPE	SA234WPB SA106GRB	508	12.7	TIG& ARC	12.7◇	ER70SA1	E7018–1			1003 REV 03	10	–	–	10% RT	*	*	
		FITTING PIPE	SA234WPB SA106GRB				12	2172	456	756	216								
06	0–80–401–07010	FITTING PIPE	SA234WPB SA106GRB	114.3	6.02	TIG& ARC	6.02◇	ER70SA1	E7018–1			1003 REV 03	10	–	–	10% RT	*	*	
		FITTING PIPE	SA234WPB SA106GRB				4	108	84	–	–								

NOTES: 01. * REFER NDE MANUAL DOC NO. AA/CQ/GL/011 REV 00 dtd 24.10.16

PREPARED	DESIGN/CHD.	DESIGN/APPD.	CHD./APPD. – QA	DATE	DRAWING NO.	REV.
RAJESH KUMAR	DHINESH	S.RAMAMURHTY	HARITHA.C	03.12.16	4-80-401-80015	00

ERECTION / FIELD WELDING SCHEDULE

PROJECT : KOTHAGUDAM 1X800MW
CONTRACTOR : M/S BHEL

CUST. NO : 7268
PGMA : 80–401
SYSTEM : CEP DISCHARGE TO DEAERATOR

REV. NO. : 00
WELDING CODE : – / ASME
PAGE NO : 02 OF 02

SL. NO.	DRG NO. FOR WELD LOCATION IDENTIFICATION MARK	DESCRIPTION OF PARTS TO BE WELDED	MATL.SPEC. (ATT)	DIMENSIONS SIZE OD mm	DIMENSIONS THICK mm	PROCESS OF WELDING	TYPE OF WELD	ELECTRODE FILLER SPEC. (ATT) TIG	ARC SPEC.			W.P.S NO.	MIN. PRE HEAT TEMP. °C	HEAT TREATMENT TEMP. °C	HEAT TREATMENT HOLD TIME	NDT METHOD/ QUANTUM	REF. SPEC. NO.	ACC. NORM REF.	REMARKS
		PART–1	PART–1				QTY	QTY(gms)	QTY(NOS.)										
		PART–2	PART–2					ø2.4	ø2.5	ø3.2	ø4.0								
07	1–80–401–21258	FITTING PIPE	SA234WPB SA106GRB	168.3	7.11	TIG& ARC	7.11 ⩛	ER70SA1	E7018–1			1003 REV 03	10	–	–	10% RT	*	*	
		FITTING PIPE	SA234WPB SA106GRB				46	2438	690	506	–								
08	1–80–401–21258	VALVE	WC6	168.3	7.11	TIG& ARC	7.11 ⩛	ER70SA1	E7018–1			1033 REV 04	150	650 TO 670	2.5mtS PER mm minimum 60 min	10% RT 3% HARDNESS	*	*	
		PIPE	SA106GRC				2	106	30	18	–								

NOTES:

01. * REFER NDE MANUAL DOC NO. AA/CQ/GL/011 REV 00 dtd 24.10.16

PREPARED	DESIGN/CHD.	DESIGN/APPD.	CHD./APPD. – QA	DATE	DRAWING NO.	REV .
RAJESH KUMAR	DHINESH	S.RAMAMURTHY	HARITHA.C	03.12.16	4-80-401-80015	00

ERECTION / FIELD WELDING SCHEDULE

PROJECT : KOTHAGUDAM 1X800MW
CONTRACTOR : M/S BHEL

CUST. NO : 7268
PGMA : 80–402
SYSTEM : CEP DISCHARGE TO DEAERATOR

REV. NO. : 00
WELDING CODE : – / ASME
PAGE NO : 01 OF 01

SL. NO.	DRG NO. FOR WELD LOCATION IDENTIFICATION MARK	DESCRIPTION OF PARTS TO BE WELDED	MATL.SPEC. (ATT)	DIMENSIONS		PROCESS OF WELDING	TYPE OF WELD	ELECTRODE FILLER SPEC. (ATT)				W.P.S NO.	MIN. PRE HEAT TEMP. °C	HEAT TREATMENT		NDT METHOD/ QUANTUM	REF. SPEC. NO.	ACC. NORM REF.	REMARKS
				SIZE OD mm	THICK mm			TIG	ARC SPEC.					TEMP. °C	HOLD TIME				
								QTY(gms)	QTY(NOS.)										
		PART–1	PART–1																
		PART–2	PART–2				QTY	ø2.4	ø2.5	ø3.2	ø4.0								
01	1–80–402–21204	FITTING PIPE/VALVE	SA234WPB SA106GRB/WCC	457.2	12.7	TIG& ARC	12.7◊	ER70SA1	E7018–1			1003 REV 03	10	–	–	10% RT	*	*	
		FITTING PIPE	SA234WPB SA106GRB				26	4212	884	1456	448								
02	1–80–402–21204	FITTING PIPE/VALVE	SA234WPB SA106GRB/WCC	323.9	9.53	TIG& ARC	9.53◊	ER70SA1	E7018–1			1003 REV 03	10	–	–	10% RT	*	*	
		FITTING PIPE	SA234WPB SA106GRB				14	1456	336	518	–								
03	1–80–402–21204	FITTING PIPE	SA234WPB SA106GRB	508	12.7	TIG& ARC	12.7◊	ER70SA1	E7018–1			1003 REV 03	10	–	–	10% RT	*	*	
		FITTING PIPE	SA234WPB SA106GRB				2	362	80	126	36								
04	1–80–402–21204	FITTING PIPE/VALVE	SA234WPB SA106GRB/WCC	406.4	12.7	TIG& ARC	12.7◊	ER70SA1	E7018–1			1003 REV 03	10	–	–	10% RT	*	*	
		FITTING PIPE	SA234WPB SA106GRB				28	4004	840	1400	392								

NOTES: 01. * REFER NDE MANUAL DOC NO. AA/CQ/GL/011 REV 00 dtd 24.10.16

PREPARED	DESIGN/CHD.	DESIGN/APPD.	CHD./APPD. – QA	DATE	DRAWING NO.	REV .
RAJESH KUMAR	DHINESH	S.RAMAMURTHY	HARITHA.C	11.08.16	4-80-402-80002	00

ERECTION / FIELD WELDING SCHEDULE

PROJECT : KOTHAGUDAM 1X800MW
CONTRACTOR : M/S BHEL

CUST. NO : 7268
PGMA : 80–403
SYSTEM : CEP DISCHARGE TO DEAERATOR

REV. NO. : 00
WELDING CODE : – / ASME
PAGE NO : 01 OF 01

SL. NO.	DRG NO. FOR WELD LOCATION IDENTIFICATION MARK	DESCRIPTION OF PARTS TO BE WELDED	MATL.SPEC. (ATT)	DIMENSIONS SIZE OD mm	DIMENSIONS THICK mm	PROCESS OF WELDING	TYPE OF WELD	ELECTRODE FILLER SPEC. (ATT) TIG	ARC SPEC.			W.P.S NO.	MIN. PRE HEAT TEMP. °C	HEAT TREATMENT TEMP. °C	HEAT TREATMENT HOLD TIME	NDT METHOD/ QUANTUM	REF. SPEC. NO.	ACC. NORM REF.	REMARKS
		PART–1	PART–1				QTY(gms)		QTY(NOS.)										
		PART–2	PART–2				QTY	ø2.4	ø2.5	ø3.2	ø4.0								
01	1–80–403–21259	FITTING PIPE/VALVE	SA234WPB SA106GRB/WCC	323.9	9.53	TIG& ARC	9.53◊	ER70SA1	E7018–1			1003 REV 03	10	–	–	10% RT	*	*	
		FITTING PIPE	SA234WPB SA106GRB				12	1248	288	444	–								
02	1–80–403–21259	FITTING PIPE/VALVE	SA234WPB SA106GRB/WCC	457.2	12.7	TIG& ARC	12.7◊	ER70SA1	E7018–1			1003 REV 03	10	–	–	10% RT	*	*	
		FITTING PIPE/VALVE	SA234WPB SA106GRB/WCC				62	10044	2108	3472	992								
03	1–80–403–21259	FITTING PIPE	SA234WPB SA106GRB	406.4	12.7	TIG& ARC	12.7◊	ER70SA1	E7018–1			1003 REV 03	10	–	–	10% RT	*	*	
		FITTING PIPE	SA234WPB SA106GRB				5	810	170	0	60								
04	1–80–403–21259	FITTING PIPE	SA234WPB SA106GRB	508	12.7	TIG& ARC	12.7◊	ER70SA1	E7018–1			1003 REV 03	10	–	–	10% RT	*	*	
		FITTING PIPE	SA234WPB SA106GRB				5	905	190	0	70								

NOTES: 01. * REFER NDE MANUAL DOC NO. AA/CQ/GL/011 REV 00 dtd 24.10.16

PREPARED	DESIGN/CHD.	DESIGN/APPD.	CHD./APPD. – QA	DATE	DRAWING NO.	REV.
RAJESH KUMAR	DHINESH	S.RAMAMURTHY	HARITHA.C	11.08.16	4-80-403-80093	00

ERECTION / FIELD WELDING SCHEDULE

PROJECT : KOTHAGUDAM 1X800MW
CONTRACTOR : M/S BHEL

CUST. NO : 7268
PGMA : 80–407
SYSTEM : CONDENSATE TO VALVE GLAND SEALING

REV. NO. : 00
WELDING CODE : – / ASME
PAGE NO : 01 OF 01

SL. NO.	DRG NO. FOR WELD LOCATION IDENTIFICATION MARK	DESCRIPTION OF PARTS TO BE WELDED	MATL.SPEC. (ATT)	DIMENSIONS SIZE OD mm	DIMENSIONS THICK mm	PROCESS OF WELDING	TYPE OF WELD	ELECTRODE FILLER SPEC. (ATT) TIG	ELECTRODE FILLER SPEC. (ATT) ARC SPEC.			W.P.S NO.	MIN. PRE HEAT TEMP. °C	HEAT TREATMENT TEMP. °C	HEAT TREATMENT HOLD TIME	NDT METHOD/ QUANTUM	REF. SPEC. NO.	ACC. NORM REF.	REMARKS
		PART–1	PART–1					QTY(gms)	QTY(NOS.)										
		PART–2	PART–2				QTY	ø2.4	ø2.5	ø3.2	ø4.0								
01	1–80–407–21506	PIPE	SA106GRB	60.3	5.54	ARC	6	–	E7018–1			1003 REV 03	10	–	–	10% RT	*	*	
		FITTING	SA105				~54	–	150	–	–								
02	1–80–407–21506	PIPE	SA106GRB	33.4	4.55	ARC	5	–	E7018–1			1003 REV 03	10	–	–	10% RT	*	*	
		FITTING	SA105				~200	–	231	–	–								
03	1–80–407–21506	PIPE	SA106GRB	21.3	3.73	ARC	4	--	E7018–1			1003 REV 03	10	–	–	10% RT	*	*	
		FITTING	SA105				~230	--	112	–	–								
04	1–80–407–21506	FITTING PIPE	SA234WPB SA106GRB	114.3	6.02	TIG& ARC	6.02 ▽	ER70SA1	E7018–1			1003 REV 03	10	–	–	10% RT	*	*	
		FITTING PIPE	SA234WPB SA106GRB				~16	426	336	–	–								
04	1–80–407–21506	FITTING PIPE	SA234WPB SA106GRB	60.3	5.54	TIG& ARC	5.54 ▽	ER70SA1	E7018–1			1003 REV 03	10	–	–	10% RT	*	*	
		FITTING PIPE	SA234WPB SA106GRB				~17	215	170	–	–								
04	1–80–407–21506	FITTING PIPE	SA234WPB SA106GRB	88.9	5.54	TIG& ARC	5.54 ▽	ER70SA1	E7018–1			1003 REV 03	10	–	–	10% RT	*	*	
		FITTING PIPE	SA234WPB SA106GRB				~6	118	90	–	–								

NOTES:
01. * REFER NDE MANUAL DOC NO. AA/CQ/GL/011 REV 00 dtd 24.10.16

PREPARED	DESIGN/CHD.	DESIGN/APPD.	CHD./APPD. – QA	DATE	DRAWING NO.	REV.
RAJESH KUMAR	DHINESH	S.RAMAMURTHY	HARITHA.C	11.08.16	4-80-407-80185	00

ERECTION / FIELD WELDING SCHEDULE

PROJECT : KOTHAGUDAM 1X800MW
CONTRACTOR : M/S BHEL

CUST. NO : 7268
PGMA : 80-419
SYSTEM : DEAERATOR SAFETY VALVE EXHAUST TO ATM

REV. NO. : 00
WELDING CODE : - / ASME
PAGE NO : 01 OF 01

SL. NO.	DRG NO. FOR WELD LOCATION IDENTIFICATION MARK	DESCRIPTION OF PARTS TO BE WELDED	MATL.SPEC. (ATT)	DIMENSIONS SIZE OD mm	DIMENSIONS THICK mm	PROCESS OF WELDING	TYPE OF WELD	ELECTRODE FILLER SPEC. (ATT) TIG	ARC SPEC.			W.P.S NO.	MIN. PRE HEAT TEMP. °C	HEAT TREATMENT TEMP. °C	HEAT TREATMENT HOLD TIME	NDT METHOD/ QUANTUM	REF. SPEC. NO.	ACC. NORM REF.	REMARKS
		PART-1	PART-1					QTY(gms)	QTY(NOS.)										
		PART-2	PART-2				QTY	ø2.4	ø2.5	ø3.2	ø4.0								
01	1-80-419-21311	PIPE FITTING	SA106GRB SA234WPB	273	6.35	TIG& ARC	6.35√	ER70SA1	E7018-1			1003 REV 03	10	-	-	10% RT	*	*	
		PIPE FITTING/WCB	SA106GRB SA234WPB				7	623	140	77	-								
02	1-80-419-21311	PIPE FITTING	SA106GRB SA234WPB	355.6	9.53	TIG& ARC	9.53√	ER70SA1	E7018-1			1003 REV 03	10	-	-	10% RT	*	*	
		PIPE FITTING/WCB	SA106GRB SA234WPB				35	4025	945	1435	-								
03	1-80-419-21310	FITTING PIPE	SA106GRB SA234WPB	60.3	5.54	TIG& ARC	5.54√	ER70SA1	E7018-1			1003 REV 03	10	-	-	10% RT	*	*	
		FITTING PIPE	SA106GRB SA234WPB				25	315	315	250	-								
04	1-80-419-21310	FITTING PIPE	SA106GRB SA234WPB	114.3	6.02	TIG& ARC	6.02√	ER70SA1	E7018-1			1003 REV 03	10	-	-	10% RT	*	*	
		FITTING PIPE	SA106GRB SA234WPB				20	532	420	-	-								
05	1-80-419-21311	PIPE FITTING	SA106GRB SA234WPB	457	9.53	TIG& ARC	9.53√	ER70SA1	E7018-1			1003 REV 03	10	-	-	10% RT	*	*	
		PIPE FITTING/WCB	SA106GRB SA234WPB				5	750	170	265	-								
06	1-80-419-21311	PIPE FITTING	SA106GRB SA234WPB	406.4	9.53	TIG& ARC	9.53√	ER70SA1	E7018-1			1003 REV 03	10	-	-	10% RT	*	*	
		PIPE FITTING/WCB	SA106GRB SA234WPB				2	264	60	94	-								

NOTES:
01. * REFER NDE MANUAL DOC NO. AA/CQ/GL/011 REV 00 dtd 24.10.16

PREPARED	DESIGN/CHD.	DESIGN/APPD.	CHD./APPD. - QA	DATE	DRAWING NO.	REV.
RAJESH KUMAR	DHINESH	S.RAMAMURTHY	HARITHA.C	07.02.17	4-80-419-80118	00

ERECTION / FIELD WELDING SCHEDULE

PROJECT : KOTHAGUDAM 1X800MW
CONTRACTOR : M/S BHEL

CUST. NO : 7268
PGMA : 80–420
SYSTEM : BOOSTER PUMP DISCHARGE TO BFP SUCTION PIPING

REV. NO. : 00
WELDING CODE : – / ASME
PAGE NO : 01 OF 02

SL. NO.	DRG NO. FOR WELD LOCATION IDENTIFICATION MARK	DESCRIPTION OF PARTS TO BE WELDED	MATL.SPEC. (ATT)	DIMENSIONS SIZE OD mm	DIMENSIONS THICK mm	PROCESS OF WELDING	TYPE OF WELD	ELECTRODE FILLER SPEC. (ATT) TIG	ELECTRODE FILLER SPEC. (ATT) ARC SPEC.			W.P.S NO.	MIN. PRE HEAT TEMP. °C	HEAT TREATMENT TEMP. °C	HEAT TREATMENT HOLD TIME	NDT METHOD/ QUANTUM	REF. SPEC. NO.	ACC. NORM REF.	REMARKS
		PART–1	PART–1					QTY(gms)	QTY(NOS.)										
		PART–2	PART–2				QTY	ø2.4	ø2.5	ø3.2	ø4.0								
01	1–80–420–21218	FITTING	SA106GRB SA234WPB	406.4	9.53	TIG& ARC	9.53◇	ER70SA1	E7018–1			1003 REV 03	10	–	–	10% RT	*	*	
		FITTING PIPE	SA106GRB SA234WPB				48	6336	1440	2256	–								
02	1–80–420–21218	FITTING	SA106GRB SA234WPB	355.6	9.53	TIG& ARC	9.53◇	ER70SA1	E7018–1			1003 REV 03	10	–	–	10% RT	*	*	
		NOZZLE PIPE	GRB EQUIVALENT SA234WPB				6	690	162	246	–								
03	1–80–420–21219	FITTING	SA106GRB	457.2	9.53	TIG& ARC	9.53◇	ER70SA1	E7018–1			1003 REV 03	10	–	–	10% RT	*	*	
		STRAINER	GRB EQUIVALENT				74	11100	2516	3922	–								
04	1–80–420–21219	PIPE	SA106GRB	559	9.53	TIG& ARC	9.53◇	ER70SA1	E7018–1			1003 REV 03	10	–	–	10% RT	*	*	
		FITTING NOZZLE	GRB EQUIVALENT				6	1215	280	458	–								
05	1–80–420–21219	FITTING	SA106GRB	610	10	TIG& ARC	10 ◇	ER70SA1	E7018–1			1003 REV 03	10	–	–	10% RT	*	*	
		STRAINER	GRB EQUIVALENT				6	1215	300	450	–								
06	1–80–420–21219	PIPE	SA106GRB	33.4	4.55	ARC	6◺ 7◺	–	E7018–1			1022 REV 00	–	–	–	LPI/MPI 10%	*	*	
		FLANGE	SA105				3	–	100	–	–								

NOTES:

01. * REFER NDE MANUAL DOC NO. AA/CQ/GL/011 REV 00 dtd 24.10.16

PREPARED	DESIGN/CHD.	DESIGN/APPD.	CHD./APPD. – QA	DATE	DRAWING NO.	REV.
RAJESH KUMAR	DHINESH	S.RAMAMURTHY	HARITHA.C	07.02.17	4-80-420-80002	00

ERECTION / FIELD WELDING SCHEDULE

PROJECT : KOTHAGUDAM 1X800MW
CONTRACTOR : M/S BHEL

CUST. NO : 7268
PGMA : 80-420
SYSTEM : BOOSTER PUMP DISCHARGE TO BFP SUCTION PIPING

REV. NO. : 00
WELDING CODE : - / ASME
PAGE NO : 02 OF 02

SL. NO.	DRG NO. FOR WELD LOCATION IDENTIFICATION MARK	DESCRIPTION OF PARTS TO BE WELDED	MATL.SPEC. (ATT)	DIMENSIONS SIZE OD mm	DIMENSIONS THICK mm	PROCESS OF WELDING	TYPE OF WELD	ELECTRODE FILLER SPEC. (ATT) TIG QTY(gms)	ELECTRODE FILLER SPEC. (ATT) ARC SPEC. QTY(NOS.)			W.P.S NO.	MIN. PRE HEAT TEMP. °C	HEAT TREATMENT TEMP. °C	HEAT TREATMENT HOLD TIME	NDT METHOD/ QUANTUM	REF. SPEC. NO.	ACC. NORM REF.	REMARKS
		PART-1	PART-1				QTY	ø2.4	ø2.5	ø3.2	ø4.0								
		PART-2	PART-2																
07	1-80-420-21219	PIPE	SA106GRB	60.3	5.54	ARC	6△ 7△	-	E7018-1			1022 REV 00	-	-	-	LPI/MPI 10%	*	*	
		FLANGE	SA105				3	-	150	-	-								

NOTES:

01. * REFER NDE MANUAL DOC NO. AA/CQ/GL/011 REV 00 dtd 24.10.16

PREPARED	DESIGN/CHD.	DESIGN/APPD.	CHD./APPD. - QA	DATE	DRAWING NO.	REV.
RAJESH KUMAR	DHINESH	S.RAMAMURTHY	HARITHA.C	07.02.17	4-80-420-80002	00

ERECTION / FIELD WELDING SCHEDULE

PROJECT : KOTHAGUDAM 1X800MW
CONTRACTOR : M/S BHEL

CUST. NO : 7268
PGMA : 80–421
SYSTEM : BFD RECIRULATION PIPING

REV. NO. : 00
WELDING CODE : IBR / ASME
PAGE NO : 01 OF 01

SL. NO.	DRG NO. FOR WELD LOCATION IDENTIFICATION MARK	DESCRIPTION OF PARTS TO BE WELDED	MATL.SPEC. (ATT)	DIMENSIONS SIZE OD mm	DIMENSIONS THICK mm	PROCESS OF WELDING	TYPE OF WELD	ELECTRODE FILLER SPEC. (ATT) TIG	ARC SPEC.			W.P.S NO.	MIN. PRE HEAT TEMP. °C	HEAT TREATMENT TEMP. °C	HEAT TREATMENT HOLD TIME	NDT METHOD/ QUANTUM	REF. SPEC. NO.	ACC. NORM REF.	REMARKS
								QTY(gms)	QTY(NOS.)										
		PART–1	PART–1																
		PART–2	PART–2				QTY	ø2.4	ø2.5	ø3.2	ø4.0								
01	1–80–421–21060	FITTING PIPE	SA234WPC SA106GRC	323.9	56	TIG& ARC	56 V̂	ER70SA1	E7018–A1			1005 REV 05	100	635±15	2.5mtS PER mm minimum 30 min	RT 100%	*	*	
		FITTING PIPE	SA234WPC SA106GRC				30	2550	720	1170	5040								
02	1–80–421–21060	FITTING PIPE	SA234WPC SA106GRC	273	12.7	TIG& ARC	12.7 V̂	ER70SA1	E7018–1			1003 REV 03	10	–	–	RT 10%	*	*	
		FITTING PIPE	SA234WPC SA106GRC				51	4743	1020	1683	306								
03	1–80–421–21060	MATCHING PIECE	SA182F12CL2	323.9	56	TIG& ARC	56 V̂	ER80S–B2	E8018–B2			1012 REV 04	150	700±25	2.5mtS PER mm minimum 60 min	RT 100%	*	*	3% HARDNESS
		CONTROL VAL	SA182F22				6	510	150	240	1008								
04	1–80–421–21060	MATCHING PIECE	SA182F12CL2	323.9	56	TIG& ARC	56 V̂	ER70S–A1	E7018–1			1033 REV 04	150	660±10	2.5mtS PER mm minimum 60 min	RT 100%	*	*	3% HARDNESS
		ELBOW	SA234WPC				6	510	150	240	1008								

NOTES: 01. * REFER NDE MANUAL DOC NO. AA/CQ/GL/011 REV 00 dtd 24.10.16

PREPARED	DESIGN/CHD.	DESIGN/APPD.	CHD./APPD. – QA	DATE	DRAWING NO.	REV.
RAJESH KUMAR	DHINESH	S.RAMAMURTHY	HARITHA.C	10.03.17	4-80-421-79673	00

ERECTION / FIELD WELDING SCHEDULE

PROJECT : KOTHAGUDAM 1X800MW
CONTRACTOR : M/S BHEL

CUST. NO : 7268
PGMA : 80–430
SYSTEM : SPRAY WATER PIPING TO HPBP VALVE

REV. NO. : 00
WELDING CODE : IBR / ASME
PAGE NO : 01 OF 01

SL. NO.	DRG NO. FOR WELD LOCATION IDENTIFICATION MARK	DESCRIPTION OF PARTS TO BE WELDED	MATL.SPEC. (ATT)	DIMENSIONS SIZE OD mm	DIMENSIONS THICK mm	PROCESS OF WELDING	TYPE OF WELD	ELECTRODE FILLER SPEC. (ATT) TIG QTY(gms) ø2.4	ARC SPEC. QTY(NOS.) ø2.5	ø3.2	ø4.0	W.P.S NO.	MIN. PRE HEAT TEMP. °C	HEAT TREATMENT TEMP. °C	HEAT TREATMENT HOLD TIME	NDT METHOD/ QUANTUM	REF. SPEC. NO.	ACC. NORM REF.	REMARKS
01	2–80–430–14091	FITTING PIPE	SA234WPC SA106GRC	168.3	26	TIG& ARC	26 V	ER70SA1	E7018–1			1005 REV05	100	635 ±15	2.5mtS PER mm minimum 30 min	RT100%	*	*	
		FITTING PIPE/VALVE	SA234WPC SA106GRC/WCC				20	900	281	500	400								
02	2–80–430–14091	FITTING PIPE	SA234WPC SA106GRC	114.3	17.12 20	TIG& ARC	17.12 V 20 V	ER70SA1	E7018–1			1005 REV05	10	635 ±15	2.5mtS PER mm minimum 30 min	RT100%	*	*	
		FITTING PIPE/VALVE	SA234WPC SA106GRC/WCC				12	372	144	168	72								
03	2–80–430–14091	PIPE	SA335P11	114.3	20	TIG& ARC	20 V	ER70SA1	E7018–1			1033 REV03	150	660 ±10	2.5mtS PER mm minimum 60 min	RT100%	*	*	3% HARDNESS
		VALVE	WCC				2	62	24	28	12								
04	2–80–430–14091	VALVE(NRV)	WC9	114.3	20	TIG& ARC	20 V	ER80SB2	E8018B2			1012 REV04	150	700 ±20	2.5mtS PER mm minimum 60 min	RT100%	*	*	3% HARDNESS
		PIPE	SA335P11				2	62	24	28	12								
05	2–80–430–14091	FITTING PIPE	SA234WP22 SA335P22	114.3	20	TIG& ARC	20 V	ER90SB3	E9018–B3			1014 REV 03	150	680 TO 720	2.5mtS PER mm minimum 60 min	RT100%	*	*	3% HARDNESS
		FITTING PIPE/VALVE	SA234WP22 SA335P22/WC9				16	496	192	448	96								
06	2–80–430–14091	FITTING PIPE	SA234WP22 SA335P22	88.9	15.24	TIG& ARC	15.24 V	ER90SB3	E9018–B3			1014 REV 03	150	680 TO 720	2.5mtS PER mm minimum 60 min	RT100%	*	*	3% HARDNESS
		FITTING PIPE/VALVE	SA234WP22 SA335P22/F22				4	96	32	44	20								

NOTES: 01. * REFER NDE MANUAL DOC NO. AA/CQ/GL/011 REV 00 dtd 24.10.16

PREPARED	DESIGN/CHD.	DESIGN/APPD.	CHD./APPD. – QA	DATE	DRAWING NO.	REV.
RAJESH KUMAR	DHINESH	S.RAMAMURHTY	HARITHA.C	10.03.2017	4-80-430-80133	00

ERECTION / FIELD WELDING SCHEDULE

PROJECT : KOTHAGUDAM 1X800MW
CONTRACTOR : M/S BHEL

CUST. NO : 7268
PGMA : 80–459
SYSTEM : FLASH TANK–A DRAIN TO CONDENSER

REV. NO. : 00
WELDING CODE : – / ASME
PAGE NO : 01 OF 01

SL. NO.	DRG NO. FOR WELD LOCATION IDENTIFICATION MARK	DESCRIPTION OF PARTS TO BE WELDED	MATL.SPEC. (ATT)	DIMENSIONS SIZE OD mm	DIMENSIONS THICK mm	PROCESS OF WELDING	TYPE OF WELD	ELECTRODE FILLER SPEC. (ATT) TIG QTY(gms) ø2.4	ELECTRODE FILLER SPEC. (ATT) ARC SPEC. QTY(NOS.) ø2.5	ø3.2	ø4.0	W.P.S NO.	MIN. PRE HEAT TEMP. °C	HEAT TREATMENT TEMP. °C	HEAT TREATMENT HOLD TIME	NDT METHOD/ QUANTUM	REF. SPEC. NO.	ACC. NORM REF.	REMARKS
		PART–1	PART–1																
		PART–2	PART–2				QTY												
01	2–80–459–14061	FITTING PIPE	SA106GRB SA234WPB	323.9	6.35	TIG& ARC	6.35√	ER70SA1	E7018–1			1003 REV 03	10	–	–	10% RT	*	*	
		FITTING PIPE/NOZZLE	SA106GRB SA234WPB GRB EQUIVALENT				11	1177	264	401	–								

NOTES: 01. * REFER NDE MANUAL DOC NO. AA/CQ/GL/011 REV 00 dtd 24.10.16

PREPARED	DESIGN/CHD.	DESIGN/APPD.	CHD./APPD. – QA	DATE	DRAWING NO.	REV.
RAJESH KUMAR	DHINESH	S.RAMAMURTHY	HARITHA.C	10.03.17	4-80-459-80057	00

ERECTION / FIELD WELDING SCHEDULE

PROJECT : KOTHAGUDAM–1X800MW
CONTRACTOR : M/S BHEL

CUST. NO : 7268
PGMA : 80–342
SYSTEM : AUXILIARY STEAM PIPING TO STEAM COIL AIR PRE–HEATER

DOC.NO. : NA
REV. NO. : 00
WELDING CODE : IBR / ASME
PAGE NO : 01 OF 01

SL. NO.	DRG NO. FOR WELD LOCATION IDENTIFICATION MARK	DESCRIPTION OF PARTS TO BE WELDED	MATL.SPEC. (ATT)	DIMENSIONS SIZE OD mm	DIMENSIONS THICK mm	PROCESS OF WELDING	TYPE OF WELD	ELECTRODE FILLER SPEC. (ATT) TIG	ELECTRODE FILLER SPEC. (ATT) ARC SPEC.			W.P.S NO.	MIN. PRE HEAT TEMP. °C	HEAT TREATMENT TEMP. °C	HEAT TREATMENT HOLD TIME	NDT METHOD/ QUANTUM	REF. SPEC. NO.	ACC. NORM REF.	REMARKS
								QTY(gms)	QTY(NOS.)										
		PART–1	PART–1																
		PART–2	PART–2				QTY	ø2.4	ø2.5	ø3.2	ø4.0								
01	1–80–342–21301	FITTING PIPE	SA234WPB SA106GRB	273	9.27	TIG & ARC	9.27V	ER70SA1	E7018–1			1003 REV 03	–	–	–	RT 10%	*	*	
		VALVE PIPE/FITTING	WCB SA106GRB/WPB				49	4263	980	1470	–								
02	1–80–342–21301	PIPE/FITTING	SA106GRB/WPB	219.1	8.18	TIG & ARC	8.18V	ER70SA1	E7018–1			1003 REV 03	–	–	–	RT 10%	*	*	
		VALVE PIPE/FITTING	WCB SA106GRB/WPB				67	4690	1139	1206	–								
03	1–80–342–21301	PIPE/FITTING	SA106GRB/WPB	114.3	6.02	TIG & ARC	6.02V	ER70SA1	E7018–1			1003 REV 03	–	–	–	RT 10%	*	*	
		VALVE PIPE/FITTING	WCB SA106GRB/WPB				44	1171	924	–	–								

NOTES: 01. * REFER NDE MANUAL DOC NO. AA/CQ/GL/011 REV 00 dtd 24.10.16

PREPARED	DESIGN/CHD.	DESIGN/APPD.	CHD./APPD. – QA	DATE	DRAWING NO.	REV .
EZHIL	BISWAS	RAMAMURTHY	HARITHA.C	04.02.2017	4–80–342–80186	00

ERECTION / FIELD WELDING SCHEDULE

PROJECT : KOTHAGUDAM–1X800MW
CONTRACTOR : M/S BHEL

CUST. NO : 7268
PGMA : 80–343
SYSTEM : AUXILIARY STEAM PIPING TO SOOT BLOWING

DOC.NO. : NA
REV. NO. : 00
WELDING CODE : IBR / ASME
PAGE NO : 01 OF 01

SL. NO.	DRG NO. FOR WELD LOCATION IDENTIFICATION MARK	DESCRIPTION OF PARTS TO BE WELDED	MATL.SPEC. (ATT)	DIMENSIONS SIZE OD mm	DIMENSIONS THICK mm	PROCESS OF WELDING	TYPE OF WELD	ELECTRODE FILLER SPEC. (ATT) TIG QTY(gms)	ELECTRODE FILLER SPEC. (ATT) ARC SPEC. QTY(NOS.)			W.P.S NO.	MIN. PRE HEAT TEMP. °C	HEAT TREATMENT TEMP. °C	HEAT TREATMENT HOLD TIME	NDT METHOD/ QUANTUM	REF. SPEC. NO.	ACC. NORM REF.	REMARKS
							QTY	ø2.4	ø2.5	ø3.2	ø4.0								
01	2–80–343–14097	FITTING PIPE	SA234WPB SA106GRB	168.3	7.11	TIG & ARC	7.11V	ER70SA1	E7018–1			1003 REV 03	–	–	–	RT 10%	*	*	
		VALVE PIPE/FITTING	WCB SA106GRB/WPB				61	3233	915	671	–								

NOTES: 01. * REFER NDE MANUAL DOC NO. AA/CQ/GL/011 REV 00 dtd 24.10.16

PREPARED	DESIGN/CHD.	DESIGN/APPD.	CHD./APPD. – QA	DATE	DRAWING NO.	REV .
EZHIL	BISWAS	RAMAMURTHY	HARITHA.C	04.02.2017	4–80–343–80145	00

ERECTION / FIELD WELDING SCHEDULE

PROJECT : KOTHAGUDAM–1X800MW
CONTRACTOR : M/S BHEL

CUST. NO : 7268
PGMA : 80–351
SYSTEM : AUXILIARY STEAM PIPING TO MILL INERTING

DOC.NO. : NA
REV. NO. : 00
WELDING CODE : IBR / ASME
PAGE NO : 01 OF 01

SL. NO.	DRG NO. FOR WELD LOCATION IDENTIFICATION MARK	DESCRIPTION OF PARTS TO BE WELDED	MATL.SPEC. (ATT)	DIMENSIONS SIZE OD mm	DIMENSIONS THICK mm	PROCESS OF WELDING	TYPE OF WELD	ELECTRODE FILLER SPEC. (ATT) TIG	ELECTRODE FILLER SPEC. (ATT) ARC SPEC.			W.P.S NO.	MIN. PRE HEAT TEMP. °C	HEAT TREATMENT TEMP. °C	HEAT TREATMENT HOLD TIME	NDT METHOD/ QUANTUM	REF. SPEC. NO.	ACC. NORM REF.	REMARKS
							QTY	QTY(gms) ø2.4	QTY(NOS.) ø2.5	ø3.2	ø4.0								
01	1–80–351–21397	FITTING PIPE	SA234WPB SA106GRB	355.6	9.53	TIG & ARC	9.53√V	ER70SA1	E7018–1			1003 REV 03	–	–	–	RT 10%	*	*	
		VALVE PIPE/FITTING	WCB SA106GRB/WPB				12	1380	324	492									
02	1–80–351–21397	PIPE/FITTING	SA106GRB/WPB	219.1	8.18	TIG & ARC	8.18√V	ER70SA1	E7018–1			1003 REV 03	–	–	–	RT 10%	*	*	
		VALVE PIPE/FITTING	WCB SA106GRB/WPB				54	3780	918	972	–								
03	1–80–351–21397	FITTING PIPE	SA234WPB SA106GRB	273	9.27	TIG & ARC	9.27√V	ER70SA1	E7018–1			1003 REV 03	–	–	–	RT 10%	*	*	
		VALVE PIPE/FITTING	WCB SA106GRB/WPB				80	6960	1600	2400	–								

NOTES: 01. * REFER NDE MANUAL DOC NO. AA/CQ/GL/011 REV 00 dtd 24.10.16

PREPARED	DESIGN/CHD.	DESIGN/APPD.	CHD./APPD. – QA	DATE	DRAWING NO.	REV .
EZHIL	BISWAS	RAMAMURTHY	HARITHA.C	04.02.2017	4–80–351–80307	00

ERECTION / FIELD WELDING SCHEDULE

PROJECT : KOTHAGUDAM–1X800MW
CONTRACTOR : M/S BHEL

CUST. NO : 7268
PGMA : 80–370
SYSTEM : FLASH TANK AND FLASH TANK DRAIN TANK VENT TO ATMOSPHERE

DOC.NO. : NA
REV. NO. : 00
WELDING CODE : – / ASME
PAGE NO : 01 OF 01

SL. NO.	DRG NO. FOR WELD LOCATION IDENTIFICATION MARK	DESCRIPTION OF PARTS TO BE WELDED	MATL.SPEC. (ATT)	DIMENSIONS SIZE OD mm	DIMENSIONS THICK mm	PROCESS OF WELDING	TYPE OF WELD	ELECTRODE FILLER SPEC. (ATT) TIG	ELECTRODE FILLER SPEC. (ATT) ARC SPEC.			W.P.S NO.	MIN. PRE HEAT TEMP. °C	HEAT TREATMENT TEMP. °C	HEAT TREATMENT HOLD TIME	NDT METHOD/ QUANTUM	REF. SPEC. NO.	ACC. NORM REF.	REMARKS
								QTY(gms)	QTY(NOS.)										
		PART–2	PART–2				QTY	ø2.4	ø2.5	ø3.2	ø4.0								
01	1–80–370–21212	PIPE	SA515GR70	1868	20	TIG & ARC	20 V	ER70SA1	E7018–1			1004 REV 03	10	610±10	2.5mtS PER mm minimum 30 min	RT 10%	*	*	
		PIPE/NOZZLE MITRE BEND	SA515GR70				19	12662	2714	4458	3295								
02	1–80–370–21212	PIPE	SA106GRB/WPB	273	9.27	TIG & ARC	9.27 V	ER70SA1	E7018–1			1004 REV 03	10	610±10	2.5mtS PER mm minimum 30 min	RT 10%	*	*	
		PIPE/FITTING NOZZLE	SA106GRB/WPB				13	1131	260	390	–								

NOTES: 01. * REFER NDE MANUAL DOC NO. AA/CQ/GL/011 REV 00 dtd 24.10.16

PREPARED	DESIGN/CHD.	DESIGN/APPD.	CHD./APPD. – QA	DATE	DRAWING NO.	REV .
EZHIL	BISWAS	RAMAMURTHY	HARITHA.C	04.02.2017	4–80–370–80016	00

ERECTION / FIELD WELDING SCHEDULE

PROJECT : KOTHAGUDAM–1X800MW
CONTRACTOR : M/S BHEL

CUST. NO : 7268
PGMA : 80–395
SYSTEM : AUXILIARY STEAM PIPING TO FUEL OIL ATOMISATION

DOC.NO. : NA
REV. NO. : 00
WELDING CODE : IBR / ASME
PAGE NO : 01 OF 01

SL. NO.	DRG NO. FOR WELD LOCATION IDENTIFICATION MARK	DESCRIPTION OF PARTS TO BE WELDED	MATL.SPEC. (ATT)	DIMENSIONS SIZE OD mm	DIMENSIONS THICK mm	PROCESS OF WELDING	TYPE OF WELD	ELECTRODE FILLER SPEC. (ATT) TIG QTY(gms) ø2.4	ELECTRODE FILLER SPEC. (ATT) ARC SPEC. QTY(NOS.) ø2.5	ø3.2	ø4.0	W.P.S NO.	MIN. PRE HEAT TEMP. °C	HEAT TREATMENT TEMP. °C	HEAT TREATMENT HOLD TIME	NDT METHOD/ QUANTUM	REF. SPEC. NO.	ACC. NORM REF.	REMARKS
		PART–1	PART–1				QTY												
		PART–2	PART–2																
01	3–80–395–32971	FITTING	SA234WPB	114.3	6.02	TIG & ARC	6.02V	ER70SA1	E7018–1			1003 REV 03	–	–	–	RT 10%	*	*	
		PIPE	SA106GRB																
		PIPE/FITTING	SA106GRB/WPB				8	213	168	–	–								

NOTES: 01. * REFER NDE MANUAL DOC NO. AA/CQ/GL/011 REV 00 dtd 24.10.16

PREPARED	DESIGN/CHD.	DESIGN/APPD.	CHD./APPD. – QA	DATE	DRAWING NO.	REV .
EZHIL	BISWAS	RAMAMURTHY	HARITHA.C	04.02.2017	4–80–395–80089	00

ERECTION / FIELD WELDING SCHEDULE

PROJECT : KOTHAGUDAM–1X800MW
CONTRACTOR : M/S BHEL

CUST. NO : 7268
PGMA : 80–451
SYSTEM : BOILER INTEGRAL PIPING DRAINS

DOC.NO. : NA
REV. NO. : 00
WELDING CODE : IBR / ASME
PAGE NO : 01 OF 02

SL. NO.	DRG NO. FOR WELD LOCATION IDENTIFICATION MARK	DESCRIPTION OF PARTS TO BE WELDED	MATL.SPEC. (ATT)	DIMENSIONS SIZE OD mm	DIMENSIONS THICK mm	PROCESS OF WELDING	TYPE OF WELD	ELECTRODE FILLER SPEC. (ATT) TIG	ARC SPEC.			W.P.S NO.	MIN. PRE HEAT TEMP. °C	HEAT TREATMENT TEMP. °C	HEAT TREATMENT HOLD TIME	NDT METHOD / QUANTUM	REF. SPEC. NO.	ACC. NORM REF.	REMARKS
		PART–1	PART–1					QTY(gms)	QTY(NOS.)										
		PART–2	PART–2				QTY	ø2.4	ø2.5	ø3.2	ø4.0								
01	1–80–451–21369	FITTING PIPE	SA234WP22 SA335P22	60.3	11.07	TIG & ARC	11.07V	ER90S–B3	E9018–B3			1014 REV 03	150	680 TO 720	2.5mts PER mm MINIMUM 60 MIN	RT 10% HARDNESS 3%	*	*	
		VALVE PIPE/FITTING	SA182F22 SA335P22/WP22				64	583	832	448	–								
02	1–80–451–21357 1–80–451–21358 1–80–451–21359 1–80–451–21360 1–80–451–21365	FITTING PIPE	SA234WP22 SA335P22	60.3	5.54	TIG & ARC	5.54V	ER90S–B3	E9018–B3			1013 REV 02	150	–	–	RT 10% HARDNESS 3%	*	*	
		VALVE PIPE/FITTING	SA182F22 SA335P22/WP22				107	1349	1070	–	–								
03	1–80–451–21361 1–80–451–21362	FITTING PIPE	SA234WP22 SA335P22	88.9	15.24	TIG & ARC	15VV	ER90S–B3	E9018–B3			1014 REV 03	150	680 TO 720	2.5mts PER mm MINIMUM 60 MIN	RT 10% HARDNESS 3%	*	*	
		VALVE PIPE/FITTING	SA182F22 SA335P22/WP22				41	984	328	410	205								
04	1–80–451–21369 1–80–451–21361 1–80–451–21362	PIPE	SA335P22	33.4	9.09	TIG & ARC	9.09V	ER90S–B3	E9018–B3			1014 REV 03	150	680 TO 720	2.5mts PER mm MINIMUM 60 MIN	RT 10%	*	*	
		PLATE	SA387 Gr22				84	303	1176	–	–								
05	1–80–451–21358 1–80–451–21359	PIPE	SA335P22	33.4	4.55	TIG & ARC	4.55V	ER90S–B3	E9018–B3			1013 REV 02	150	–	–	RT 10%	*	*	
		PLATE	SA387 Gr22				28	180	140	–	–								
06	1–80–451–21370 1–80–451–21371 1–80–451–21363 1–80–451–21364	PIPE/FITTING	SA106GRB/WPB	73.0	14.02	TIG & ARC	14V	ER70SA1	E7018–1			1003 REV 03	–	–	–	RT 10%	*	*	
		VALVE PIPE/FITTING	WCB SA106GRB/WPB				142	3550	1136	1420	284								

NOTES: 01. * REFER NDE MANUAL DOC NO. AA/CQ/GL/011 REV 00 dtd 24.10.16

PREPARED	DESIGN/CHD.	DESIGN/APPD.	CHD./APPD. – QA	DATE	DRAWING NO.	REV .
EZHIL	BISWAS	RAMAMURTHY	HARITHA.C	04.02.17	4–80–451–80272	00

ERECTION / FIELD WELDING SCHEDULE

PROJECT : KOTHAGUDAM–1X800MW
CONTRACTOR : M/S BHEL

CUST. NO : 7268
PGMA : 80–451
SYSTEM : BOILER INTEGRAL PIPING DRAINS

DOC.NO. : NA
REV. NO. : 00
WELDING CODE : IBR / ASME
PAGE NO : 02 OF 02

SL. NO.	DRG NO. FOR WELD LOCATION IDENTIFICATION MARK	DESCRIPTION OF PARTS TO BE WELDED	MATL.SPEC. (ATT)	DIMENSIONS SIZE OD mm	DIMENSIONS THICK mm	PROCESS OF WELDING	TYPE OF WELD	ELECTRODE FILLER SPEC. (ATT) TIG	ELECTRODE FILLER SPEC. (ATT) ARC SPEC.			W.P.S NO.	MIN. PRE HEAT TEMP. °C	HEAT TREATMENT TEMP. °C	HEAT TREATMENT HOLD TIME	NDT METHOD/ QUANTUM	REF. SPEC. NO.	ACC. NORM REF.	REMARKS
								QTY(gms)	QTY(NOS.)										
		PART–2	PART–2				QTY	ø2.4	ø2.5	ø3.2	ø4.0								
07	1–80–451–21357	PIPE/FITTING	SA106GRB/WPB	88.9	15.24	TIG & ARC	15V̂V̂	ER70SA1	E7018–1			1003 REV 03	–	–	–	RT 10%	*	*	
		VALVE PIPE/FITTING	WCB SA106GRB/WPB				8	192	64	80	40								
08	1–80–451–21374	PIPE/FITTING	SA106GRB/WPB	168.3	27.5	TIG & ARC	27.5V̂V̂	ER70SA1	E7018–1			1004 REV 03	100	595 TO 625	2.5mts PER mm MINIMUM 30 MIN	RT 100%	*	*	
		VALVE PIPE/FITTING	WCB SA106GRB/WPB				24	1080	336	576	480								
09	1–80–451–21373	PIPE/FITTING	SA106GRB/WPB	60.3	11.07	TIG & ARC	11V̂	ER70SA1	E7018–1			1003 REV 03	–	–	–	RT 10%	*	*	
		VALVE PIPE/FITTING	WCB SA106GRB/WPB				10	91	130	70	–								
10	1–80–451–21370 1–80–451–21371 1–80–451–21363 1–80–451–21364	PIPE	SA106GRB	33.4	9.09	TIG & ARC	9.09V̂	ER70SA1	E7018–1			1003 REV 03	–	–	–	RT 10%	*	*	
		PLATE	SA515 Gr70				176	634	2464	–	–								

NOTES: 01. * REFER NDE MANUAL DOC NO. AA/CQ/GL/011 REV 00 dtd 24.10.16

PREPARED	DESIGN/CHD.	DESIGN/APPD.	CHD./APPD. – QA	DATE	DRAWING NO.	REV .
EZHIL	BISWAS	RAMAMURTHY	HARITHA.C	04.02.17	4–80–451–80272	00

ERECTION / FIELD WELDING SCHEDULE

PROJECT : KOTHAGUDAM–1X800MW
CONTRACTOR : M/S BHEL

CUST. NO : 7268
PGMA : 80–453
SYSTEM : LP PIPING DRAINS

REV. NO. : 00
WELDING CODE : IBR / ASME
PAGE NO : 01 OF 01

SL. NO.	DRG NO. FOR WELD LOCATION IDENTIFICATION MARK	DESCRIPTION OF PARTS TO BE WELDED	MATL.SPEC. (ATT)	DIMENSIONS SIZE OD mm	DIMENSIONS THICK mm	PROCESS OF WELDING	TYPE OF WELD	ELECTRODE FILLER SPEC. (ATT) TIG	ELECTRODE FILLER SPEC. (ATT) ARC SPEC.			W.P.S NO.	MIN. PRE HEAT TEMP. °C	HEAT TREATMENT TEMP. °C	HEAT TREATMENT HOLD TIME	NDT METHOD/ QUANTUM	REF. SPEC. NO.	ACC. NORM REF.	REMARKS
		PART–1	PART–1					QTY(gms)	QTY(NOS.)										
		PART–2	PART–2				QTY	ø2.4	ø2.5	ø3.2	ø4.0								
01	3–80–453–33105	PIPE	SA106GRB	21.3	3.73	TIG& ARC	3.73V	ER70SA1	E7018–1			1003 REV 03	–	–	–	10% RT	*	*	
		PIPE	SA106GRB				~15	203	–	–	–								
02	3–80–453–33105	PIPE	SA106GRB	33.4	4.55	TIG& ARC	4.55V	ER70SA1	E7018–1			1003 REV 03	–	–	–	10% RT	*	*	
		PIPE	SA106GRB				~100	640	500	–	–								
03	3–80–453–33105	PIPE	SA106GRB	21.3	3.73	ARC	4∆	–	E 7018–1			1022 REV 00	–	–	–	10% MPI/LPI	*	*	
		FITTING	SA105				15	–	7	–	–								
04	3–80–453–33105	PIPE	SA106GRB	33.4	4.55	ARC	5∆	–	E 7018–1			1022 REV 00	–	–	–	10% MPI/LPI	*	*	
		FITTING	SA105				305	–	305	–	–								
05	3–80–453–33105	PIPE	SA106GRB	60.3	5.54	ARC	6∆	–	E 7018–1			1022 REV 00	–	–	–	10% MPI/LPI	*		
		FITTING	SA105				2	–	6	–	–								

NOTES: 01. * REFER NDE MANUAL DOC NO. AA/CQ/GL/011 REV 00 dtd 24.10.16

PREPARED	DESIGN/CHD.	DESIGN/APPD.	CHD./APPD. – QA	DATE	DRAWING NO.	REV.
EZHIL	BISWAS	RAMAMURTHY	HARITHA.C	04.02.2017	4-80-453-80336	00

ERECTION / FIELD WELDING SCHEDULE

PROJECT : KOTHAGUDAM–1X800MW
CONTRACTOR : M/S BHEL

CUST. NO : 7268
PGMA : 80–454
SYSTEM : SCAPH DRAIN TO FLASH TANK MANIFOLD

DOC.NO. : NA
REV. NO. : 00
WELDING CODE : IBR / ASME
PAGE NO : 01 OF 01

SL. NO.	DRG NO. FOR WELD LOCATION IDENTIFICATION MARK	DESCRIPTION OF PARTS TO BE WELDED	MATL.SPEC. (ATT)	DIMENSIONS SIZE OD mm	DIMENSIONS THICK mm	PROCESS OF WELDING	TYPE OF WELD	ELECTRODE FILLER SPEC. (ATT) TIG	ELECTRODE FILLER SPEC. (ATT) ARC SPEC.			W.P.S NO.	MIN. PRE HEAT TEMP. °C	HEAT TREATMENT TEMP. °C	HEAT TREATMENT HOLD TIME	NDT METHOD/ QUANTUM	REF. SPEC. NO.	ACC. NORM REF.	REMARKS
		PART–1	PART–1					QTY(gms)	QTY(NOS.)										
		PART–2	PART–2				QTY	ø2.4	ø2.5	ø3.2	ø4.0								
01	2–80–454–14208	FITTING PIPE	SA234WPB SA106GRB	114.3	6.02	TIG & ARC	6.02V	ER70SA1	E7018–1			1003 REV 03	–	–	–	RT 10%	*	*	
		PIPE/FITTING	SA106GRB/WPB				18	479	378	–	–								
02	2–80–454–14208	PIPE/FITTING	SA106GRB/WPB	88.9	5.49	TIG & ARC	5.49V	ER70SA1	E7018–1			1003 REV 03	–	–	–	RT 10%	*	*	
		PIPE/FITTING	SA106GRB/WPB				24	471	360	–	–								
03	2–80–454–14208	PIPE/FITTING	SA106GRB/WPB	60.3	5.54	TIG & ARC	5.54V	ER70SA1	E7018–1			1003 REV 03	–	–	–	RT 10%	*	*	
		PIPE/FITTING	SA106GRB/WPB				16	202	160	–	–								
04	2–80–454–14208	PIPE/FITTING	SA106GRB/WPB	48.3	5.08	TIG & ARC	5.08V	ER70SA1	E7018–1			1003 REV 03	–	–	–	RT 10%	*	*	
		VALVE PIPE/FITTING	WCB SA106GRB/WPB				250	2475	1990	–	–								

NOTES: 01. * REFER NDE MANUAL DOC NO. AA/CQ/GL/011 REV 00 dtd 24.10.16

PREPARED	DESIGN/CHD.	DESIGN/APPD.	CHD./APPD. – QA	DATE	DRAWING NO.	REV .
EZHIL	BISWAS	RAMAMURTHY	HARITHA.C	04.02.17	4–80–545–80267	00

ERECTION / FIELD WELDING SCHEDULE

PROJECT : KOTHAGUDAM–1X800MW
CONTRACTOR : M/S BHEL

CUST. NO : 7268
PGMA : 80–455
SYSTEM : DRAIN FROM UNLISTED EQPT/VESSEL–SG SCOPE

DOC.NO. : NA
REV. NO. : 00
WELDING CODE : – / ASME
PAGE NO : 01 OF 02

SL. NO.	DRG NO. FOR WELD LOCATION IDENTIFICATION MARK	DESCRIPTION OF PARTS TO BE WELDED	MATL.SPEC. (ATT)	DIMENSIONS SIZE OD mm	DIMENSIONS THICK mm	PROCESS OF WELDING	TYPE OF WELD	ELECTRODE FILLER SPEC. (ATT) TIG	ELECTRODE FILLER SPEC. (ATT) ARC SPEC.			W.P.S NO.	MIN. PRE HEAT TEMP. °C	HEAT TREATMENT TEMP. °C	HEAT TREATMENT HOLD TIME	NDT METHOD/ QUANTUM	REF. SPEC. NO.	ACC. NORM REF.	REMARKS
		PART–1	PART–1					QTY(gms)	QTY(NOS.)										
		PART–2	PART–2				QTY	ø2.4	ø2.5	ø3.2	ø4.0								
01	2–80–455–14239	FITTING PIPE	SA234WPB SA106GRB	609.6	9.53	TIG & ARC	9.53V	ER70SA1	E7018–1			1003 REV 03	–	–	–	RT 10%	*	*	
		NOZZLE PIPE/FITTING	WCB SA106GRB/WPB				9	1822	416	654	–								
02	1–80–455–21318	PIPE/FITTING	SA106GRB/WPB	457.2	9.53	TIG & ARC	9.53V	ER70SA1	E7018–1			1003 REV 03	–	–	–	RT 10%	*	*	
		VALVE PIPE/FITTING	WCB SA106GRB/WPB				17	2550	578	901	–								
03	1–80–455–21318 1–80–455–21412	PIPE/FITTING	SA106GRB/WPB	323.9	9.53	TIG & ARC	9.53V	ER70SA1	E7018–1			1003 REV 03	–	–	–	RT 10%	*	*	
		VALVE PIPE/FITTING	WCB SA106GRB/WPB				49	5096	1176	1813	–								
04	1–80–455–21412	PIPE/FITTING	SA106GRB/WPB	219.1	8.18	TIG & ARC	8.18V	ER70SA1	E7018–1			1003 REV 03	–	–	–	RT 10%	*	*	
		VALVE PIPE/FITTING	WCB SA106GRB/WPB				28	1960	476	504	–								
05	1–80–455–21386 1–80–455–21387	PIPE/FITTING	SA106GRC/WPC	273	15.09	TIG & ARC	15.09V	ER70SA1	E7018–1			1003 REV 03	–	–	–	RT 10%	*	*	
		PIPE/FITTING	SA106GRC/WPC				33	2904	660	1089	330								
05	1–80–455–21386 1–80–455–21387	PIPE	SA106GRC	273	15.09	TIG & ARC	15.09V	ER70SA1	E7018–1			1033 REV 04	150	650 TO 670	2.5 mts PER mm MINIMUM 60 min	RT 10% HARDNESS 3%	*	*	
		PIPE	SA335P11				8	704	160	264	80								

NOTES: 01. * REFER NDE MANUAL DOC NO. AA/CQ/GL/011 REV 00 dtd 24.10.16

PREPARED	DESIGN/CHD.	DESIGN/APPD.	CHD./APPD. – QA	DATE	DRAWING NO.	REV .
EZHIL	BISWAS	RAMAMURTHY	HARITHA.C	04.02.2017	4–80–455–80272	00

ERECTION / FIELD WELDING SCHEDULE

PROJECT : KOTHAGUDAM–1X800MW
CONTRACTOR : M/S BHEL

CUST. NO : 7268
PGMA : 80–455
SYSTEM : DRAIN FROM UNLISTED EQPT/VESSEL–SG SCOPE

DOC.NO. : NA
REV. NO. : 00
WELDING CODE : – / ASME
PAGE NO : 02 OF 02

SL. NO.	DRG NO. FOR WELD LOCATION IDENTIFICATION MARK	DESCRIPTION OF PARTS TO BE WELDED	MATL.SPEC. (ATT)	DIMENSIONS SIZE OD mm	DIMENSIONS THICK mm	PROCESS OF WELDING	TYPE OF WELD	ELECTRODE FILLER SPEC. (ATT) TIG	ELECTRODE FILLER SPEC. (ATT) ARC SPEC.			W.P.S NO.	MIN. PRE HEAT TEMP. °C	HEAT TREATMENT TEMP. °C	HEAT TREATMENT HOLD TIME	NDT METHOD/ QUANTUM	REF. SPEC. NO.	ACC. NORM REF.	REMARKS
		PART–1	PART–1					QTY(gms)	QTY(NOS.)										
		PART–2	PART–2				QTY	ø2.4	ø2.5	ø3.2	ø4.0								
07	2–80–455–14237	FITTING PIPE	SA234WPB SA106GRB	508	9.52	TIG & ARC	9.52√V	ER70SA1	E7018–1			1003 REV 03	–	–	–	RT 10%	*	*	
		NOZZLE PIPE/FITTING	WCB SA106GRB/WPB				22	3674	836	1320	–								
08	2–80–455–14238	PIPE/FITTING	SA106GRB/WPB	88.9	5.49	TIG & ARC	5.49√V	ER70SA1	E7018–1			1003 REV 03	–	–	–	RT 10%	*	*	
		VALVE PIPE/FITTING	WCB SA106GRB/WPB				19	373	285	–	–								
09	2–80–455–14147	PIPE/FITTING	SA106GRB/WPB	406.4	9.53	TIG & ARC	9.53√V	ER70SA1	E7018–1			1003 REV 03	–	–	–	RT 10%	*	*	
		PIPE/FITTING	SA106GRB/WPB				5	660	150	235	–								
10	2–80–455–14147	PIPE/FITTING	SA106GRB/WPB	273	9.27	TIG & ARC	9.27√V	ER70SA1	E7018–1			1003 REV 03	–	–	–	RT 10%	*	*	
		VALVE PIPE/FITTING	WCB SA106GRB/WPB				18	1566	360	540	–								
11	1–80–455–21412	PIPE/FITTING	SA106GRB/WPB	60.3	5.54	TIG & ARC	5.54√V	ER70SA1	E7018–1			1003 REV 03	–	–	–	RT 10%	*	*	
		VALVE PIPE/FITTING	WCB SA106GRB/WPB				23	290	230	–	–								

NOTES: 01. * REFER NDE MANUAL DOC NO. AA/CQ/GL/011 REV 00 dtd 24.10.16

PREPARED	DESIGN/CHD.	DESIGN/APPD.	CHD./APPD. – QA	DATE	DRAWING NO.	REV .
EZHIL	BISWAS	RAMAMURTHY	HARITHA.C	04.02.2017	4–80–455–80272	00

ERECTION / FIELD WELDING SCHEDULE

PROJECT : KOTHAGUDAM–1X800MW
CONTRACTOR : M/S BHEL

CUST. NO : 7268
PGMA : 80–460
SYSTEM : SG AUX. COOLING WATER UNIT SYSTEM

DOC.NO. : NA
REV. NO. : 00
WELDING CODE : – / ASME
PAGE NO : 01 OF 02

SL. NO.	DRG NO. FOR WELD LOCATION IDENTIFICATION MARK	DESCRIPTION OF PARTS TO BE WELDED	MATL.SPEC. (ATT)	DIMENSIONS		PROCESS OF WELDING	TYPE OF WELD	ELECTRODE FILLER SPEC. (ATT)				W.P.S NO.	MIN. PRE HEAT TEMP. °C	HEAT TREATMENT		NDT METHOD/ QUANTUM	REF. SPEC. NO.	ACC. NORM REF.	REMARKS
				SIZE OD mm	THICK mm			TIG	ARC SPEC.					TEMP. °C	HOLD TIME				
		PART–1	PART–1					QTY(gms)	QTY(NOS.)										
		PART–2	PART–2				QTY	ø2.4	ø2.5	ø3.2	ø4.0								
01	––	PIPE	IS3589–410MPA	323.9	6	ARC	6 V	–	E7018–1			1213 REV 00	–	–	–	RT 10%	*	*	
		PIPE FITTING	IS3589–410MPA SA 234 WPB				~30	–	720	450	–								
02	––	PIPE	IS3589–410MPA	219.1	6	ARC	6 V	–	E7018–1			1213 REV 00	–	–	–	RT 10%	*	*	
		PIPE FITTING	IS3589–410MPA SA 234 WPB				~200	–	7400	–	–								
03	––	PIPE	IS1239 BLACK	150	5.4	ARC	5.4 V	–	E 6013 / E 7018			1001 REV 01	–	–	–	RT 10%	*	*	
		PIPE FITTING	IS1239 BLACK IS1239 BLACK				~140	–	7560 / 3780	–	–								
04	––	PIPE	IS1239 BLACK	100	5.4	ARC	5.4 V	–	E 6013 / E 7018	E 7018		1001 REV 01	–	–	–	RT 10%	*	*	
		PIPE FITTING	IS1239 BLACK IS1239 BLACK				~122	–	3246 / 2196	–	–								
05	––	PIPE	IS1239 BLACK	80	4.8	ARC	4.8 V	–	E 7018			1001 REV 01	–	–	–	RT 10%	*	*	
		PIPE FITTING	IS1239 BLACK IS1239 BLACK				~530	–	18000	–	–								
06	––	PIPE	IS1239 BLACK	15	3.2	ARC	3.2 V	–	E 7018			1001 REV 01	–	–	–	RT 10%	*	*	
		FITTING	SA 105				~360	–	126	–	–								

NOTES: 01. * REFER NDE MANUAL DOC NO. AA/CQ/GL/011 REV 00 dtd 24.10.16

PREPARED	DESIGN/CHD.	DESIGN/APPD.	CHD./APPD. – QA	DATE	DRAWING NO.	REV .
EZHIL	BISWAS	RAMAMURTHY	HARITHA.C	04.02.2017	4–80–460–80690	00

ERECTION / FIELD WELDING SCHEDULE

PROJECT : KOTHAGUDAM–1X800MW
CONTRACTOR : M/S BHEL

CUST. NO : 7268
PGMA : 80–460
SYSTEM : SG AUX. COOLING WATER UNIT SYSTEM

DOC.NO. : NA
REV. NO. : 00
WELDING CODE : – / ASME
PAGE NO : 02 OF 02

SL. NO.	DRG NO. FOR WELD LOCATION IDENTIFICATION MARK	DESCRIPTION OF PARTS TO BE WELDED	MATL.SPEC. (ATT)	DIMENSIONS		PROCESS OF WELDING	TYPE OF WELD	ELECTRODE FILLER SPEC. (ATT)				W.P.S NO.	MIN. PRE HEAT TEMP. °C	HEAT TREATMENT		NDT METHOD/ QUANTUM	REF. SPEC. NO.	ACC. NORM REF.	REMARKS
				SIZE OD mm	THICK mm			TIG	ARC SPEC.					TEMP. °C	HOLD TIME				
		PART–1	PART–1					QTY(gms)	QTY(NOS.)										
		PART–2	PART–2				QTY	ø2.4	ø2.5	ø3.2	ø4.0								
07	––	PIPE	IS1239 BLACK	50	4.5	ARC	4.5 $\overline{V}$	–	E7018–1			1001 REV 01	–	–	–	RT 10%	*	*	
		PIPE	IS1239 BLACK				~130	–	1300	–	–								
08	––	PIPE	IS1239 BLACK	25	4.0	ARC	4.0 $\overline{V}$	–	E7018–1			1001 REV 01	–	–	–	RT 10%	*	*	
		PIPE	IS1239 BLACK				~125	–	625	–	–								
09	––	PIPE	IS1239 BLACK	15	3.2	ARC	3.2 $\overline{V}$	E 6013	E7018–1			1001 REV 01	–	–	–	RT 10%	*	*	
		PIPE	IS1239 BLACK				~140	896	700	–	–								
10	––	PIPE	IS1239 BLACK	50	4.5	ARC	4.5 $\overline{V}$	–	E7018–1			1001 REV 01	–	–	–	RT 10%	*	*	
		FITTING	SA 105				~500	–	778	–	–								
11	––	PIPE	IS1239 BLACK	25	4.0	ARC	4.0 $\overline{V}$	–	E7018–1			1001 REV 01	–	–	–	RT 10%	*	*	
		FITTING	SA 105				~160	–	112	–	–								

NOTES: 01. * REFER NDE MANUAL DOC NO. AA/CQ/GL/011 REV 00 dtd 24.10.16

PREPARED	DESIGN/CHD.	DESIGN/APPD.	CHD./APPD. – QA	DATE	DRAWING NO.	REV .
EZHIL	BISWAS	RAMAMURTHY	HARITHA.C	04.02.2017	4–80–460–80690	00

ERECTION / FIELD WELDING SCHEDULE

PROJECT : KOTHAGUDAM 1X800MW
CONTRACTOR : M/S BHEL

CUST. NO : 7268
PGMA : 80–471
SYSTEM : BOILER WATER WASH TO AND FROM UNIT

DOC.NO. : NA
REV. NO. : 00
WELDING CODE : – / ASME
PAGE NO : 01 OF 02

SL. NO.	DRG NO. FOR WELD LOCATION IDENTIFICATION MARK	DESCRIPTION OF PARTS TO BE WELDED	MATL.SPEC. (ATT)	DIMENSIONS SIZE OD mm	DIMENSIONS THICK mm	PROCESS OF WELDING	TYPE OF WELD	ELECTRODE FILLER SPEC. (ATT) TIG	ELECTRODE FILLER SPEC. (ATT) ARC SPEC.			W.P.S NO.	MIN. PRE HEAT TEMP. °C	HEAT TREATMENT TEMP. °C	HEAT TREATMENT HOLD TIME	NDT METHOD/ QUANTUM	REF. SPEC. NO.	ACC. NORM REF.	REMARKS
		PART–1	PART–1					QTY(gms)	QTY(NOS.)										
		PART–2	PART–2				QTY	ø2.4	ø2.5	ø3.2	ø4.0								
01	– –	PIPE	IS 3589	406.4	6	ARC	6 V	–	E 7018			1213 REV 00	–	–	–	RT 10%	*	*	
		PIPE FITTING	IS 3589 SA234WPB				~85	–	2550	1785	–								
02	– –	PIPE	IS 3589	273	6	ARC	6 V	–	E 7018			1213 REV 00	–	–	–	RT 10%	*	*	
		PIPE FITTING	IS 3589 SA234WPB				~30	–	600	270	–								
03	– –	PIPE	IS1239BLACK	40	4.0	ARC	4.0 V	–	E 7018			1001 REV 01	–	–	–	RT 10%	*	*	
		FITTING	SA 105				~10	–	22	–	–								
04	– –	PIPE	IS1239BLACK	25	4.0	ARC	4.0 V	–	E 7018			1001 REV 01	–	–	–	RT 10%	*	*	
		PIPE FITTING	IS1239BLACK IS1239BLACK				~110	–	130	–	–								
08	– –	PIPE	IS1239BLACK	25	4.0	ARC	4.0 V	E 6013	E 7018			1001 REV 01	–	–	–	RT 10%	*	*	SMAW ONLY
		PIPE FITTING	IS1239BLACK IS1239BLACK				~50	280	350	–	–								
06	– –	PIPE	IS 3589	219.1	6.4	ARC	6.4 V	–	E 7018			1213 REV 00	–	–	–	RT 10%	*	*	
		FITTING	SA234WPB				~30	–	5550	–	–								

NOTES: 01. * REFER NDE MANUAL DOC NO. AA/CQ/GL/011 REV 00 dtd 24.10.16

PREPARED	DESIGN/CHD.	DESIGN/APPD.	CHD./APPD. – QA	DATE	DRAWING NO.	REV .
EZHIL	BISWAS	RAMAMURTHY	HARITHA.C	04.02.2017	4–80–471–80178	00

ERECTION / FIELD WELDING SCHEDULE

PROJECT : KOTHAGUDAM 1X800MW
CONTRACTOR : M/S BHEL

CUST. NO : 7268
PGMA : 80–471
SYSTEM : BOILER WATER WASH TO AND FROM UNIT

DOC.NO. : NA
REV. NO. : 00
WELDING CODE : – / ASME
PAGE NO : 02 OF 02

SL. NO.	DRG NO. FOR WELD LOCATION IDENTIFICATION MARK	DESCRIPTION OF PARTS TO BE WELDED	MATL.SPEC. (ATT)	DIMENSIONS		PROCESS OF WELDING	TYPE OF WELD	ELECTRODE FILLER SPEC. (ATT)				W.P.S NO.	MIN. PRE HEAT TEMP.	HEAT TREATMENT		NDT METHOD/ QUANTUM	REF. SPEC. NO.	ACC. NORM REF.	REMARKS
				SIZE OD	THICK			TIG	ARC SPEC.					TEMP.	HOLD TIME				
		PART–1	PART–1	mm	mm			QTY(gms)	QTY(NOS.)										
		PART–2	PART–2				QTY	ø2.4	ø2.5	ø3.2	ø4.0		°C	°C					
06	––	PIPE	IS1239BLACK	100	6.4	ARC	6.4 V	E 6013	E 7018			1001 REV 01	–	–	–	RT 10%	*	*	SMAW ONLY
		PIPE FITTING	IS1239BLACK IS1239BLACK				~35	931	770	–	–								

NOTES: 01. * REFER NDE MANUAL DOC NO. AA/CQ/GL/011 REV 00 dtd 24.10.16

PREPARED	DESIGN/CHD.	DESIGN/APPD.	CHD./APPD. – QA	DATE	DRAWING NO.	REV .
EZHIL	BISWAS	RAMAMURTHY	HARITHA.C	04.02.2017	4–80–471–80178	00

ERECTION / FIELD WELDING SCHEDULE

PROJECT : KOTHAGUDAM 1X800MW
CONTRACTOR : M/S BHEL

CUST. NO : 7268
PGMA : 80–480
SYSTEM : FIRE WATER–OTHER AREAS

DOC.NO. : NA
REV. NO. : 00
WELDING CODE : – / ASME
PAGE NO : 01 OF 02

SL. NO.	DRG NO. FOR WELD LOCATION IDENTIFICATION MARK	DESCRIPTION OF PARTS TO BE WELDED	MATL.SPEC. (ATT)	DIMENSIONS		PROCESS OF WELDING	TYPE OF WELD	ELECTRODE FILLER SPEC. (ATT)				W.P.S NO.	MIN. PRE HEAT TEMP.	HEAT TREATMENT		NDT METHOD/ QUANTUM	REF. SPEC. NO.	ACC. NORM REF.	REMARKS
				SIZE OD	THICK			TIG	ARC SPEC.					TEMP.	HOLD TIME				
		PART–1	PART–1	mm	mm			QTY(gms)	QTY(NOS.)										
		PART–2	PART–2				QTY	ø2.4	ø2.5	ø3.2	ø4.0		°C	°C					
01	– –	PIPE	IS 3589	406.4	6	ARC	6 V	–	E 7018			1213 REV 00	–	–	–	RT 10%	*	*	
		PIPE FITTING	IS 3589 SA234WPB				~50	–	1500	1050	–								
02	– –	PIPE	IS 3589	273	6	ARC	6 V	–	E 7018			1213 REV 00	–	–	–	RT 10%	*	*	
		PIPE FITTING	IS 3589 SA234WPB				~35	–	700	315	–								
03	– –	PIPE	IS1239BLACK	40	4.0	ARC	4.0 V	E 6013	E 7018			1001 REV 01	–	–	–	RT 10%	*	*	
		PIPE	IS1239BLACK				~65	644	520	–	–								
04	– –	PIPE	IS1239BLACK	25	4.0	ARC	4.0 V	E 6013	E 7018			1001 REV 01	–	–	–	RT 10%	*	*	SMAW ONLY
		PIPE	IS1239BLACK				~110	616	770	–	–								
05	– –	PIPE	IS1239BLACK	50	4.5	ARC	4.5 V	E 6013	E 7018			1001 REV 01	–	–	–	RT 10%	*	*	SMAW ONLY
		PIPE	IS1239BLACK				~40	504	400	–	–								
06	– –	PIPE	IS 3589	219.1	6.4	ARC	6.4 V	–	E 7018			1213 REV 00	–	–	–	RT 10%	*	*	
		FITTING	SA234WPB				~10	–	1080	1620	–								

NOTES: 01. * REFER NDE MANUAL DOC NO. AA/CQ/GL/011 REV 00 dtd 24.10.16

PREPARED	DESIGN/CHD.	DESIGN/APPD.	CHD./APPD. – QA	DATE	DRAWING NO.	REV .
EZHIL	BISWAS	RAMAMURTHY	HARITHA.C	03.12.2016	4–80–480–80191	00

ERECTION / FIELD WELDING SCHEDULE

PROJECT : KOTHAGUDAM 1X800MW
CONTRACTOR : M/S BHEL

CUST. NO : 7268
PGMA : 80–480
SYSTEM : FIRE WATER–OTHER AREAS

DOC.NO. : NA
REV. NO. : 00
WELDING CODE : – / ASME
PAGE NO : 02 OF 02

SL. NO.	DRG NO. FOR WELD LOCATION IDENTIFICATION MARK	DESCRIPTION OF PARTS TO BE WELDED	MATL.SPEC. (ATT)	DIMENSIONS		PROCESS OF WELDING	TYPE OF WELD	ELECTRODE FILLER SPEC. (ATT)				W.P.S NO.	MIN. PRE HEAT TEMP.	HEAT TREATMENT		NDT METHOD/ QUANTUM	REF. SPEC. NO.	ACC. NORM REF.	REMARKS
				SIZE OD	THICK			TIG	ARC SPEC.					TEMP.	HOLD TIME				
		PART–1	PART–1	mm	mm			QTY(gms)	QTY(NOS.)										
		PART–2	PART–2				QTY	ø2.4	ø2.5	ø3.2	ø4.0		°C	°C					
06	––	PIPE	IS1239BLACK	50	4.5	ARC	5 V	–	E 7018			1001 REV 01	–	–	–	RT 10%	*	*	
		FITTING	SA 105				~80	–	167	–	–								
07	––	PIPE	IS1239BLACK	40	4.0	ARC	4 V	–	E 7018			1001 REV 01	–	–	–	RT 10%	*	*	
		FITTING	SA 105				~400	–	642	–	–								
08	––	PIPE	IS1239BLACK	25	4.0	ARC	4 V	–	E 7018			1001 REV 01	–	–	–	RT 10%	*	*	
		FITTING	SA 105				~275	–	248	–	–								
09	––	PIPE	IS1239BLACK	15	3.2	ARC	3 V	–	E 7018			1001 REV 01	–	–	–	RT 10%	*	*	
		FITTING	SA 105				~30	–	14	–	–								

NOTES: 01. * REFER NDE MANUAL DOC NO. AA/CQ/GL/011 REV 00 dtd 24.10.16

PREPARED	DESIGN/CHD.	DESIGN/APPD.	CHD./APPD. – QA	DATE	DRAWING NO.	REV .
EZHIL	BISWAS	RAMAMURTHY	HARITHA.C	03.12.2016	4–80–480–80191	00

ERECTION / FIELD WELDING SCHEDULE

PROJECT : KOTHAGUDAM–1X800MW
CONTRACTOR : M/S BHEL

CUST. NO : 7268
PGMA : 80–545
SYSTEM : CONDENSATE PUMP A AND B DISCHARGE TO HP FLASH TANK

DOC.NO. : NA
REV. NO. : 00
WELDING CODE : – / ASME
PAGE NO : 01 OF 01

SL. NO.	DRG NO. FOR WELD LOCATION IDENTIFICATION MARK	DESCRIPTION OF PARTS TO BE WELDED	MATL.SPEC. (ATT)	DIMENSIONS SIZE OD mm	DIMENSIONS THICK mm	PROCESS OF WELDING	TYPE OF WELD	ELECTRODE FILLER SPEC. (ATT) TIG	ELECTRODE FILLER SPEC. (ATT) ARC SPEC.			W.P.S NO.	MIN. PRE HEAT TEMP. °C	HEAT TREATMENT TEMP. °C	HEAT TREATMENT HOLD TIME	NDT METHOD/ QUANTUM	REF. SPEC. NO.	ACC. NORM REF.	REMARKS
								QTY(gms)	QTY(NOS.)										
		PART–1	PART–1																
		PART–2	PART–2				QTY	ø2.4	ø2.5	ø3.2	ø4.0								
01	2–80–545–14159	FITTING PIPE	SA234WPB SA106GRB	457.2	9.53	TIG & ARC	9.53V	ER70SA1	E7018–1			1003 REV 03	–	–	–	RT 10%	*	*	
		VALVE PIPE/FITTING	WCB SA106GRB/WPB				36	5400	1224	1908	–								

NOTES: 01. * REFER NDE MANUAL DOC NO. AA/CQ/GL/011 REV 00 dtd 24.10.16

PREPARED	DESIGN/CHD.	DESIGN/APPD.	CHD./APPD. – QA	DATE	DRAWING NO.	REV .
EZHIL	BISWAS	RAMAMURTHY	HARITHA.C	04.02.2017	4–80–545–80222	00

ERECTION / FIELD WELDING SCHEDULE

PROJECT : KOTHAGUDAM 1X800MW
CONTRACTOR : M/S BHEL

CUST. NO : 7268
PGMA : 80–612
SYSTEM : SERVICE AIR PIPING

DOC.NO. : NA
REV. NO. : 00
WELDING CODE : – / ASME
PAGE NO : 01 OF 02

SL. NO.	DRG NO. FOR WELD LOCATION IDENTIFICATION MARK	DESCRIPTION OF PARTS TO BE WELDED	MATL.SPEC. (ATT)	DIMENSIONS		PROCESS OF WELDING	TYPE OF WELD	ELECTRODE FILLER SPEC. (ATT)				W.P.S NO.	MIN. PRE HEAT TEMP.	HEAT TREATMENT		NDT METHOD/ QUANTUM	REF. SPEC. NO.	ACC. NORM REF.	REMARKS
				SIZE OD	THICK			TIG	ARC SPEC.					TEMP.	HOLD TIME				
		PART–1	PART–1	mm	mm			QTY(gms)	QTY(NOS.)										
		PART–2	PART–2				QTY	ø2.4	ø2.5	ø3.2	ø4.0		°C	°C					
01	––	PIPE	IS1239 BLACK	150	5.4	ARC	5.4 V	E 6013	E 7018			1001 REV 01	–	–	–	RT 10%	*	*	SMAW ONLY
		PIPE FITTING	IS1239 BLACK IS1239 BLACK				~100	5400	3100	–	–								
02	––	PIPE	IS1239 BLACK	80	4.8	ARC	4.8 V	E 6013	E 7018			1001 REV 01	–	–	–	RT 10%	*	*	SMAW ONLY
		PIPE FITTING	IS1239 BLACK IS1239 BLACK				~105	2058	1785	–	–								
03	––	PIPE	IS1239 BLACK	50	4.5	ARC	4.5 V	E 6013	E 7018			1001 REV 01	–	–	–	RT 10%	*	*	SMAW ONLY
		PIPE	IS1239 BLACK				~100	1260	1000	–	–								
04	––	PIPE	IS1239 BLACK	25	4.0	ARC	4.0 V	E 6013	E 7018			1001 REV 01	–	–	–	RT 10%	*	*	SMAW ONLY
		PIPE	IS1239 BLACK				~130	728	910	–	–								
05	––	PIPE	IS1239 BLACK	15	3.2	ARC	3.2 V	E 6013	E 7018			1001 REV 01	–	–	–	RT 10%	*	*	SMAW ONLY
		PIPE	IS1239 BLACK				~600	3360	4200	–	–								
06	––	PIPE	IS1239 BLACK	50	4.5	ARC	4.5 V	–	E 7018			1001 REV 01	–	–	–	RT 10%	*	*	
		FITTING	SA 105				~140	–	291	–	–								

NOTES: 01. * REFER NDE MANUAL DOC NO. AA/CQ/GL/011 REV 00 dtd 24.10.16

PREPARED	DESIGN/CHD.	DESIGN/APPD.	CHD./APPD. – QA	DATE	DRAWING NO.	REV .
EZHIL	BISWAS	RAMAMURTHY	HARITHA.C	04.02.2017	4–80–612–80691	00

ERECTION / FIELD WELDING SCHEDULE

PROJECT : KOTHAGUDAM 1X800MW
CONTRACTOR : M/S BHEL

CUST. NO : 7268
PGMA : 80–612
SYSTEM : SERVICE AIR PIPING

DOC.NO. : NA
REV. NO. : 00
WELDING CODE : – / ASME
PAGE NO : 02 OF 02

SL. NO.	DRG NO. FOR WELD LOCATION IDENTIFICATION MARK	DESCRIPTION OF PARTS TO BE WELDED	MATL.SPEC. (ATT)	DIMENSIONS SIZE OD mm	DIMENSIONS THICK mm	PROCESS OF WELDING	TYPE OF WELD	ELECTRODE FILLER SPEC. (ATT) TIG	ELECTRODE FILLER SPEC. (ATT) ARC SPEC.			W.P.S NO.	MIN. PRE HEAT TEMP. °C	HEAT TREATMENT TEMP. °C	HEAT TREATMENT HOLD TIME	NDT METHOD/ QUANTUM	REF. SPEC. NO.	ACC. NORM REF.	REMARKS
		PART–1	PART–1					QTY(gms)	QTY(NOS.)										
		PART–2	PART–2				QTY	ø2.4	ø2.5	ø3.2	ø4.0								
07	––	PIPE	IS1239 BLACK	25	4.0	ARC	4.0 V	–	E 7018			1001 REV 01	–	–	–	RT 10%	*	*	
		FITTING	SA 105				~250	–	225	–	–								
08	––	PIPE	IS1239 BLACK	15	3.2	ARC	3.2 V	–	E 7018			1001 REV 01	–	–	–	RT 10%	*	*	
		FITTING	SA 105				~1270	–	540	–	–								

NOTES: 01. * REFER NDE MANUAL DOC NO. AA/CQ/GL/011 REV 00 dtd 24.10.16

PREPARED	DESIGN/CHD.	DESIGN/APPD.	CHD./APPD. – QA	DATE	DRAWING NO.	REV .
EZHIL	BISWAS	RAMAMURTHY	HARITHA.C	04.02.2017	4–80–612–80691	00

ERECTION / FIELD WELDING SCHEDULE

PROJECT : KOTHAGUDAM 1X800MW
CONTRACTOR : M/S BHEL

CUST. NO : 7268
PGMA : 80–616
SYSTEM : INSTRUMENT AIR PIPING

DOC.NO. : NA
REV. NO. : 00
WELDING CODE : – / ASME
PAGE NO : 01 OF 01

SL. NO.	DRG NO. FOR WELD LOCATION IDENTIFICATION MARK	DESCRIPTION OF PARTS TO BE WELDED	MATL.SPEC. (ATT)	DIMENSIONS SIZE OD mm	DIMENSIONS THICK mm	PROCESS OF WELDING	TYPE OF WELD	ELECTRODE FILLER SPEC. (ATT) TIG	ELECTRODE FILLER SPEC. (ATT) ARC SPEC.			W.P.S NO.	MIN. PRE HEAT TEMP. °C	HEAT TREATMENT TEMP. °C	HEAT TREATMENT HOLD TIME	NDT METHOD/ QUANTUM	REF. SPEC. NO.	ACC. NORM REF.	REMARKS
		PART–1	PART–1					QTY(gms)	QTY(NOS.)										
		PART–2	PART–2				QTY	ø2.4	ø2.5	ø3.2	ø4.0								
01	– –	PIPE	SA312TP304H	114.3	3.05	TIG& ARC	3.05√	ER347	E347			1016 REV02	20	–	–	RT 100%	*	*	
		PIPE FITTING	SA312TP304H SA413WP304H				~180	4788	2880	–	–								
02	– –	PIPE	SA312TP304H	88.9	3.05	TIG& ARC	3.05√	ER347	E347			1016 REV02	20	–	–	RT 100%	*	*	
		PIPE FITTING	SA312TP304H SA413WP304H				~110	2310	1430	–	–								
03	– –	PIPE	SA312TP304H	60.3	3.91	TIG& ARC	3.91√	ER347	E347			1016 REV02	20	–	–	RT 100%	*	*	
		PIPE FITTING	SA312TP304H SA413WP304H				~225	13680	–	–	–								
04	– –	PIPE	SA312TP304H	48.3	3.68	TIG& ARC	3.68√	ER347	E347			1016 REV02	20	–	–	RT 100%	*	*	
		PIPE FITTING	SA312TP304H SA413WP304H				~670	6633	5360	–	–								
05	– –	PIPE	SA312TP304H	33.4	3.38	TIG& ARC	3.38√	ER347	E347			1016 REV02	20	–	–	RT 100%	*	*	
		PIPE FITTING	SA312TP304H SA413WP304H				~1460	9344	7300	–	–								
06	– –	PIPE	SA312TP304H	21.3	3.73	TIG& ARC	3.73√	ER347	E347			1016 REV02	20	–	–	RT 100%	*	*	
		PIPE FITTING	SA312TP304H SA413WP304H				~4280	57780	–	–	–								

NOTES: 01. * REFER NDE MANUAL DOC NO. AA/CQ/GL/011 REV 00 dtd 24.10.16

PREPARED	DESIGN/CHD.	DESIGN/APPD.	CHD./APPD. – QA	DATE	DRAWING NO.	REV .
EZHIL	BISWAS	RAMAMURTHY	HARITHA.C	04.02.2017	4–80–616–80692	00

ERECTION / FIELD WELDING SCHEDULE

PROJECT : KOTHAGUDAM (1X800MW)
CONTRACTOR : M/S BHEL

CUST. NO : 7268
PGMA : 80–363
SYSTEM : EXHAUST STEAM FROM PRIME MOVERS

REV. NO. : 00
WELDING CODE : – / ASME
PAGE NO : 01 OF 01

SL. NO.	DRG NO. FOR WELD LOCATION IDENTIFICATION MARK	DESCRIPTION OF PARTS TO BE WELDED	MATL.SPEC. (ATT)	DIMENSIONS SIZE OD mm	DIMENSIONS THICK mm	PROCESS OF WELDING	TYPE OF WELD	ELECTRODE FILLER SPEC. (ATT) TIG	ELECTRODE FILLER SPEC. (ATT) ARC SPEC.			W.P.S NO.	MIN. PRE HEAT TEMP. °C	HEAT TREATMENT TEMP. °C	HEAT TREATMENT HOLD TIME	NDT METHOD/ QUANTUM	REF. SPEC. NO.	ACC. NORM REF.	REMARKS
		PART–1	PART–1					QTY(gms)	QTY(NOS.)										
		PART–2	PART–2				QTY	ø2.4	ø2.5	ø3.2	ø4.0								
01	1–80–363–21299	FITTING PIPE	SA106GRB SA234WPB	60.3	5.54	TIG& ARC	5.54◊	ER70SA1	E7018–1			1003 REV 03	–	–	–	10% RT	*	*	
		FITTING PIPE	SA106GRB SA234WPB				40	520	400	–	–								
02	1–80–363–21297	PIPE	SA515GR70	2032	16	TIG& ARC	16 ◊	ER70SA1	E7018–1			1003 REV 03	–	–	–	10% RT	*	*	
		FITTING	SA515GR70				28	20636	4368	7168	2408								
03	1–80–363–21299	FITTING PIPE	SA106GRB SA234WPB	168.3	7.11	TIG& ARC	7.11 ◊	ER70SA1	E7018–1			1003 REV 03	–	–	–	10% RT	*	*	
		FITTING PIPE	SA106GRB SA234WPB				12	640	180	110	–								
04	1–80–363–21298	FITTING PIPE	SA106GRB SA234WPB	323.9	9.53	TIG& ARC	9.53◊	ER70SA1	E7018–1			1003 REV 03	–	–	–	10% RT	*	*	
		FITTING PIPE	SA106GRB SA234WPB				36	3744	864	1332	–								
05	1–80–363–21299	FITTING	SA234WPB	114.3	6.02	TIG& ARC	6.02◊	ER70SA1	E7018–1			1003 REV 03	–	–	–	10% RT	*	*	
		FITTING	SA234WPB				2	54	42	–	–								

NOTES: 01. * REFER NDE MANUAL DOC NO. AA/CQ/GL/011 REV 00 dtd 24.10.16

PREPARED	DESIGN/CHD.	DESIGN/APPD.	CHD./APPD. – QA	DATE	DRAWING NO.	REV .
EZHIL KUMAR	I BISWAS	SRM	HARITHA.C	03.02.2017	4-80-363-80181	00

ERECTION / FIELD WELDING SCHEDULE

PROJECT : KOTHAGUDAM 1X800MW
CONTRACTOR : M/S BHEL

CUST. NO : 7268
PGMA : 80–370
SYSTEM : HP DRAIN FLASH TANK VENT TO ATMOSPHERE

DOC.NO. : NA
REV. NO. : 00
WELDING CODE : – / ASME
PAGE NO : 01 OF 01

SL. NO.	DRG NO. FOR WELD LOCATION IDENTIFICATION MARK	DESCRIPTION OF PARTS TO BE WELDED	MATL.SPEC. (ATT)	DIMENSIONS SIZE OD mm	DIMENSIONS THICK mm	PROCESS OF WELDING	TYPE OF WELD	ELECTRODE FILLER SPEC. (ATT) TIG	ELECTRODE FILLER SPEC. (ATT) ARC SPEC.			W.P.S NO.	MIN. PRE HEAT TEMP. °C	HEAT TREATMENT TEMP. °C	HEAT TREATMENT HOLD TIME	NDT METHOD/ QUANTUM	REF. SPEC. NO.	ACC. NORM REF.	REMARKS
								QTY(gms)	QTY(NOS.)										
		PART–2	PART–2				QTY	ø2.4	ø2.5	ø3.2	ø4.0								
01	1–80–370–21212	PIPE	SA515GR70	1870	20	TIG & ARC	20V	ER70SA1	E7018–1			1003 REV 03	–	–	–	RT 10%	*	*	
		PIPE/NOZZLE MITRE BEND	SA515GR70				17	11133	2387	3920	2916								
02	1–80–370–21212	PIPE	SA106GRB	273	9.27	TIG & ARC	9.27V	ER70SA1	E7018–1			1003 REV 03	–	–	–	RT 10%	*	*	
		PIPE FITTING	GRB/WPB				13	1170	260	390	–								

NOTES: 01. * REFER NDE MANUAL DOC NO. AA/CQ/GL/011 REV 00 dtd 24.10.16

PREPARED	DESIGN/CHD.	DESIGN/APPD.	CHD./APPD. – QA	DATE	DRAWING NO.	REV .
EZHIL	BISWAS	SRM	C.HARITHA	03.02.2017	4–80–370–80016	00

ERECTION / FIELD WELDING SCHEDULE

PROJECT : KOTHAGUDAM 1X800MW
CONTRACTOR : M/S BHEL

CUST. NO : 7268
PGMA : 80–371
SYSTEM : UNIT FLASH TANK VENT

REV. NO. : 00
WELDING CODE : – / ASME
PAGE NO : 01 OF 01

SL. NO.	DRG NO. FOR WELD LOCATION IDENTIFICATION MARK	DESCRIPTION OF PARTS TO BE WELDED	MATL.SPEC. (ATT)	DIMENSIONS SIZE OD mm	DIMENSIONS THICK mm	PROCESS OF WELDING	TYPE OF WELD	ELECTRODE FILLER SPEC. (ATT) TIG	ELECTRODE FILLER SPEC. (ATT) ARC SPEC.			W.P.S NO.	MIN. PRE HEAT TEMP. °C	HEAT TREATMENT TEMP. °C	HEAT TREATMENT HOLD TIME	NDT METHOD/ QUANTUM	REF. SPEC. NO.	ACC. NORM REF.	REMARKS
								QTY(gms)	QTY(NOS.)										
		PART–1	PART–1																
		PART–2	PART–2				QTY	ø2.4	ø2.5	ø3.2	ø4.0								
01	2–80–371–14207	FITTING PIPE	SA234WPB SA106GRB	508	12.7	TIG& ARC	12.7 ◊	ER70SA1	E7018–1			1003 REV 03	–	–	–	10% RT	*	*	
		FITTING PIPE/NOZZLE	SA234WPB SA106GRB SA516GR60				8	1320	320	520	144								

NOTES: 01. * REFER NDE MANUAL DOC NO. AA/CQ/GL/011 REV 00 dtd 24.10.16

PREPARED	DESIGN/CHD.	DESIGN/APPD.	CHD./APPD. – QA	DATE	DRAWING NO.	REV.
EZHIL	BISWAS	SRM	HARITHA.C	03.02.17	4-80-371-80266	00

ERECTION / FIELD WELDING SCHEDULE

PROJECT : KOTHAGUDAM (1X800MW)
CONTRACTOR : M/S BHEL

CUST. NO : 7268
PGMA : 80–373
SYSTEM : AUX STEAM HDR SV EXHAUST PIPING

DOC.NO. : –
REV. NO. : 00
WELDING CODE : – / ASME
PAGE NO : 01 OF 01

SL. NO.	DRG NO. FOR WELD LOCATION IDENTIFICATION MARK	DESCRIPTION OF PARTS TO BE WELDED	MATL.SPEC. (ATT)	DIMENSIONS SIZE OD mm	DIMENSIONS THICK mm	PROCESS OF WELDING	TYPE OF WELD	ELECTRODE FILLER SPEC. (ATT) TIG QTY(gms) ø2.4	ELECTRODE FILLER SPEC. (ATT) ARC SPEC. QTY(NOS.) ø2.5	ø3.2	ø4.0	W.P.S NO.	MIN. PRE HEAT TEMP. °C	HEAT TREATMENT TEMP. °C	HEAT TREATMENT HOLD TIME	NDT METHOD/ QUANTUM	REF. SPEC. NO.	ACC. NORM REF.	REMARKS
		PART–1	PART–1				QTY												
		PART–2	PART–2																
01	1–80–373–21262	PIPE	SA106GRB	273	6.35	TIG & ARC	6.35√V	ER70SA1	E7018–1			1003 REV 03	–	–	–	RT 10%	*	*	
		FITTING	WPB				8	900	220	120	–								
02	1–80–373–21262	PIPE	SA106GRB	355.6	9.53	TIG & ARC	9.53√V	ER70SA1	E7018–1			1003 REV 03	–	–	–	RT 10%	*	*	
		FITTING	WPB				16	2300	475	722	–								

NOTES: 01. * REFER NDE MANUAL DOC NO. AA/CQ/GL/011 REV 00 dtd 24.10.16

PREPARED	DESIGN/CHD.	DESIGN/APPD.	CHD./APPD. – QA	DATE	DRAWING NO.	REV .
EZHIL	BISWAS	SRM	HARITHA.C	03.02.2017	4–80–373–80100	00

ERECTION / FIELD WELDING SCHEDULE

PROJECT : KOTHAGUDAM, 1X800MW
CONTRACTOR : M/S BHEL

CUST. NO : 7268
PGMA : 80–375
SYSTEM : LP HEATERS SAFETY VALVE DISCHARGE TO LP FLASH PIPE

REV. NO. : 00
WELDING CODE : – / ASME
PAGE NO : 01 OF 01

SL. NO.	DRG NO. FOR WELD LOCATION IDENTIFICATION MARK	DESCRIPTION OF PARTS TO BE WELDED	MATL.SPEC. (ATT)	DIMENSIONS SIZE OD mm	DIMENSIONS THICK mm	PROCESS OF WELDING	TYPE OF WELD	ELECTRODE FILLER SPEC. (ATT) TIG	ELECTRODE FILLER SPEC. (ATT) ARC SPEC.			W.P.S NO.	MIN. PRE HEAT TEMP. °C	HEAT TREATMENT TEMP. °C	HEAT TREATMENT HOLD TIME	NDT METHOD/ QUANTUM	REF. SPEC. NO.	ACC. NORM REF.	REMARKS
		PART–1	PART–1					QTY(gms)	QTY(NOS.)										
		PART–2	PART–2				QTY	ø2.4	ø2.5	ø3.2	ø4.0								
01	2–80–375–14142	PIPE FITTING	SA106GRB SA234WPB	219.1	6.35	TIG& ARC	6.35▽	ER70SA1	E7018–1			1003 REV 03	–	–	–	10% RT	*	*	
		PIPE FITTING	SA106GRB SA234WPB				33	2343	1221	–	–								
02	2–80–375–14142	PIPE	SA106GRB	168.3	7.11	TIG& ARC	7.11▽	ER70SA1	E7018–1			1003 REV 03	–	–	–	10% RT	*	*	
		FITTING	SA234WPB				2	106	30	18	–								
03	2–80–375–14142	PIPE	SA106GRB	168.3	7.11	ARC	7◺ 8◺	ER70SA1	E7018–1			1022 REV 00	–	–	–	LPI/MPI 10%	*	*	
		FLANGE	SA515GR70				2	–	50	–	–								

NOTES:
01. * REFER NDE MANUAL DOC NO. AA/CQ/GL/011 REV 00 dtd 24.10.16

PREPARED	DESIGN/CHD.	DESIGN/APPD.	CHD./APPD. – QA	DATE	DRAWING NO.	REV.
EZHIL	BISWAS	SRM	HARITHA.C	03.02.2017	4-80-375-80200	00

ERECTION / FIELD WELDING SCHEDULE

PROJECT : KOTHAGUDAM 1X800MW
CONTRACTOR : M/S BHEL

CUST. NO : 7268
PGMA : 80–379
SYSTEM : HP HEATERS SAFETY VALVE DISCHARGE TO HP FLASH PIPE

REV. NO. : 00
WELDING CODE : – / ASME
PAGE NO : 01 OF 01

SL. NO.	DRG NO. FOR WELD LOCATION IDENTIFICATION MARK	DESCRIPTION OF PARTS TO BE WELDED	MATL.SPEC. (ATT)	DIMENSIONS SIZE OD mm	DIMENSIONS THICK mm	PROCESS OF WELDING	TYPE OF WELD	ELECTRODE FILLER SPEC. (ATT) TIG	ARC SPEC.			W.P.S NO.	MIN. PRE HEAT TEMP. °C	HEAT TREATMENT TEMP. °C	HEAT TREATMENT HOLD TIME	NDT METHOD/ QUANTUM	REF. SPEC. NO.	ACC. NORM REF.	REMARKS
							QTY	QTY(gms) ø2.4	QTY(NOS.) ø2.5	ø3.2	ø4.0								
01	1–80–379–21334	PIPE FITTING	SA106GRB SA234WPB	168.3	7.11	TIG& ARC	7.11 V	ER70SA1	E7018–1			1003 REV 03	–	–	–	10% RT	*	*	
		PIPE FITTING	SA106GRB SA234WPB				100	5300	1497	898	–								
02	1–80–379–21334	PIPE	SA106GRB	114.3	6.02	ARC	6 7	ER70SA1	E7018–1			1022 REV 00	–	–	–	LPI/MPI 10%	*	*	
		FLANGE	SA515GR70				6	–	80	–	–								

NOTES:
01. * REFER NDE MANUAL DOC NO. AA/CQ/GL/011 REV 00 dtd 24.10.16

PREPARED	DESIGN/CHD.	DESIGN/APPD.	CHD./APPD. – QA	DATE	DRAWING NO.	REV.
EZHIL	BISWAS	SRM	HARITHA.C	03.02.2017	4-80-379-80242	00

ERECTION / FIELD WELDING SCHEDULE

PROJECT : KOTHAGUDAM 1X800MW
CONTRACTOR : M/S BHEL

CUST. NO : 7268
PGMA : 80–381
SYSTEM : HP HEATERS VENTS

REV. NO. : 00
WELDING CODE : – / ASME
PAGE NO : 01 OF 01

SL. NO.	DRG NO. FOR WELD LOCATION IDENTIFICATION MARK	DESCRIPTION OF PARTS TO BE WELDED	MATL.SPEC. (ATT)	DIMENSIONS SIZE OD mm	DIMENSIONS THICK mm	PROCESS OF WELDING	TYPE OF WELD	ELECTRODE FILLER SPEC. (ATT) TIG QTY(gms) ø2.4	ELECTRODE FILLER SPEC. (ATT) ARC SPEC. QTY(NOS.) ø2.5	ø3.2	ø4.0	W.P.S NO.	MIN. PRE HEAT TEMP. °C	HEAT TREATMENT TEMP. °C	HEAT TREATMENT HOLD TIME	NDT METHOD/ QUANTUM	REF. SPEC. NO.	ACC. NORM REF.	REMARKS
		PART–2	PART–2				QTY												
01	––	PIPE	SA106GRB	60.3	5.54	ARC	6 ∆	––	E7018–1			1022 REV 00	–	–	–	10% MPI/LPI	*	*	
		FITTING	SA105				~150	––	564	–	–								
02	––	PIPE	SA106GRB	33.4	4.55	ARC	5 ∆	––	E7018–1			1022 REV 00	–	–	–	10% MPI/LPI	*	*	
		FITTING	SA105				~25	––	33	–	–								
03	––	PIPE	SA106GRB	33.4	4.55	TIG& ARC	4.55 V	ER70SA1	E7018–1			1003 REV 03	–	–	–	10% RT	*	*	
		PIPE	SA106GRB				~20	146	105	–	–								
04	––	PIPE	SA106GRB	60.3	5.54	TIG& ARC	5.54 V	ER70SA1	E7018–1			1003 REV 03	–	–	–	10% RT	*	*	
		PIPE	SA106GRB				~100	1300	1000	–	–								

NOTES: 01. * REFER NDE MANUAL DOC NO. AA/CQ/GL/011 REV 00 dtd 24.10.16

PREPARED	DESIGN/CHD.	DESIGN/APPD.	CHD./APPD. – QA	DATE	DRAWING NO.	REV .
EZHIL	BISWAS	SRM	HARITHA.C	03.02.2017	4-80-381-80232	00

ERECTION / FIELD WELDING SCHEDULE

PROJECT : KOTHAGUDAM 1X800MW
CONTRACTOR : M/S BHEL

CUST. NO : 7268
PGMA : 80–382
SYSTEM : AIR EXTRACTION FROM LP HEATERS TO CONDENSER

REV. NO. : 00
WELDING CODE : – / ASME
PAGE NO : 01 OF 01

SL. NO.	DRG NO. FOR WELD LOCATION IDENTIFICATION MARK	DESCRIPTION OF PARTS TO BE WELDED	MATL.SPEC. (ATT)	DIMENSIONS SIZE OD mm	DIMENSIONS THICK mm	PROCESS OF WELDING	TYPE OF WELD	ELECTRODE FILLER SPEC. (ATT) TIG	ELECTRODE FILLER SPEC. (ATT) ARC SPEC.			W.P.S NO.	MIN. PRE HEAT TEMP. °C	HEAT TREATMENT TEMP. °C	HEAT TREATMENT HOLD TIME	NDT METHOD/ QUANTUM	REF. SPEC. NO.	ACC. NORM REF.	REMARKS
		PART–1	PART–1					QTY(gms)	QTY(NOS.)										
		PART–2	PART–2				QTY	ø2.4	ø2.5	ø3.2	ø4.0								
01	1–80–382–21325	FITTING PIPE	SA234WPB SA106GRB	OD114.3	6.02	TIG& ARC	6.02◊	ER70SA1	E7018–1			1003 REV 03	–	–	–	10% RT	*	*	
		FITTING PIPE/VALVE	SA234WPB SA106GRB/WCB				7	160	125	–	–								
02	1–80–382–21324	FITTING PIPE	SA234WPB SA106GRB	OD168.3	7.11	TIG& ARC	7.11◊	ER70SA1	E7018–1			1003 REV 03	–	–	–	10% RT	*	*	
		FITTING PIPE	SA234WPB SA106GRB				52	2756	792	476	–								
03	1–80–382–21325 1–80–382–21326	PIPE	SA106GRB	OD88.9	5.49	TIG& ARC	5.49◊	ER70SA1	E7018–1			1003 REV 03	–	–	–	10% RT	*	*	
		NOZZLE(COND)	GRB EQUIVALENT				80	1600	1200	—	–								
04	1–80–382–21326	BEND PIPE	SA106GRB SA106GRB	OD33.4	4.55	TIG& ARC	4.55◊	ER70SA1	E7018–1			1003 REV 03	–	–	–	10% RT	*	*	
		BEND PIPE	SA106GRB SA106GRB				~40	260	200		–								
05	1–80–382–21326	PIPE	SA106GRB	OD33.4	4.55	ARC	5◺	–	E7018–1			1022 REV 00	–	–	–	LPI/MPI 10%	*	*	
		SW STUB	SA105				6	–	33	–	–								

NOTES: 01. * REFER NDE MANUAL DOC NO. AA/CQ/GL/011 REV 00 dtd 24.10.16

PREPARED	DESIGN/CHD.	DESIGN/APPD.	CHD./APPD. – QA	DATE	DRAWING NO.	REV.
EZHIL	BISWAS	SRM	C.HARITHA	03.02.2017	4-80-382-80239	00

ERECTION / FIELD WELDING SCHEDULE

PROJECT : KOTHAGUDAM 1X800MW
CONTRACTOR : M/S BHEL

CUST. NO : 7268
PGMA : 80–385
SYSTEM : SAFETY VALVE ESCAPE PIPING FROM EXTRACTION LINE TO BFPT

REV. NO. : 00
WELDING CODE : – / ASME
PAGE NO : 01 OF 01

SL. NO.	DRG NO. FOR WELD LOCATION IDENTIFICATION MARK	DESCRIPTION OF PARTS TO BE WELDED	MATL.SPEC. (ATT)	DIMENSIONS SIZE OD mm	DIMENSIONS THICK mm	PROCESS OF WELDING	TYPE OF WELD	ELECTRODE FILLER SPEC. (ATT) TIG	ARC SPEC.			W.P.S NO.	MIN. PRE HEAT TEMP. °C	HEAT TREATMENT TEMP. °C	HEAT TREATMENT HOLD TIME	NDT METHOD/ QUANTUM	REF. SPEC. NO.	ACC. NORM REF.	REMARKS
							QTY	QTY(gms) ø2.4	QTY(NOS.) ø2.5	ø3.2	ø4.0								
01	1–80–385–21263 2–80–385–14469	FITTING PIPE FITTING PIPE	SA234WPB SA106GRB SA234WPB SA106GRB	355.6	9.53	TIG& ARC	9.53V 43	ER70SA1 4472	E7018–1 1032	1591	–	1003 REV 03	–	–	–	10% RT	*	*	
02	1–80–385–21263	FITTING PIPE FITTING PIPE	SA234WPB SA106GRB SA234WPB SA106GRB	273	6.35	TIG& ARC	6.35V 4	ER70SA1 360	E7018–1 80	36	–	1003 REV 03	–	–	–	10% RT	*	*	
03	2–80–385–14469	FITTING PIPE FITTING PIPE	SA234WPB SA106GRB SA234WPB SA106GRB	60.3	5.54	TIG& ARC	5.54V 6	ER70SA1 78	E7018–1 60	–	–	1003 REV 03	–	–	–	10% RT	*	*	

NOTES:
01. * REFER NDE MANUAL DOC NO. AA/CQ/GL/011 REV 00 dtd 24.10.16

PREPARED	DESIGN/CHD.	DESIGN/APPD.	CHD./APPD. – QA	DATE	DRAWING NO.	REV.
EZHIL	BISWAS	SRM	C.HARITHA	03.02.2017	4-80-385-80101	00

ERECTION / FIELD WELDING SCHEDULE

PROJECT : KOTHAGUDAM 1X800MW
CONTRACTOR : M/S BHEL

CUST. NO : 7268
PGMA : 80–388
SYSTEM : CONDENSER AIR EVACUATION PIPING

REV. NO. : 00
WELDING CODE : – / ASME
PAGE NO : 01 OF 01

SL. NO.	DRG NO. FOR WELD LOCATION IDENTIFICATION MARK	DESCRIPTION OF PARTS TO BE WELDED	MATL.SPEC. (ATT)	DIMENSIONS SIZE OD mm	DIMENSIONS THICK mm	PROCESS OF WELDING	TYPE OF WELD	ELECTRODE FILLER SPEC. (ATT) TIG	ELECTRODE FILLER SPEC. (ATT) ARC SPEC.			W.P.S NO.	MIN. PRE HEAT TEMP. °C	HEAT TREATMENT TEMP. °C	HEAT TREATMENT HOLD TIME	NDT METHOD/ QUANTUM	REF. SPEC. NO.	ACC. NORM REF.	REMARKS
								TIG QTY(gms)	ARC SPEC. QTY(NOS.)										
		PART–1	PART–1																
		PART–2	PART–2				QTY	ø2.4	ø2.5	ø3.2	ø4.0								
01	1–80–388–21384 1–80–388–21385	FITTING PIPE	SA234WPB SA106GRB	219.1	6.35	TIG& ARC	6.35V	ER70SA1	E7018–1			1003 REV 03	–	–	–	10% RT	*	*	
		FITTING PIPE/VALVE	SA234WPB SA106GRB/WCB				60	5325	2442	–	–								
02	1–80–388–21384 1–80–388–21385	FITTING PIPE	SA234WPB SA106GRB	323.9	9.53	TIG& ARC	9.53V	ER70SA1	E7018–1			1003 REV 03	–	–	–	10% RT	*	*	
		FITTING PIPE/VALVE	SA234WPB SA106GRB/WCB				25	3250	660	1018	–								
03	1–80–388–21384 1–80–388–21385	FITTING PIPE	SA234WPB SA106GRB	273	6.35	TIG& ARC	6.35V	ER70SA1	E7018–1			1003 REV 03	–	–	–	10% RT	*	*	
		FITTING PIPE/VALVE	SA234WPB SA106GRB/WCB				50	5563	1100	495	–								

NOTES:
01. * REFER NDE MANUAL DOC NO. AA/CQ/GL/011 REV 00 dtd 24.10.16

PREPARED	DESIGN/CHD.	DESIGN/APPD.	CHD./APPD. – QA	DATE	DRAWING NO.	REV.
EZHIL	BISWAS	SRM	C.HARITHA	19.09.16	4-80-388-80300	00

ERECTION / FIELD WELDING SCHEDULE

PROJECT : KOTHAGUDAM 1X800MW
CONTRACTOR : M/S BHEL

CUST. NO : 7268
PGMA : 80–408
SYSTEM : CONDENSATE DUMP FROM HEADER

REV. NO. : 00
WELDING CODE : – / ASME
PAGE NO : 01 OF 01

SL. NO.	DRG NO. FOR WELD LOCATION IDENTIFICATION MARK	DESCRIPTION OF PARTS TO BE WELDED	MATL.SPEC. (ATT)	DIMENSIONS		PROCESS OF WELDING	TYPE OF WELD	ELECTRODE FILLER SPEC. (ATT)				W.P.S NO.	MIN. PRE HEAT TEMP. °C	HEAT TREATMENT		NDT METHOD/ QUANTUM	REF. SPEC. NO.	ACC. NORM REF.	REMARKS
				SIZE OD mm	THICK mm			TIG	ARC SPEC.					TEMP. °C	HOLD TIME				
		PART–1	PART–1					QTY(gms)	QTY(NOS.)										
		PART–2	PART–2				QTY	ø2.4	ø2.5	ø3.2	ø4.0								
01	1–80–408–21307	PIPE FITTING/VALVE	SA106GRB SA234WPB/WCB	219.1	8.18	TIG& ARC	8.18 V	ER70SA1	E7018–1			1003 REV 03	–	–	–	10% RT	*	*	
		PIPE FITTING	SA106GRB SA234WPB				4	273	66	66	–								
02	1–80–408–21307	PIPE FITTING/VALVE	SA106GRB SA234WPB	219.1	6.35	TIG& ARC	6.35 V	ER70SA1	E7018–1			1003 REV 03	–	–	–	10% RT	*	*	
		PIPE FITTING	SA106GRB SA234WPB/WCB				42	2982	1554	–	–								
03	1–80–408–21307	FITTING	SA234WPB	168.3	7.11	TIG& ARC	7.11 V	ER70SA1	E7018–1			1033 REV 04	150	660±10	2.5mtS PER mm minimum 60 min	RT 100%	*	*	
		CONTROL VAL	WC6				2	106	30	18	–								
04	1–80–408–21307	FITTING	SA234WPB	168.3	7.11	TIG& ARC	7.11 V	ER70SA1	E7018–1			1003 REV 03	–	–	–	10% RT	*	*	
		FITTING	SA234WPB				2	106	30	18	–								

NOTES:
01. * REFER NDE MANUAL DOC NO. AA/CQ/GL/011 REV 00 dtd 24.10.16

PREPARED	DESIGN/CHD.	DESIGN/APPD.	CHD./APPD. – QA	DATE	DRAWING NO.	REV .
EZHIL KUMAR	BISWAS	SRM	HARITHA.C	08.02.2017	4-80-408-80203	00

ERECTION / FIELD WELDING SCHEDULE

PROJECT : KOTHAGUDAM 1X800MW
CONTRACTOR : M/S BHEL

CUST. NO : 7268
PGMA : 80–412
SYSTEM : CONDENSER EMERGENCY MAKE UP FROM CST

REV. NO. : 00
WELDING CODE : – / ASME
PAGE NO : 01 OF 01

SL. NO.	DRG NO. FOR WELD LOCATION IDENTIFICATION MARK	DESCRIPTION OF PARTS TO BE WELDED	MATL.SPEC. (ATT)	DIMENSIONS SIZE OD mm	DIMENSIONS THICK mm	PROCESS OF WELDING	TYPE OF WELD	ELECTRODE FILLER SPEC. (ATT) TIG	ELECTRODE FILLER SPEC. (ATT) ARC SPEC.			W.P.S NO.	MIN. PRE HEAT TEMP. °C	HEAT TREATMENT TEMP. °C	HEAT TREATMENT HOLD TIME	NDT METHOD/ QUANTUM	REF. SPEC. NO.	ACC. NORM REF.	REMARKS
		PART–1	PART–1					QTY(gms)	QTY(NOS.)										
		PART–2	PART–2				QTY	ø2.4	ø2.5	ø3.2	ø4.0								
01	1–80–412–21317	FITTING PIPE	SA312TP304 SA403WP304H	114.3	3.05	TIG& ARC	3.05▽	ER347	E347			1016 REV 02	10	–	–	RT10% LPI100%	*	*	
		FITTING PIPE	SA312TP304 SA403WP304H				60	1596	960	–	–								
02	1–80–412–21317	FITTING PIPE	SA312TP304 SA403WP304H	88.9	3.05	TIG& ARC	3.05▽	ER347	E347			1016 REV 02	10	–	–	RT10% LPI100%	*	*	
		FITTING PIPE	SA403WP304H				30	630	390	–	–								

NOTES: 01. * REFER NDE MANUAL DOC NO. AA/CQ/GL/011 REV 00 dtd 24.10.16

PREPARED	DESIGN/CHD.	DESIGN/APPD.	CHD./APPD. – QA	DATE	DRAWING NO.	REV.
EZHIL KUMAR	BISWAS	SRM	HARITHA.C	08.02.2017	4-80-412-80219	00

ERECTION / FIELD WELDING SCHEDULE

PROJECT : KOTHAGUDAM 1X800MW
CONTRACTOR : M/S BHEL

CUST. NO : 7268
PGMA : 80–433
SYSTEM : SPRAY WATER PIPING TO RE–HEATER ATTEMPERATION

REV. NO. : 00
WELDING CODE : IBR / ASME
PAGE NO : 01 OF 01

SL. NO.	DRG NO. FOR WELD LOCATION IDENTIFICATION MARK	DESCRIPTION OF PARTS TO BE WELDED	MATL.SPEC. (ATT)	DIMENSIONS SIZE OD mm	DIMENSIONS THICK mm	PROCESS OF WELDING	TYPE OF WELD	ELECTRODE FILLER SPEC. (ATT) TIG	ELECTRODE FILLER SPEC. (ATT) ARC SPEC.			W.P.S NO.	MIN. PRE HEAT TEMP. °C	HEAT TREATMENT TEMP. °C	HEAT TREATMENT HOLD TIME	NDT METHOD/ QUANTUM	REF. SPEC. NO.	ACC. NORM REF.	REMARKS
							QTY	QTY(gms) ø2.4	QTY(NOS.) ø2.5	ø3.2	ø4.0								
01	1–80–433–21286	PIPE FITTING/VALVE	SA106GRC SA234WPC/WCC	114.3	13.49	TIG& ARC	13.49◊	ER70SA1	E7018–1			1003 REV 03	10	–	–	10% RT	*	*	
		PIPE FITTING	SA106GRC SA234WPC				40	1360	440	600	–								
02	1–80–433–21286	PIPE FITTING/VALVE	SA106GRC SA234WPC/WCC	168.3	21.95	TIG& ARC	21.95◊	ER70SA1	E7018–1			1004 REV 03	10	610±10	2.5mtS PER mm minimum 30 min	100% RT	*	*	
		PIPE FITTING	SA106GRC SA234WPC				52	3528	2541	1245	675								
03	1–80–433–21286	PIPE FITTING/VALVE	SA106GRC SA234WPC/WCC	114.3	17.12	TIG& ARC	17.12◊	ER70SA1	E7018–1			1003 REV 03	10	–	–	10% RT	*	*	
		PIPE FITTING	SA106GRC SA234WPC				20	640	240	280	60								

NOTES:
01. * REFER NDE MANUAL DOC NO. AA/CQ/GL/011 REV 00 dtd 24.10.16

PREPARED	DESIGN/CHD.	DESIGN/APPD.	CHD./APPD. – QA	DATE	DRAWING NO.	REV .
EZHIL	BISWAS	SRM	HARITHA.C	04.02.2017	4-80-433-80136	00

ERECTION / FIELD WELDING SCHEDULE

PROJECT : KOTHAGUDAM 1X800MW
CONTRACTOR : M/S BHEL

CUST. NO : 7268
PGMA : 80–435
SYSTEM : CEP DISCHARGE TO APRDS

REV. NO. : 00
WELDING CODE : – / ASME
PAGE NO : 01 OF 01

SL. NO.	DRG NO. FOR WELD LOCATION IDENTIFICATION MARK	DESCRIPTION OF PARTS TO BE WELDED	MATL.SPEC. (ATT)	DIMENSIONS SIZE OD mm	DIMENSIONS THICK mm	PROCESS OF WELDING	TYPE OF WELD	ELECTRODE FILLER SPEC. (ATT) TIG	ELECTRODE FILLER SPEC. (ATT) ARC SPEC.			W.P.S NO.	MIN. PRE HEAT TEMP. °C	HEAT TREATMENT TEMP. °C	HEAT TREATMENT HOLD TIME	NDT METHOD/ QUANTUM	REF. SPEC. NO.	ACC. NORM REF.	REMARKS
		PART–1	PART–1					QTY(gms)	QTY(NOS.)										
		PART–2	PART–2				QTY	ø2.4	ø2.5	ø3.2	ø4.0								
01	0–80–435–07038	PIPE FITTING/VALVE	SA106GRB SA234WPB	168.3	7.11	TIG& ARC	7.11 ◊	ER70SA1	E7018–1			1003 REV 03	–	–	–	10% RT	*	*	
		PIPE FITTING	SA106GRB SA234WPB				17	901	255	153	–								
02	0–80–435–07038	PIPE FITTING/VALVE	SA106GRB SA234WPB	88.9	5.49	TIG& ARC	5.49◊	ER70SA1	E7018–1			1003 REV 03	–	–	–	10% RT	*	*	
		PIPE FITTING	SA106GRB SA234WPB				48	960	720	–	–								
03	0–80–435–07038	PIPE	SA335P11	88.9	5.49	TIG& ARC	5.49◊	ER80SB2	E8018B2			1011 REV 01	150	–	–	RT 100%	*	*	
		VALVE	WC9				1	20	15	–	–								
04	0–80–435–07038	PIPE FITTING/VALVE	SA335P22 SA234WP22/WC9	88.9	5.49	TIG& ARC	5.49◊	ER90SB3	E9018B3			1014 REV 03	150	680 –720	2.5 Mts PER mm 60 min	RT 100%	*	*	3% HARDNESS
		PIPE FITTING	SA335P22 SA234WP22				6	120	90	–	–								
05	0–80–435–07038	PIPE	SA106GRB	60.3	5.54	ARC	6◺	––	E 7018–1			1022 REV 00	–	–	–	10% MPI/LPI	*	*	
		FITTING	SA105				~20	––	90	–	–								
06	0–80–435–07038	FITTING	SA234WPB	88.9	5.49	TIG& ARC	5.49◊	ER70SA1	E7018–1			1033 REV 04	150	650 –670	2.5 Mts PER mm 60 min	RT 100%	*	*	
		PIPE	SA335P11				1	20	15	–	–								

NOTES:
01. * REFER NDE MANUAL DOC NO. AA/CQ/GL/011 REV 00 dtd 24.10.16

PREPARED	DESIGN/CHD.	DESIGN/APPD.	CHD./APPD. – QA	DATE	DRAWING NO.	REV .
EZHIL	BISWAS	RAMAMURTHY	C.HARITHA	04.02.2017	4-80-435-80213	00

ERECTION / FIELD WELDING SCHEDULE

PROJECT : KOTHAGUDAM 1X800MW
CONTRACTOR : M/S BHEL

CUST. NO : 7268
PGMA : 80–436
SYSTEM : CONDENSER LP BYPASS SPRAY PIPING

REV. NO. : 00
WELDING CODE : – / ASME
PAGE NO : 01 OF 01

SL. NO.	DRG NO. FOR WELD LOCATION IDENTIFICATION MARK	DESCRIPTION OF PARTS TO BE WELDED	MATL.SPEC. (ATT)	DIMENSIONS SIZE OD mm	DIMENSIONS THICK mm	PROCESS OF WELDING	TYPE OF WELD	ELECTRODE FILLER SPEC. (ATT) TIG	ELECTRODE FILLER SPEC. (ATT) ARC SPEC.			W.P.S NO.	MIN. PRE HEAT TEMP. °C	HEAT TREATMENT TEMP. °C	HEAT TREATMENT HOLD TIME	NDT METHOD/ QUANTUM	REF. SPEC. NO.	ACC. NORM REF.	REMARKS
								QTY(gms)	QTY(NOS.)										
		PART–2	PART–2				QTY	ø2.4	ø2.5	ø3.2	ø4.0								
01	2–80–436–14069	PIPE FITTING	SA106GRB SA234WPB	323.9	9.53	TIG& ARC	9.53◊	ER70SA1	E7018–1			1003 REV 03	–	–	–	10% RT	*	*	
		PIPE FITTING	SA106GRB SA234WPB				30	3120	720	1110	–								
02	2–80–436–14069	PIPE FITTING/VALVE	SA106GRB SA234WPB/WCB	273	9.27	TIG& ARC	9.27◊	ER70SA1	E7018–1			1003 REV 03	–	–	–	10% RT	*	*	
		PIPE FITTING	SA106GRB SA234WPB				8	700	160	240	–								

NOTES:
01. * REFER NDE MANUAL DOC NO. AA/CQ/GL/011 REV 00 dtd 24.10.16

PREPARED	DESIGN/CHD.	DESIGN/APPD.	CHD./APPD. – QA	DATE	DRAWING NO.	REV.
EZHIL	BISWAS	RAMAMURTHY	C.HARITHA	04.02.2017	4-80-436-80084	00

ERECTION / FIELD WELDING SCHEDULE

PROJECT : KOTHAGUDAM 1X800MW
CONTRACTOR : M/S BHEL

CUST. NO : 7268
PGMA : 80–439
SYSTEM : UFT DRAIN TO TRENCH

REV. NO. : 00
WELDING CODE : – / ASME
PAGE NO : 01 OF 01

SL. NO.	DRG NO. FOR WELD LOCATION IDENTIFICATION MARK	DESCRIPTION OF PARTS TO BE WELDED	MATL.SPEC. (ATT)	DIMENSIONS SIZE OD mm	DIMENSIONS THICK mm	PROCESS OF WELDING	TYPE OF WELD	ELECTRODE FILLER SPEC. (ATT) TIG	ELECTRODE FILLER SPEC. (ATT) ARC SPEC.			W.P.S NO.	MIN. PRE HEAT TEMP. °C	HEAT TREATMENT TEMP. °C	HEAT TREATMENT HOLD TIME	NDT METHOD/ QUANTUM	REF. SPEC. NO.	ACC. NORM REF.	REMARKS
								QTY(gms)	QTY(NOS.)										
		PART–1	PART–1				QTY	ø2.4	ø2.5	ø3.2	ø4.0								
		PART–2	PART–2																
01	3–80–439–33074	FITTING PIPE	SA234WPB SA106GRB	219.1	6.35	TIG& ARC	6.35V	ER70SA1	E7018–1			1003 REV 03	–	–	–	10% RT	*	*	
		FITTING PIPE	SA234WPB SA106GRB				8	568	296	–	–								

NOTES:
01. * REFER NDE MANUAL DOC NO. AA/CQ/GL/011 REV 00 dtd 24.10.16

PREPARED	DESIGN/CHD.	DESIGN/APPD.	CHD./APPD. – QA	DATE	DRAWING NO.	REV.
EZHIL	BISWAS	SRM	HARITHA.C	04.02.2017	4-80-439-80194	00

ERECTION / FIELD WELDING SCHEDULE

PROJECT : KOTHAGUDAM 1X800MW
CONTRACTOR : M/S BHEL

CUST. NO : 7268
PGMA : 80–442
SYSTEM : GSC DRAIN TO FLASH TANK–B

REV. NO. : 00
WELDING CODE : – / ASME
PAGE NO : 01 OF 01

SL. NO.	DRG NO. FOR WELD LOCATION IDENTIFICATION MARK	DESCRIPTION OF PARTS TO BE WELDED	MATL.SPEC. (ATT)	DIMENSIONS SIZE OD mm	DIMENSIONS THICK mm	PROCESS OF WELDING	TYPE OF WELD	ELECTRODE FILLER SPEC. (ATT) TIG	ELECTRODE FILLER SPEC. (ATT) ARC SPEC.			W.P.S NO.	MIN. PRE HEAT TEMP. °C	HEAT TREATMENT TEMP. °C	HEAT TREATMENT HOLD TIME	NDT METHOD/ QUANTUM	REF. SPEC. NO.	ACC. NORM REF.	REMARKS
								QTY(gms)	QTY(NOS.)										
		PART–2	PART–2				QTY	ø2.4	ø2.5	ø3.2	ø4.0								
01	1–80–442–21303	PIPE FITTING/VALVE	SA106GRB SA234WPB/WCB	88.9	5.49	TIG& ARC	5.49◊	ER70SA1	E7018–1			1003 REV 03	–	–	–	10% RT	*	*	
		PIPE FITTING	SA106GRB SA234WPB				30	600	450	–	–								
02	1–80–442–21303	PIPE FITTING/VALVE	SA106GRB SA234WPB/WCB	60.3	5.54	TIG& ARC	5.54◊	ER70SA1	E7018–1			1003 REV 03	–	–	–	10% RT	*	*	
		PIPE FITTING	SA106GRB SA234WPB				15	100	75	–	–								
03	1–80–442–21303	PIPE FITTING	SA106GRB SA234WPB	33.4	4.55	TIG& ARC	4.55◊	ER70SA1	E7018–1			1003 REV 03	–	–	–	10% RT	*	*	
		PIPE FITTING	SA106GRB SA234WPB				5	30	25	–	–								

NOTES: 01. * REFER NDE MANUAL DOC NO. AA/CQ/GL/011 REV 00 dtd 24.10.16

PREPARED	DESIGN/CHD.	DESIGN/APPD.	CHD./APPD. – QA	DATE	DRAWING NO.	REV.
EZHIL	BISWAS	RAMAMURTHY	C.HARITHA	04.02.2017	4-80-442-80192	00

ERECTION / FIELD WELDING SCHEDULE

PROJECT : KOTHAGUDAM 1X800MW
CONTRACTOR : M/S BHEL

CUST. NO : 7268
PGMA : 80–443
SYSTEM : LPH–2 DRAIN PIPING TO LPH–1 AND ALTERNATE DRAIN TO FLASH TANK–B

REV. NO. : 00
WELDING CODE : – / ASME
PAGE NO : 01 OF 01

SL. NO.	DRG NO. FOR WELD LOCATION IDENTIFICATION MARK	DESCRIPTION OF PARTS TO BE WELDED	MATL.SPEC. (ATT)	DIMENSIONS SIZE OD mm	DIMENSIONS THICK mm	PROCESS OF WELDING	TYPE OF WELD	ELECTRODE FILLER SPEC. (ATT) TIG	ELECTRODE FILLER SPEC. (ATT) ARC SPEC.			W.P.S NO.	MIN. PRE HEAT TEMP. °C	HEAT TREATMENT TEMP. °C	HEAT TREATMENT HOLD TIME	NDT METHOD/ QUANTUM	REF. SPEC. NO.	ACC. NORM REF.	REMARKS
								QTY(gms)	QTY(NOS.)										
		PART–2	PART–2				QTY	ø2.4	ø2.5	ø3.2	ø4.0								
01	1–80–443–21272 1–80–443–21273 1–80–443–21274	PIPE FITTING/WCB	SA106GRB SA234WPB/WCB	323.9	9.53	TIG& ARC	9.53 ◊	ER70SA1	E7018–1			1003 REV 03	–	–	–	10% RT	*	*	
		PIPE FITTING/NOZZ	SA106GRB SA234WPB/CS				27	2808	648	1000	–								
02	1–80–443–21272 1–80–443–21273 1–80–443–21274	PIPE FITTING/WCB	SA106GRB SA234WPB/WCB	219.1	6.35	TIG& ARC	6.35 ◊	ER70SA1	E7018–1			1003 REV 03	–	–	–	10% RT	*	*	
		PIPE FITTING/NOZZ	SA106GRB SA234WPB/CS				80	5680	2960	–	–								
03	1–80–443–21272 1–80–443–21273 1–80–443–21274	PIPE FITTING/WCB	SA106GRB SA234WPB/WCB	168.3	7.11	TIG& ARC	7.11 ◊	ER70SA1	E7018–1			1003 REV 03	–	–	–	10% RT	*	*	
		PIPE FITTING/NOZZ	SA106GRB SA234WPB/CS				43	2280	645	430	–								
04	1–80–443–21272	REDUCER	SA234WPB	219.1	6.35	TIG& ARC	6.35 ◊	ER70SA1	E7018–1			1033 REV 04	150	660±10	2.5mtS PER mm minimum 60 min	RT 100%	*	*	
		CONTROL VAL (DRV–78,81)	WC6				4	284	148	–									

NOTES: 01. * REFER NDE MANUAL DOC NO. AA/CQ/GL/011 REV 00 dtd 24.10.16

PREPARED	DESIGN/CHD.	DESIGN/APPD.	CHD./APPD. – QA	DATE	DRAWING NO.	REV .
EZHIL	BISWAS	RAMAMURTHY	C.HARITHA	04.02.17	4-80-443-80120	00

ERECTION / FIELD WELDING SCHEDULE

PROJECT : KOTHAGUDAM 1X800MW
CONTRACTOR : M/S BHEL

CUST. NO : 7268
PGMA : 80–444
SYSTEM : LP HEATER DRAINS

REV. NO. : 00
WELDING CODE : – / ASME
PAGE NO : 01 OF 02

SL. NO.	DRG NO. FOR WELD LOCATION IDENTIFICATION MARK	DESCRIPTION OF PARTS TO BE WELDED	MATL.SPEC. (ATT)	DIMENSIONS SIZE OD mm	DIMENSIONS THICK mm	PROCESS OF WELDING	TYPE OF WELD	ELECTRODE FILLER SPEC. (ATT) TIG	ARC SPEC.			W.P.S NO.	MIN. PRE HEAT TEMP. °C	HEAT TREATMENT TEMP. °C	HEAT TREATMENT HOLD TIME	NDT METHOD/ QUANTUM	REF. SPEC. NO.	ACC. NORM REF.	REMARKS
								QTY(gms)	QTY(NOS.)										
		PART–1	PART–1				QTY	ø2.4	ø2.5	ø3.2	ø4.0								
		PART–2	PART–2																
01	1–80–444–21278	PIPE FITTING/VAL	SA106GRB SA234WPB/WCB	219.1	6.35	TIG& ARC	6.35 ◊	ER70SA1	E7018–1			1003 REV 03	–	–	–	10% RT	*	*	
		PIPE FITTING	SA106GRB SA234WPB				13	3220	782	736	–								
02	1–80–444–21278	PIPE FITTING/VAL	SA106GRB SA234WPB/WCB	168.3	7.11	TIG& ARC	7.11 ◊	ER70SA1	E7018–1			1003 REV 03	–	–	–	10% RT	*	*	
		PIPE FITTING	SA106GRB SA234WPB				46	106	30	18	–								
03	1–80–444–21278	REDUCER	SA234WPB	168.3	7.11	TIG& ARC	7.11 ◊	ER70SA1	E7018–1			1033 REV 04	150	660±10	2.5mtS PER mm minimum 120 min	RT 100%	*	*	
		CONTROL VAL (DRV–43)	WC6				2	106	30	18	–								
04	1–80–444–21278	REDUCER	SA234WPB	88.9	5.49	TIG& ARC	5.49 ◊	ER70SA1	E7018–1			1033 REV 04	150	660±10	2.5mtS PER mm minimum 120 min	RT 100%	*	*	
		CONTROL VAL (DRV–40)	WC6				2	106	30	18	–								
05	1–80–444–21488	PIPE FITTING/VAL	SA106GRB SA234WPB/WCB	219.1	8.18	TIG& ARC	8.18 ◊	ER70SA1	E7018–1			1003 REV 03	–	–	–	10% RT	*	*	
		PIPE FITTING	SA106GRB SA234WPB				48	3220	782	736	–								
06	1–80–444–21488	PIPE FITTING/VAL	SA106GRB SA234WPB/WCB	273	6.35	TIG& ARC	6.35 ◊	ER70SA1	E7018–1			1003 REV 03	–	–	–	10% RT	*	*	
		PIPE FITTING	SA106GRB SA234WPB				48	4717	1060	477	–								

NOTES: 01. * REFER NDE MANUAL DOC NO. AA/CQ/GL/011 REV 00 dtd 24.10.16

PREPARED	DESIGN/CHD.	DESIGN/APPD.	CHD./APPD. – QA	DATE	DRAWING NO.	REV .
EZHIL	BISWAS	RAMAMURTHY	C.HARITHA	04.02.17	4-80-444-80123	00

ERECTION / FIELD WELDING SCHEDULE

PROJECT : KOTHAGUDAM 1X800MW
CONTRACTOR : M/S BHEL

CUST. NO : 7268
PGMA : 80–444
SYSTEM : LP HEATER DRAINS

REV. NO. : 00
WELDING CODE : – / ASME
PAGE NO : 02 OF 02

SL. NO.	DRG NO. FOR WELD LOCATION IDENTIFICATION MARK	DESCRIPTION OF PARTS TO BE WELDED	MATL.SPEC. (ATT)	DIMENSIONS SIZE OD mm	DIMENSIONS THICK mm	PROCESS OF WELDING	TYPE OF WELD	ELECTRODE FILLER SPEC. (ATT) TIG	ELECTRODE FILLER SPEC. (ATT) ARC SPEC.			W.P.S NO.	MIN. PRE HEAT TEMP. °C	HEAT TREATMENT TEMP. °C	HEAT TREATMENT HOLD TIME	NDT METHOD/ QUANTUM	REF. SPEC. NO.	ACC. NORM REF.	REMARKS
							QTY	QTY(gms) ø2.4	QTY(NOS.) ø2.5	ø3.2	ø4.0								
07	1–80–444–21488	FITTING LP HEATER NOZLLES	SA106GRB SA106GRB	323.9	9.53	TIG& ARC	9.53 ▽ 6	ER70SA1 208	E7018–1 48	75	–	1003 REV 03	–	–	–	10% RT	*	*	
08	1–80–444–21488	PIPE FITTING VALVE (DRV–58)	SA106GRB SA234WPB WC6	273	6.35	TIG& ARC	6.35 ▽ 2	ER70SA1 180	E7018–1 40	18	–	1033 REV 04	150	660±10	2.5mtS PER mm minimum 120 min	RT 100%	*	*	

NOTES: 01. * REFER NDE MANUAL DOC NO. AA/CQ/GL/011 REV 00 dtd 24.10.16

PREPARED	DESIGN/CHD.	DESIGN/APPD.	CHD./APPD. – QA	DATE	DRAWING NO.	REV .
EZHIL	BISWAS	RAMAMURTHY	C.HARITHA	04.02.2017	4-80-444-80123	00

ERECTION / FIELD WELDING SCHEDULE

PROJECT : KOTHAGUDAM 1X800MW
CONTRACTOR : M/S BHEL

CUST. NO : 7268
PGMA : 80–446
SYSTEM : DEAERATOR DRAIN TO UFT AND OVER FLOW DRAIN TO F/T–B

REV. NO. : 00
WELDING CODE : – / ASME
PAGE NO : 01 OF 01

SL. NO.	DRG NO. FOR WELD LOCATION IDENTIFICATION MARK	DESCRIPTION OF PARTS TO BE WELDED	MATL.SPEC. (ATT)	DIMENSIONS SIZE OD mm	DIMENSIONS THICK mm	PROCESS OF WELDING	TYPE OF WELD	ELECTRODE FILLER SPEC. (ATT) TIG	ARC SPEC.			W.P.S NO.	MIN. PRE HEAT TEMP. °C	HEAT TREATMENT TEMP. °C	HEAT TREATMENT HOLD TIME	NDT METHOD/ QUANTUM	REF. SPEC. NO.	ACC. NORM REF.	REMARKS
							QTY	QTY(gms) ø2.4	QTY(NOS.) ø2.5	ø3.2	ø4.0								
01	1–80–446–21280	FITTING PIPE	SA106GRB SA234WPB	323.9	9.53	TIG& ARC	9.53◊	ER70SA1	E7018–1			1003 REV 03	–	–	–	10% RT	*	*	
		FITTING PIPE	SA106GRB SA234WPB				5	520	120	185	–								
02	1–80–446–21280	FITTING PIPE	SA106GRB SA234WPB	219.1	6.35	TIG& ARC	6.35◊	ER70SA1	E7018–1			1003 REV 03	–	–	–	10% RT	*	*	
		FITTING PIPE	SA106GRB SA234WPB				54	3834	2000	–	–								
03	1–80–446–21280	FITTING	SA234WPB	168.3	7.11	TIG& ARC	7.11 ◊	ER70SA1	E7018–1			WT412 REV01				RT 100%	*	*	
		VALVE (DRV–73)	WC9				2	106	30	18	–								
04	1–80–446–21280	FITTING PIPE	SA106GRB SA234WPB	168.3	7.11	TIG& ARC	7.11 ◊	ER70SA1	E7018–1			1003 REV 03	–	–	–	10% RT	*	*	
		FITTING PIPE	SA106GRB SA234WPB				63	53	3339	567	–								

NOTES: 01. * REFER NDE MANUAL DOC NO. AA/CQ/GL/011 REV 00 dtd 24.10.16

PREPARED	DESIGN/CHD.	DESIGN/APPD.	CHD./APPD. – QA	DATE	DRAWING NO.	REV .
EZHIL	BISWAS	S. RAMAMURTHY	C.HARITHA	04.02.17	4-80-446-80126	00

ERECTION / FIELD WELDING SCHEDULE

PROJECT : WANAKBORI 1X800MW
CONTRACTOR : M/S BHEL

CUST. NO : 7266
PGMA : 80–447
SYSTEM : HIGH PRESSURE HEATER DRAINS

REV. NO. : 00
WELDING CODE : – / ASME
PAGE NO : 01 OF 02

SL. NO.	DRG NO. FOR WELD LOCATION IDENTIFICATION MARK	DESCRIPTION OF PARTS TO BE WELDED	MATL.SPEC. (ATT)	DIMENSIONS SIZE OD mm	DIMENSIONS THICK mm	PROCESS OF WELDING	TYPE OF WELD	ELECTRODE FILLER SPEC. (ATT) TIG	ARC SPEC.			W.P.S NO.	MIN. PRE HEAT TEMP. °C	HEAT TREATMENT TEMP. °C	HEAT TREATMENT HOLD TIME	NDT METHOD/ QUANTUM	REF. SPEC. NO.	ACC. NORM REF.	REMARKS
		PART–1	PART–1					QTY(gms)	QTY(NOS.)										
		PART–2	PART–2				QTY	ø2.4	ø2.5	ø3.2	ø4.0								
01	1–80–447–21245 1–80–447–21246	FITTING PIPE	SA106GRB SA234WPB	168.3	10.97	TIG& ARC	10.97◊ 112	ER70SA1 5712	E7018–1 1680	2576	–	1003 REV 03	–	–	–	10% RT	*	*	
		FITTING PIPE	SA106GRB SA234WPB																
02	1–80–447–21245 1–80–447–21246 1–80–447–21247 1–80–447–21248	FITTING PIPE	SA106GRB SA234WPB	219.1	12.7	TIG& ARC	12.7 ◊ 100	ER70SA1 6700	E7018–1 1700	2500	800	1003 REV 03	–	–	–	10% RT	*	*	
		FITTING PIPE	SA106GRB SA234WPB																
03	1–80–447–21245 1–80–447–21246	FITTING	SA335P11	88.9	7.62	TIG& ARC	7.62 ◊ 4	ER80SB2 80	E8018–B2 32	24	–	1011 REV 01	150	–	–	RT 100%	*	*	
		CONTROL VAL (DRV–5,11)	WC9																
04	1–80–447–21245 1–80–447–21246	FITTING	SA335P11	88.9	7.62	TIG& ARC	7.62 ◊ 4	ER80SB2 80	E8018–B2 32	24	–	1011 REV 01	150	–	–	RT 100%	*	*	
		CONTROL VAL (DRV–2,8)	WC9																
05	1–80–447–21247 1–80–447–21248	FITTING PIPE	SA106GRB SA234WPB	323.9	12.7	TIG& ARC	12.7 ◊ 10	ER70SA1 1030	E7018–1 240	550	–	1003 REV 03	–	–	–	10% RT	*	*	
		FITTING PIPE	SA106GRB SA234WPB																
06	1–80–447–21247 1–80–447–21248	FITTING	SA234WPB/WPC	168.3	7.11	TIG& ARC	7.11 ◊ 8	ER70SA1 424	E7018–1 120	72	–	1033 REV 04	150	660±10	2.5mtS PER mm minimum 60 min	RT 100%	*	*	
		CONTROL VAL (DRV–14,20,27,34)	WC6																

NOTES: 01. * REFER NDE MANUAL DOC NO. AA/CQ/GL/011 REV 00 dtd 24.10.16

PREPARED	DESIGN/CHD.	DESIGN/APPD.	CHD./APPD. – QA	DATE	DRAWING NO.	REV.
EZHIL	BISWAS	RAMAMURTHY	HARITHA.C	04.02.2017	4-80-447-80137	00

ERECTION / FIELD WELDING SCHEDULE

PROJECT : WANAKBORI 1X800MW
CONTRACTOR : M/S BHEL

CUST. NO : 7266
PGMA : 80–447
SYSTEM : HIGH PRESSURE HEATER DRAINS

REV. NO. : 00
WELDING CODE : – / ASME
PAGE NO : 02 OF 02

SL. NO.	DRG NO. FOR WELD LOCATION IDENTIFICATION MARK	DESCRIPTION OF PARTS TO BE WELDED	MATL.SPEC. (ATT)	DIMENSIONS SIZE OD mm	DIMENSIONS THICK mm	PROCESS OF WELDING	TYPE OF WELD	ELECTRODE FILLER SPEC. (ATT) TIG	ELECTRODE FILLER SPEC. (ATT) ARC SPEC.			W.P.S NO.	MIN. PRE HEAT TEMP. °C	HEAT TREATMENT TEMP. °C	HEAT TREATMENT HOLD TIME	NDT METHOD/ QUANTUM	REF. SPEC. NO.	ACC. NORM REF.	REMARKS
		PART–1	PART–1					QTY(gms)	QTY(NOS.)										
		PART–2	PART–2				QTY	ø2.4	ø2.5	ø3.2	ø4.0								
07	1–80–447–21247 1–80–447–21248 1–80–447–21249 1–80–447–21250	FITTING	SA335P11	168.3	7.11	TIG& ARC	7.11 ◊	ER80SB2	E8018B2			1011 REV 01	150	–	–	RT 100%	*	*	
		CONTROL VAL (DRV–17,23,30,37)	WC9				8	424	120	72	–								
08	1–80–447–21249 1–80–447–21250	FITTING PIPE	SA106GRB SA234WPB	273	6.35	TIG& ARC	6.35 ◊	ER70SA1	E7018–1			1003 REV 03	–	–	–	10% RT	*	*	
		FITTING PIPE	SA106GRB SA234WPB				150	13500	3000	1500	–								
09	1–80–447–21249 1–80–447–21250	FITTING PIPE	SA106GRB SA234WPB	323.9	9.53 12.7	TIG& ARC	9.53 ◊	ER70SA1	E7018–1			1003 REV 03	–	–	–	10% RT	*	*	
		FITTING PIPE	SA106GRB SA234WPB				14	1456	336	518	–								

NOTES: 01. * REFER NDE MANUAL DOC NO. AA/CQ/GL/011 REV 00 dtd 24.10.16

PREPARED	DESIGN/CHD.	DESIGN/APPD.	CHD./APPD. – QA	DATE	DRAWING NO.	REV.
EZHIL	BISWAS	R.SESHAGIRI	HARITHA.C	08.08.16	4-80-447-80137	00

ERECTION / FIELD WELDING SCHEDULE

PROJECT : KOTHAGUDAM 1X800MW
CONTRACTOR : M/S BHEL

CUST. NO : 7268
PGMA : 80–448
SYSTEM : DRAIN FROM UNLISTED EQPT/VESSEL–TG SCOPE

REV. NO. : 00
WELDING CODE : – / ASME
PAGE NO : 01 OF 01

SL. NO.	DRG NO. FOR WELD LOCATION IDENTIFICATION MARK	DESCRIPTION OF PARTS TO BE WELDED	MATL.SPEC. (ATT)	DIMENSIONS		PROCESS OF WELDING	TYPE OF WELD	ELECTRODE FILLER SPEC. (ATT)				W.P.S NO.	MIN. PRE HEAT TEMP. °C	HEAT TREATMENT		NDT METHOD/ QUANTUM	REF. SPEC. NO.	ACC. NORM REF.	REMARKS
				SIZE OD mm	THICK mm			TIG	ARC SPEC.					TEMP. °C	HOLD TIME				
		PART–1	PART–1					QTY(gms)	QTY(NOS.)										
		PART–2	PART–2				QTY	ø2.4	ø2.5	ø3.2	ø4.0								
01	1–80–448–21344	FITTING PIPE	SA234WPB SA106GRB	273	6.35	TIG& ARC	6.35 ◊	ER70SA1	E7018–1			1003 REV 03	–	–	–	10% RT	*	*	
		FITTING PIPE	SA234WPB SA106GRB				10	900	200	100	–								
02	1–80–448–21344	FITTING PIPE	SA234WPB SA106GRB	508	12.7	TIG& ARC	12.7 ◊	ER70SA1	E7018–1			1003 REV 03	–	–	–	10% RT	*	*	
		FITTING PIPE	SA234WPB SA106GRB				11	1815	418	693	198								
03	1–80–448–21344	FITTING PIPE	SA234WPB SA106GRB	323.9	6.35	TIG& ARC	6.35 ◊	ER70SA1	E7018–1			1003 REV 03	–	–	–	10% RT	*	*	
		FITTING PIPE	SA234WPB SA106GRB				12	1248	288	444	–								
04	1–80–448–21343 1–80–448–21508	FITTING PIPE	SA234WPB SA106GRB	219.1	6.35	TIG& ARC	6.35 ◊	ER70SA1	E7018–1			1003 REV 03	–	–	–	10% RT	*	*	
		FITTING PIPE/NOZZ	SA234WPB SA106GRB				50	3550	1850	–	–								
05	1–80–448–21343	FITTING PIPE	SA234WPB SA106GRB	168.3	7.11	TIG& ARC	7.11 ◊	ER70SA1	E7018–1			1003 REV 03	–	–	–	10% RT	*	*	
		FITTING PIPE	SA234WPB SA106GRB				75	3975	1125	675	–								
06	1–80–448–21343 1–80–448–21508	FITTING PIPE	SA234WPB SA106GRB	114.3	6.02	TIG& ARC	6.02 ◊	ER70SA1	E7018–1			1003 REV 03	–	–	–	10% RT	*	*	
		FITTING PIPE	SA234WPB SA106GRB				50	1350	1050	–	–								

NOTES: 01. * REFER NDE MANUAL DOC NO. AA/CQ/GL/011 REV 00 dtd 24.10.16

PREPARED	DESIGN/CHD.	DESIGN/APPD.	CHD./APPD. – QA	DATE	DRAWING NO.	REV.
EZHIL	BISWAS	RAMAMURTHY	C.HARITHA	04.02.2017	4-80-448-80265	00

ERECTION / FIELD WELDING SCHEDULE

PROJECT : KOTHAGUDAM 1X800MW
CONTRACTOR : M/S BHEL

CUST. NO : 7268
PGMA : 80–449
SYSTEM : TG CYCLE PIPING DRAINS AND VENTS

REV. NO. : 00
WELDING CE : – / ASME
PAGE NO : 01 OF 02

SL. NO.	DRG NO. FOR WELD LOCATION IDENTIFICATION MARK	DESCRIPTION OF PARTS TO BE WELDED	MATL.SPEC. (ATT)	DIMENSIONS SIZE OD mm	DIMENSIONS THICK mm	PROCESS OF WELDING	TYPE OF WELD	ELECTRE FILLER SPEC. (ATT) TIG	ARC SPEC.			W.P.S NO.	MIN. PRE HEAT TEMP. °C	HEAT TREATMENT TEMP. °C	HEAT TREATMENT HOLD TIME	NDT METH/ QUANTUM	REF. SPEC. NO.	ACC. NORM REF.	REMARKS
		PART–1	PART–1				QTY	QTY(gms) ø2.4	QTY(NOS.) ø2.5	ø3.2	ø4.0								
		PART–2	PART–2																
01	––	PIPE	SA106GRB	33.4	4.55	TIG& ARC	4.55◊	ER70SA1	E7018–1			1003 REV 03	–	–	–	10% RT	*	*	
		PIPE	SA106GRB				~350	2524	1802	–	–								
02	––	PIPE	SA106GRB	33.4	4.55	ARC	5△	–	E 7018–1			1022 REV 00	–	–	–	10% MPI/LPI	*	*	
		FITTING	SA105				~920	–	1062	–	–								
03	––	PIPE	SA106GRB	60.3	5.54	TIG& ARC	5.54◊	ER70SA1	E7018–1			1003 REV 03	–	–	–	10% RT	*	*	
		PIPE	SA106GRB				~25	340	260	–	–								
04	––	PIPE	SA106GRB	60.3	5.54	ARC	6△	–	E 7018–1			1022 REV 00	–	–	–	10% MPI/LPI	*	*	
		FITTING	SA105				~150	–	430	–	–								
05	––	PIPE	SA106GRB	48.3	5.08	ARC	5△	–	E 7018–1			1022 REV 00	–	–	–	10% MPI/LPI	*	*	
		FITTING	SA105				~10	–	22	–	–								
06	––	PIPE	SA312TP304H	33.4	3.38	TIG& ARC	3.38◊	ER347	E 347			1016 REV 02	10	–	–	RT10% LPI100%	*	*	
		PIPE	SA312TP304H				~50	300	250	–	–								

NOTES: 01. * REFER NDE MANUAL DOC NO. AA/CQ/GL/011 REV 00 dtd 24.10.16

PREPARED	DESIGN/CHD.	DESIGN/APPD.	CHD./APPD. – QA	DATE	DRAWING NO.	REV.
EZHIL	BISWAS	RAMAMURTHY	C.HARITHA	04.02.17	4-80-449-80693	00

ERECTION / FIELD WELDING SCHEDULE

PROJECT : KOTHAGUDAM 1X800MW
CONTRACTOR : M/S BHEL

CUST. NO : 7268
PGMA : 80–449
SYSTEM : TG CYCLE PIPING DRAINS AND VENTS

REV. NO. : 00
WELDING CE : – / ASME
PAGE NO : 02 OF 02

SL. NO.	DRG NO. FOR WELD LOCATION IDENTIFICATION MARK	DESCRIPTION OF PARTS TO BE WELDED	MATL.SPEC. (ATT)	DIMENSIONS SIZE OD mm	DIMENSIONS THICK mm	PROCESS OF WELDING	TYPE OF WELD	ELECTRE FILLER SPEC. (ATT) TIG	ARC SPEC.			W.P.S NO.	MIN. PRE HEAT TEMP. °C	HEAT TREATMENT TEMP. °C	HEAT TREATMENT HOLD TIME	NDT METH/ QUANTUM	REF. SPEC. NO.	ACC. NORM REF.	REMARKS
							QTY	QTY(gms) ø2.4	QTY(NOS.) ø2.5	ø3.2	ø4.0								
07	--	PIPE	SA312TP304H	60.3	3.91	TIG& ARC	3.91 V	ER347	E 347			1016 REV 02	10	–	–	RT10% LPI100%	*	*	
		PIPE	SA312TP304H				~14	200	126	–	–								
08	--	PIPE	SA106GRB	48.3	5.08	TIG& ARC	5.08 V	ER70SA1	E7018–1			1003 REV 03	–	–	–	10% RT	*	*	
		PIPE	SA106GRB				~10	100	60	–	–								

NOTES: 01. * REFER NDE MANUAL DOC NO. AA/CQ/GL/011 REV 00 dtd 24.10.16

PREPARED	DESIGN/CHD.	DESIGN/APPD.	CHD./APPD. – QA	DATE	DRAWING NO.	REV .
EZHIL	BISWAS	RAMAMURTHY	C.HARITHA	04.02.17	4-80-449-80693	00

ERECTION / FIELD WELDING SCHEDULE

PROJECT : KOTHAGUDAM 1X800MW
CONTRACTOR : M/S BHEL

CUST. NO : 7268
PGMA : 80–457
SYSTEM : DRAIN MANIFOLD TO FLASH TANKS

REV. NO. : 00
WELDING CODE : – / ASME
PAGE NO : 01 OF 01

SL. NO.	DRG NO. FOR WELD LOCATION IDENTIFICATION MARK	DESCRIPTION OF PARTS TO BE WELDED	MATL.SPEC. (ATT)	DIMENSIONS SIZE OD mm	DIMENSIONS THICK mm	PROCESS OF WELDING	TYPE OF WELD	ELECTRODE FILLER SPEC. (ATT) TIG	ELECTRODE FILLER SPEC. (ATT) ARC SPEC.			W.P.S NO.	MIN. PRE HEAT TEMP. °C	HEAT TREATMENT TEMP. °C	HEAT TREATMENT HOLD TIME	NDT METHOD/ QUANTUM	REF. SPEC. NO.	ACC. NORM REF.	REMARKS
							QTY	QTY(gms) ø2.4	QTY(NOS.) ø2.5	ø3.2	ø4.0								
01	1–80–457–21418	FITTING PIPE	SA234WPB SA106GRB	219.1	8.18	TIG& ARC	8.18▽	ER70SA1	E7018–1			1003 REV 03	–	–	–	10% RT	*	*	
		FITTING PIPE	SA234WPB SA106GRB				10	770	170	160	–								
02	1–80–457–21418	FITTING PIPE	SA234WPB SA106GRB	355.6	9.53	TIG& ARC	9.53▽	ER70SA1	E7018–1			1003 REV 03	–	–	–	10% RT	*	*	
		FITTING PIPE	SA234WPB SA106GRB				8	805	189	287	–								
03	1–80–457–21418	FITTING PIPE	SA234WP22 SA335P22	323.9	9.53	TIG& ARC	9.53▽	ER90S–B3	E9018–B3			1014 REV 03	150	680 – 720°	2.5MIN PER 2.5MM 60 min	RT 100%	*	*	3% HARDNESS
		FITTING PIPE	SA234WP22 SA335P22				4	416	96	148	–								

NOTES:
01. * REFER NDE MANUAL DOC NO. AA/CQ/GL/011 REV 00 dtd 24.10.16

PREPARED	DESIGN/CHD.	DESIGN/APPD.	CHD./APPD. – QA	DATE	DRAWING NO.	REV.
EZHIL	BISWAS	RAMAMURTHY	HARITHA.C	04.02.2017	4-80-457-80378	00

ERECTION / FIELD WELDING SCHEDULE

PROJECT : KOTHAGUDAM 1X800MW
CONTRACTOR : M/S BHEL

CUST. NO : 7268
PGMA : 80–459
SYSTEM : FLASH TANK–A DRAIN TO CONDENSER

REV. NO. : 00
WELDING CODE : – / ASME
PAGE NO : 01 OF 01

SL. NO.	DRG NO. FOR WELD LOCATION IDENTIFICATION MARK	DESCRIPTION OF PARTS TO BE WELDED	MATL.SPEC. (ATT)	DIMENSIONS SIZE OD mm	DIMENSIONS THICK mm	PROCESS OF WELDING	TYPE OF WELD	ELECTRODE FILLER SPEC. (ATT) TIG	ELECTRODE FILLER SPEC. (ATT) ARC SPEC.			W.P.S NO.	MIN. PRE HEAT TEMP. °C	HEAT TREATMENT TEMP. °C	HEAT TREATMENT HOLD TIME	NDT METHOD/ QUANTUM	REF. SPEC. NO.	ACC. NORM REF.	REMARKS
		PART–1	PART–1					QTY(gms)	QTY(NOS.)										
		PART–2	PART–2				QTY	ø2.4	ø2.5	ø3.2	ø4.0								
01	2–80–459–14061	FITTING PIPE	SA106GRB SA234WPB	323.9	6.35	TIG& ARC	6.35V	ER70SA1	E7018–1			1003 REV 03	–	–	–	10% RT	*	*	
		FITTING PIPE/NOZZLE	SA106GRB SA234WPB GRB EQUIVALENT				11	1144	264	401	–								

NOTES: 01. * REFER NDE MANUAL DOC NO. AA/CQ/GL/011 REV 00 dtd 24.10.16

PREPARED	DESIGN/CHD.	DESIGN/APPD.	CHD./APPD. – QA	DATE	DRAWING NO.	REV.
EZHIL	BISWAS	RAMAMURTHY	C.HARITHA	04.02.17	4-80-459-80057	00

ERECTION / FIELD WELDING SCHEDULE

PROJECT : KOTHAGUDAM 1X800MW
CONTRACTOR : M/S BHEL

CUST. NO : 7268
PGMA : 80–463
SYSTEM : TG AUX COOLING WATER

REV. NO. : 00
WELDING CODE : –/ ASME
PAGE NO : 01 OF 03

SL. NO.	DRG NO. FOR WELD LOCATION IDENTIFICATION MARK	DESCRIPTION OF PARTS TO BE WELDED	MATL.SPEC. (ATT)	DIMENSIONS SIZE OD mm	DIMENSIONS THICK mm	PROCESS OF WELDING	TYPE OF WELD	ELECTRODE FILLER SPEC. (ATT) TIG QTY(gms) ø2.4	ARC SPEC. QTY(NOS.) ø2.5	ø3.2	ø4.0	W.P.S NO.	MIN. PRE HEAT TEMP. °C	HEAT TREATMENT TEMP. °C	HEAT TREATMENT HOLD TIME	NDT METHOD/ QUANTUM	REF. SPEC. NO.	ACC. NORM REF.	REMARKS
01	––	FITTING PIPE	IS 3589 IS 3589	610	8	ARC	8 V	–	E 7018			1213 REV 00	10	–	–	RT 10%	*	*	
		FITTING PIPE	IS 3589 IS 3589				15	–	630	660	–								
02	––	FITTING PIPE	IS 3589 IS 3589	508	6	ARC	6 V	–				1213 REV 00	10	–	–	RT 10%	*	*	
		FITTING PIPE	IS 3589 IS 3589				25	–	950	750	–								
03	––	FITTING PIPE	IS 3589 IS 3589	457	6	ARC	6 V	–				1213 REV 00	10	–	–	RT 10%	*	*	
		FITTING PIPE	IS 3589 IS 3589				55	–	1530	990	–								
04	––	FITTING PIPE	IS 3589 IS 3589	406.4	6	ARC	6 V	–				1213 REV 00	10	–	–	RT 10%	*	*	
		FITTING PIPE	IS 3589 IS 3589				15	–	450	315	–								
05	––	FITTING PIPE	IS 3589 IS 3589	355.6	6	ARC	6 V	–				1213 REV 00	10	–	–	RT 10%	*	*	
		FITTING PIPE	IS 3589 IS 3589				40	–	810	600	–								
06	––	FITTING PIPE	IS 3589 IS 1239	323.9	6	ARC	6 V	–				1213 REV 00	10	–	–	RT 10%	*	*	
		FITTING PIPE	IS 3589 IS 1239				56	–	1344	840	–								

NOTES: 01 * REFER NDE MANUAL DOC NO. AA/CQ/GL/011 REV 00 dtd 24.10.16

PREPARED	DESIGN/CHD.	DESIGN/APPD.	CHD./APPD. – QA	DATE	DRAWING NO.	REV .
EZHIL	BISWAS	RAMAMURTHY	C.HARITHA	04.02.2017	4-80-463-80087	00

ERECTION / FIELD WELDING SCHEDULE

PROJECT : KOTHAGUDAM 1X800MW
CONTRACTOR : M/S BHEL

CUST. NO : 7268
PGMA : 80–463
SYSTEM : TG AUX COOLING WATER

REV. NO. : 00
WELDING CODE : –/ ASME
PAGE NO : 02 OF 03

SL. NO.	DRG NO. FOR WELD LOCATION IDENTIFICATION MARK	DESCRIPTION OF PARTS TO BE WELDED	MATL.SPEC. (ATT)	DIMENSIONS SIZE OD mm	DIMENSIONS THICK mm	PROCESS OF WELDING	TYPE OF WELD	ELECTRODE FILLER SPEC. (ATT) TIG QTY(gms) ø2.4	ELECTRODE FILLER SPEC. (ATT) ARC SPEC. QTY(NOS.) ø2.5	ø3.2	ø4.0	W.P.S NO.	MIN. PRE HEAT TEMP. °C	HEAT TREATMENT TEMP. °C	HEAT TREATMENT HOLD TIME	NDT METHOD/ QUANTUM	REF. SPEC. NO.	ACC. NORM REF.	REMARKS
		PART–1	PART–1																
		PART–2	PART–2				QTY												
07	––	FITTING PIPE	IS 3589 IS 1239	OD273	6	ARC	6 V		E 7018			1213 REV 00	10	–	–	RT 10%	*	*	
		FITTING PIPE	IS 3589 IS 1239				65	–	1320	884	–								
08	––	FITTING PIPE	IS 3589 IS 1239	OD219.1	6	ARC	6 V		E 7018			1213 REV 00	10	–	–	RT 10%	*	*	
		FITTING PIPE	IS 3589 IS 1239				20	–	800	–	–								
09	––	FITTING PIPE	IS 3589 IS 1239	NB150	5.4	ARC	5.4 V		E 7018			1213 REV 00	10	–	–	RT 10%	*	*	
		FITTING PIPE	IS 3589 IS 1239				80	–	1200	800	–								
10	––	FITTING PIPE	IS 3589 IS 1239	NB100	5.4	ARC	5.4 V		E 7018			1213 REV 00	10	–	–	RT 10%	*	*	
		FITTING PIPE	IS 3589 IS 1239				20	–	3505	–	–								
11	––	FITTING PIPE	IS 3589 IS 1239	NB80	4.85	ARC	4.85 V		E 7018			1213 REV 00	10	–	–	RT 10%	*	*	
		FITTING PIPE	IS 3589 IS 1239				50	–	1050	–	–								
12	––	PIPE	IS1239	NB50	4.5	ARC	4.5 V	–	E 7018			1213 REV 00	10	–	–	RT 10%	*	*	
		FITTING	IS1239				~100	–	1100	–	–								

NOTES:
01 * REFER NDE MANUAL DOC NO. AA/CQ/GL/011 REV 00 dtd 24.10.16

PREPARED	DESIGN/CHD.	DESIGN/APPD.	CHD./APPD. – QA	DATE	DRAWING NO.	REV.
EZHIL	BISWAS	RAMAMURTHY	C.HARITHA	04.02.2017	4-80-463-80087	00

ERECTION / FIELD WELDING SCHEDULE

PROJECT : KOTHAGUDAM 1X800MW
CONTRACTOR : M/S BHEL

CUST. NO : 7268
PGMA : 80–463
SYSTEM : TG AUX COOLING WATER

REV. NO. : 00
WELDING CODE : –/ ASME
PAGE NO : 03 OF 03

SL. NO.	DRG NO. FOR WELD LOCATION IDENTIFICATION MARK	DESCRIPTION OF PARTS TO BE WELDED	MATL.SPEC. (ATT)	DIMENSIONS		PROCESS OF WELDING	TYPE OF WELD	ELECTRODE FILLER SPEC. (ATT)				W.P.S NO.	MIN. PRE HEAT TEMP. °C	HEAT TREATMENT		NDT METHOD/ QUANTUM	REF. SPEC. NO.	ACC. NORM REF.	REMARKS
				SIZE OD mm	THICK mm			TIG	ARC SPEC.					TEMP. °C	HOLD TIME				
		PART–1	PART–1					QTY(gms)	QTY(NOS.)										
		PART–2	PART–2				QTY	ø2.4	ø2.5	ø3.2	ø4.0								
13	––	PIPE	IS1239	NB50	4.5	ARC	4.5V	–	E 7018			1213 REV 00	10	–	–	RT 10%	*	*	
		FITTING	IS1239				~100	–	800	–	–								
14	––	PIPE	IS1239	NB25	4.05	ARC	4 V	–	E 7018			1213 REV 00	10	–	–	RT 10%	*	*	
		FITTING	IS1239				~100	–	500	–	–								
15	––	PIPE	IS3589	813.0	10	ARC	10 V	–	E 7018			1213 REV 00	10	–	–	RT 10%	*	*	
		FITTING	IS3589				~6	–	367	577	–								
16	––	PIPE	IS3589	711.2	10	ARC	10 V	–	E 7018			1213 REV 00	10	–	–	RT 10%	*	*	
		FITTING	IS3589				~10	–	550	850	–								
17	––	PIPE	IS3589	914	10	ARC	10 V	–	E 7018			1213 REV 00	10	–	–	RT 10%	*	*	
		FITTING	IS3589				~15	–	630	990	–								

NOTES: 01 * REFER NDE MANUAL DOC NO. AA/CQ/GL/011 REV 00 dtd 24.10.16

PREPARED	DESIGN/CHD.	DESIGN/APPD.	CHD./APPD. – QA	DATE	DRAWING NO.	REV.
EZHIL	BISWAS	RAMAMURTHY	C.HARITHA	04.02.2017	4-80-463-80087	00

ERECTION / FIELD WELDING SCHEDULE

PROJECT : KOTHAGUDAM 1X800MW
CONTRACTOR : M/S BHEL

CUST. NO : 7268
PGMA : 80–473
SYSTEM : CONDENSER NORMAL MAKE UP PIPING.

REV. NO. : 00
WELDING CODE : – / ASME
PAGE NO : 01 OF 01

SL. NO.	DRG NO. FOR WELD LOCATION IDENTIFICATION MARK	DESCRIPTION OF PARTS TO BE WELDED	MATL.SPEC. (ATT)	DIMENSIONS SIZE OD mm	DIMENSIONS THICK mm	PROCESS OF WELDING	TYPE OF WELD	ELECTRODE FILLER SPEC. (ATT) TIG	ELECTRODE FILLER SPEC. (ATT) ARC SPEC.			W.P.S NO.	MIN. PRE HEAT TEMP. °C	HEAT TREATMENT TEMP. °C	HEAT TREATMENT HOLD TIME	NDT METHOD/ QUANTUM	REF. SPEC. NO.	ACC. NORM REF.	REMARKS
		PART–1	PART–1					QTY(gms)	QTY(NOS.)										
		PART–2	PART–2				QTY	ø2.4	ø2.5	ø3.2	ø4.0								
01	–	FITTING PIPE	SA312TP304 SA403WP304H	114.3	3.05	TIG& ARC	3.05◊	ER347	E 347			1016 REV 02	10	–	–	RT10% LPI100%	*	*	
		FITTING PIPE	SA312TP304 SA403WP304H				170	4522	2720	–	–								
02	–	FITTING PIPE	SA312TP304 SA403WP304H	168.3	3.4	TIG& ARC	3.4 ◊	ER347	E347			1016 REV 02	10	–	–	RT10% LPI100%	*	*	
		FITTING PIPE	SA312TP304 SA403WP304H				85	4675	2040	–	–								
03	–	FITTING PIPE	SA312TP304 SA403WP304H	33.4	3.38	TIG& ARC	3.38◊	ER347	E347			1016 REV 02	10	–	–	RT10% LPI100%	*	*	
		FITTING PIPE	SA312TP304 SA403WP304H				80	512	400	–	–								
04	–	FITTING PIPE	SA403WP304H	21.3	3.73	TIG& ARC	3.73◊	ER347	E347			1016 REV 02	10	–	–	RT10% LPI100%	*	*	
		FITTING PIPE	SA312TP304 SA403WP304H				50	675	–	–	–								

NOTES: 01. * REFER NDE MANUAL DOC NO. AA/CQ/GL/011 REV 00 dtd 24.10.16

PREPARED	DESIGN/CHD.	DESIGN/APPD.	CHD./APPD. – QA	DATE	DRAWING NO.	REV .
EZHIL	BISWAS	SRM	HARITHA.C	08.02.2017	4-80-473-80337	00

ERECTION / FIELD WELDING SCHEDULE

PROJECT : KOTHAGUDAM 1X800MW
CONTRACTOR : M/S BHEL

CUST. NO : 7268
PGMA : 80–477
SYSTEM : SERVICE WATER PIPING

REV. NO. : 00
WELDING CODE : – / ASME
PAGE NO : 01 OF 01

SL. NO.	DRG NO. FOR WELD LOCATION IDENTIFICATION MARK	DESCRIPTION OF PARTS TO BE WELDED	MATL.SPEC. (ATT)	DIMENSIONS		PROCESS OF WELDING	TYPE OF WELD	ELECTRODE FILLER SPEC. (ATT)				W.P.S NO.	MIN. PRE HEAT TEMP. °C	HEAT TREATMENT		NDT METHOD / QUANTUM	REF. SPEC. NO.	ACC. NORM REF.	REMARKS
				SIZE OD mm	THICK mm			TIG	ARC SPEC.					TEMP. °C	HOLD TIME				
		PART–1	PART–1					QTY(gms)	QTY(NOS.)										
		PART–2	PART–2				QTY	ø2.4	ø2.5	ø3.2	ø4.0								
01	––	PIPE	IS 1239	NB80	5.4	ARC	5.4◊	–	E 7018			1213 REV 00	10	–	–	RT 10%	*	*	
		FITTING	IS 1239				~40	–	600	–	–								
02	––	PIPE	IS 1239	NB50	4.8	ARC	4.8◊	–	E 7018			1213 REV 00	10	–	–	RT 10%	*	*	
		FITTING	IS 1239				~70	–	650	–	–								
03	––	PIPE	IS 1239	NB150	5.4	ARC	5.4◊	E 6013	E 7018			1001 REV 01	–	–	–	RT 10%	*	*	
		FITTING	IS 1239				~40	2160	1080	–	–								
04	––	PIPE	IS 1239	NB25	4.0	ARC	4.0◊	–	E 7018			1213 REV 00	–	–	–	RT 10%	*	*	
		FITTING	IS 1239				~25	–	125	–	–								

NOTES: 01 * REFER NDE MANUAL DOC NO. AA/CQ/GL/011 REV 00 dtd 24.10.16

PREPARED	DESIGN/CHD.	DESIGN/APPD.	CHD./APPD. – QA	DATE	DRAWING NO.	REV.
EZHIL	BISWAS	RAMAMURTHY	C.HARITHA	04.02.2017	4-80-477-80695	00

ERECTION / FIELD WELDING SCHEDULE

PROJECT : KOTHAGUDAM 1X800MW
CONTRACTOR : M/S BHEL

CUST. NO : 7268
PGMA : 80–493
SYSTEM : FLASH TANK–A VENT TO CONDENSER

REV. NO. : 00
WELDING CODE : – / ASME
PAGE NO : 01 OF 01

SL. NO.	DRG NO. FOR WELD LOCATION IDENTIFICATION MARK	DESCRIPTION OF PARTS TO BE WELDED	MATL.SPEC. (ATT)	DIMENSIONS SIZE OD mm	DIMENSIONS THICK mm	PROCESS OF WELDING	TYPE OF WELD	ELECTRODE FILLER SPEC. (ATT) TIG	ELECTRODE FILLER SPEC. (ATT) ARC SPEC.			W.P.S NO.	MIN. PRE HEAT TEMP. °C	HEAT TREATMENT TEMP. °C	HEAT TREATMENT HOLD TIME	NDT METHOD/ QUANTUM	REF. SPEC. NO.	ACC. NORM REF.	REMARKS
								QTY(gms)	QTY(NOS.)										
		PART–1	PART–1																
		PART–2	PART–2				QTY	ø2.4	ø2.5	ø3.2	ø4.0								
01	2–80–493–14062	TANK–A NOZZLE	SA516GR70	1118	10	TIG& ARC	10 V̂	ER70SA1	E7018–1			1003 REV 03	10	–	–	RT 10%	*	*	
		BELLOW	SA515GR70				1	368	84	132	–								
02	2–80–493–14062	PIPE/BEND BELLOWS	SA515GR70	1118	10	TIG& ARC	10 V̂	ER70SA1	E7018–1			1003 REV 03	10	–	–	RT 10%	*	*	
		PIPE/BEND BELLOWS	SA515GR70				5	1840	420	660	–								
03	2–80–493–14062	CONDENSER NOZZLE	GRB EQUIVALENT	1118	10	TIG& ARC	10 V̂	ER70SA1	E7018–1			1003 REV 03	10	–	–	RT 10%	*	*	
		BELLOW	SA516GR70				1	368	84	132	–								

NOTES: 01. * REFER NDE MANUAL DOC NO. AA/CQ/GL/011 REV 00 dtd 24.10.16

PREPARED	DESIGN/CHD.	DESIGN/APPD.	CHD./APPD. – QA	DATE	DRAWING NO.	REV.
EZHIL	BISWAS	RAMAMURTHY	C.HARITHA	04.02.17	4-80-493-80058	00

ERECTION / FIELD WELDING SCHEDULE

PROJECT : KOTHAGUDAM 1X800MW
CONTRACTOR : M/S BHEL

CUST. NO : 7268
PGMA : 80–494
SYSTEM : FLSH TANK–B VENT TO CONDENSER

REV. NO. : 00
WELDING CODE : – / ASME
PAGE NO : 01 OF 01

SL. NO.	DRG NO. FOR WELD LOCATION IDENTIFICATION MARK	DESCRIPTION OF PARTS TO BE WELDED	MATL.SPEC. (ATT)	DIMENSIONS SIZE OD mm	DIMENSIONS THICK mm	PROCESS OF WELDING	TYPE OF WELD	ELECTRODE FILLER SPEC. (ATT) TIG	ARC SPEC.			W.P.S NO.	MIN. PRE HEAT TEMP. °C	HEAT TREATMENT TEMP. °C	HEAT TREATMENT HOLD TIME	NDT METHOD/ QUANTUM	REF. SPEC. NO.	ACC. NORM REF.	REMARKS
							QTY	QTY(gms) ø2.4	QTY(NOS.) ø2.5	ø3.2	ø4.0								
01	2–80–494–14063	TANK–B NOZZLE	SA516GR70	1118	10	TIG& ARC	10 V̂	ER70SA1	E7018–1			1003 REV 03	10	–	–	RT 10%	*	*	
		PIPE	SA515GR70				1	368	84	132	–								
02	2–80–494–14063	PIPE/BEND BELLOWS	SA515GR70 SA515GR70 SA516GR70	1118	10	TIG& ARC	10 V̂	ER70SA1	E7018–1			1003 REV 03	10	–	–	RT 10%	*	*	
		PIPE/BEND BELLOWS	SA515GR70 SA515GR70 SA516GR70				8	2944	672	1056	–								
03	2–80–494–14063	CONDENSER NOZZLE	GRB EQUIVALENT	1118	10	TIG& ARC	10 V̂	ER70SA1	E7018–1			1003 REV 03	10	–	–	RT 10%	*	*	
		PIPE	SA515GR70				1	368	84	132	–								

NOTES:
01. * REFER NDE MANUAL DOC NO. AA/CQ/GL/011 REV 00 dtd 24.10.16

PREPARED	DESIGN/CHD.	DESIGN/APPD.	CHD./APPD. – QA	DATE	DRAWING NO.	REV.
EZHIL	BISWAS	RAMAMURTHY	C.HARITHA	04.02.2017	4-80-494-80059	00

ERECTION / FIELD WELDING SCHEDULE

PROJECT : KOTHAGUDAM 1X800MW
CONTRACTOR : M/S BHEL

CUST. NO : 7268
PGMA : 80–495
SYSTEM : FLASH TANK–B DRAIN TO CONDENSER

REV. NO. : 00
WELDING CODE : – / ASME
PAGE NO : 01 OF 01

SL. NO.	DRG NO. FOR WELD LOCATION IDENTIFICATION MARK	DESCRIPTION OF PARTS TO BE WELDED	MATL.SPEC. (ATT)	DIMENSIONS SIZE OD mm	DIMENSIONS THICK mm	PROCESS OF WELDING	TYPE OF WELD	ELECTRODE FILLER SPEC. (ATT) TIG	ELECTRODE FILLER SPEC. (ATT) ARC SPEC.			W.P.S NO.	MIN. PRE HEAT TEMP. °C	HEAT TREATMENT TEMP. °C	HEAT TREATMENT HOLD TIME	NDT METHOD/ QUANTUM	REF. SPEC. NO.	ACC. NORM REF.	REMARKS
								QTY(gms)	QTY(NOS.)										
		PART–1	PART–1																
		PART–2	PART–2				QTY	ø2.4	ø2.5	ø3.2	ø4.0								
01	2–80–495–14064	TANK–B NOZZLE	SA516GR70	610	10	TIG& ARC	10 V̂	ER70SA1	E7018–1			1003 REV 03	10	–	–	RT 10%	*	*	
		PIPE	SA515GR70				1	201	46	72	–								
02	2–80–495–14064	PIPE FITTING	SA515GR70 SA234WPB	610	10	TIG& ARC	10 V̂	ER70SA1	E7018–1			1003 REV 03	10	–	–	RT 10%	*	*	
		PIPE FITTING	SA515GR70 SA234WPB				10	2010	460	720	–								
03	2–80–495–14064	CONDENSER NOZZLE	GRB EQUIVALENT	610	10	TIG& ARC	10 V̂	ER70SA1	E7018–1			1003 REV 03	10	–	–	RT 10%	*	*	
		PIPE	SA515GR70				1	201	46	72	–								

NOTES:
01. * REFER NDE MANUAL DOC NO. AA/CQ/GL/011 REV 00 dtd 24.10.16

PREPARED	DESIGN/CHD.	DESIGN/APPD.	CHD./APPD. – QA	DATE	DRAWING NO.	REV.
EZHIL KUMAR	BISWAS	RAMAMURTHY	C.HARITHA	04.02.17	4-80-495-80060	00

ERECTION / FIELD WELDING SCHEDULE

PROJECT : KOTHAGUDAM 1X800MW
CONTRACTOR : M/S BHEL

CUST. NO : 7268
PGMA : 80–601
SYSTEM : LP DOSING PIPING

REV. NO. : 00
WELDING CODE : – / ASME
PAGE NO : 01 OF 01

SL. NO.	DRG NO. FOR WELD LOCATION IDENTIFICATION MARK	DESCRIPTION OF PARTS TO BE WELDED	MATL.SPEC. (ATT)	DIMENSIONS SIZE OD mm	DIMENSIONS THICK mm	PROCESS OF WELDING	TYPE OF WELD	ELECTRODE FILLER SPEC. (ATT) TIG	ELECTRODE FILLER SPEC. (ATT) ARC SPEC.			W.P.S NO.	MIN. PRE HEAT TEMP. °C	HEAT TREATMENT TEMP. °C	HEAT TREATMENT HOLD TIME	NDT METHOD/ QUANTUM	REF. SPEC. NO.	ACC. NORM REF.	REMARKS
								QTY(gms)	QTY(NOS.)										
		PART–1	PART–1				QTY	ø2.4	ø2.5	ø3.2	ø4.0								
		PART–2	PART–2																
01	––	FITTING PIPE	SA312TP304 SA403WP304H	33.4	3.38	TIG& ARC	3.38V	ER347	E 347			1016 REV 02	10	–	–	RT10% LPI100%	*	*	
		FITTING PIPE	SA312TP304 SA403WP304H				~225	1440	1125	–	–								
02	––	FITTING PIPE	SA312TP304 SA403WP304H	48.3	3.68	TIG& ARC	3.38V	ER347	E 347			1016 REV 02	10	–	–	RT10% LPI100%	*	*	
		FITTING PIPE	SA403WP304H				~100	990	800	–	–								

NOTES: 01. * REFER NDE MANUAL DOC NO. AA/CQ/GL/011 REV 00 dtd 24.10.16

PREPARED	DESIGN/CHD.	DESIGN/APPD.	CHD./APPD. – QA	DATE	DRAWING NO.	REV.
EZHIL	BISWAS	RAMAMURTHY	C.HARITHA	04.02.17	4-80-601-80467	00

ERECTION / FIELD WELDING SCHEDULE

PROJECT : KOTHAGUDAM 1X800MW
CONTRACTOR : M/S BHEL

CUST. NO : 7268
PGMA : 80–673
SYSTEM : LUBE OIL PIPING SYSTEM

REV. NO. : 00
WELDING CODE : – / ASME
PAGE NO : 01 OF 01

SL. NO.	DRG NO. FOR WELD LOCATION IDENTIFICATION MARK	DESCRIPTION OF PARTS TO BE WELDED	MATL.SPEC. (ATT)	DIMENSIONS		PROCESS OF WELDING	TYPE OF WELD	ELECTRODE FILLER SPEC. (ATT)				W.P.S NO.	MIN. PRE HEAT TEMP. °C	HEAT TREATMENT		NDT METHOD/ QUANTUM	REF. SPEC. NO.	ACC. NORM REF.	REMARKS
				SIZE OD mm	THICK mm			TIG	ARC SPEC.					TEMP. °C	HOLD TIME				
		PART–1	PART–1					QTY(gms)	QTY(NOS.)										
		PART–2	PART–2				QTY	ø2.4	ø2.5	ø3.2	ø4.0								
01	––	FITTING	SA106GRB SA234WPB	88.9	5.49	TIG& ARC	5.49▽	ER70SA1	E7018–1			1003 REV 03	10	–	–	10% RT	*	*	
		FITTING PIPE	SA106GRB SA234WPB				~250	5000	3750	–	–								
02	––	FITTING	SA106GRB SA234WPB	60.3	5.54	TIG& ARC	5.54▽	ER70SA1	E7018–1			1003 REV 03	10	–	–	10% RT	*	*	
		FITTING PIPE	SA106GRB SA234WPB				~6	78	60	–	–								
03	––	FITTING	SA106GRB SA234WPB	33.4	4.55	TIG& ARC	4.55▽	ER70SA1	E7018–1			1003 REV 03	10	–	–	10% RT	*	*	
		FITTING PIPE	SA106GRB SA234WPB				~32	224	160	–	–								
04	––	FITTING	SA106GRB SA234WPB	48.3	5.08	TIG& ARC	4.55▽	ER70SA1	E7018–1			1003 REV 03	10	–	–	10% RT	*	*	
		FITTING PIPE	SA106GRB SA234WPB				~2	20	15	–	–								
05	––	FITTING	SA105	60.3	5.54	ARC	6◺	––	E 7018–1			1022 REV 00	10	–	–	LPI/MPI 10%	*	*	
		PIPE	SA106GRB				~24	––	75	–	–								
06	––	FITTING	SA105	33.4	4.55	ARC	5◺	––	E 7018–1			1022 REV 00	10	–	–	LPI/MPI 10%	*	*	
		PIPE	SA106GRB				~30	––	28	–	–								

NOTES:
01. * REFER NDE MANUAL DOC NO. AA/CQ/GL/011 REV 00 dtd 24.10.16

PREPARED	DESIGN/CHD.	DESIGN/APPD.	CHD./APPD. – QA	DATE	DRAWING NO.	REV.
EZHIL	BISWAS	RAMAMURTHY	C.HARITHA	04.02.2017	4-80-673-80233	00

TELANGANA POWER GENERATION CORPORATION LIMITED
(A Govt. Of Telangana Undertaking)
VidyutSoudha, Hyderabad - 500082.
Phone: 040 – 23499321 Fax: 040 – 23499323.

From:	To:
The Executive Director Thermal Projects Construction, TSGENCO, 2rd Floor, A-Block, VidyutSoudha, Khiarathabad Hyderabad-500 082. edtpctgenco@gmail.com	M/s BHEL, Piping Centre, Chennai-17 Ph:9500127314, E-mail: vishnujyoti@bhel.in

Kind Attention:Smt Vishnujyoti, Manager(Commercial)

Lr.No.ED/TPC/CE/SE-3/EME-14/YTPS(5X800MW)/F.Painting/D.No.99/18,Dt:06.07.2018

Sir,

Sub:- TSGENCO – YTPS(5x800 MW) –Painting Scheme for Piping - Approval-Reg.

Ref:- 1) M/s BHEL Email dt:23-04-2018
2) M/s TCE Email dt: 20-06-2018
3)Lr.No.ED/TPC/SE-3/EME-14/YTPS(5x800MW)/F.PaintingScheme/D.No.86/18,Dt.25-06-18
4) M/s BHEL Email, dt: 27-06-2018
5) M/s TCE Email dt: 05-07-2018

*****

Please refer to the letter 4th cited above, wherein M/s BHEL/Piping Centre, Chennai submitted the Painting Scheme for Piping pertaining to Yadadri TPS (5x800 MW) for review & approval.

Sl.No	Document No	Rev	Description
1.	7295:QPC:11	02	Painting Scheme for Piping

The above Painting Scheme furnished by M/s BHEL/Piping Centre, Chennai is herewith reviewed and approved. An approved copy of the above Painting Scheme is enclosed herewith for taking further necessary action at your end.

However, approval of the above Painting Scheme does not absolve the responsibility of supplying the above equipments to the specifications and relevant standards and to ensure satisfactory performance of the above equipment as per the terms of the contract.

It is requested to upload the approved Painting Scheme in PEDM Portal.

Encl: As above

Yours faithfully,

EXECUTIVE DIRECTOR/TPC

Copy Communicated to:

1) Chief Engineer/Construction/YTPS Site/Damaracherla/Nalgonda Dist.
2) Sri Y.A.Srinivas Rao, BHEL/PMG Camp Office, Vidyut Soudha, Hyderabad.
3) DE/Tech to Director/Projects/TSGENCO/VS/Hyderabad.
4) M/s Tata Consulting EngineersLimited,73/1,Sheriff Centre, St. Marks road, Bangalore-560 001.
5) M/s TCE /Room No.323 /Site Office/VidyutSoudha/Hyderabad

BHARAT HEAVY ELECTRICALS LIMITED
PIPING CENTRE, CHENNAI– 17
QUALITY ASSURANCE & CONTROL DEPT.

PAINTING SCHEME FOR PIPING

PROJECT NAME : - YADADRI TPS - 5X800 MW

BHEL CUSTOMER Nos : 7295,7296,7297,7298,7299,7300&7306

QPNo: 7295:QPC:11
Rev.No: 02
DATE : 03.07.2018

Sl. NO	PGMA / Description	Surface Preparation & Surface Profile	Primer coat		Intermediate coat			Finish coat				REMARKS
			Primer	No of coats & DFT	Paint	No of coats & DFT	Shade	Paint	No of coats & DFT	Shade	Total DFT Microns (Min.)	
1	2	3	4	5	6	7		9	10	11	12	13
1	Insulated Piping, components (MS / HRH / CRH / Aux Steam lines, ... tanks&vessels)	SSPC-SP3/ Power Tool Cleaning	Red oxide Zinc Phosphate Primer (Alkyd Base) to IS 12744	2 (30 microns per coat.)	-----	-----	-----	-----	-----	Red Oxide	60	
2	Uninsulated Piping, components (Spray Water / Condensate lines ...,Tanks & Vessels)	SSPC-SP3/ Power Tool Cleaning	Red Oxide - Zinc Phosphate (Alkyd base to IS: 12744)	2 (25 Microns per coat)	-----	-----	-----	Synthetic enamel Long oil Alkyd to IS: 2932	3 (35 microns per coat) (2 at shop + 1 at site)	Smoke Grey (Shade No. 692 of IS: 5)	120 at shop + 35 at site	
3	Structures	Abrasive Blast cleaning to Sa 2 1/2 (35-50 microns)	Epoxy based Zinc Phosphate to IS: 13238	1 (30 Microns per coat)	Epoxy Based MIO Pigmented Intermediate Coat.	1 (DFT=75 Micron Min Per coat)	----	Epoxy based finish paint to IS: 14209 + Aliphatic Acrylic PU Paint to IS: 13213	1 (30 microns per coat) + 1 (30 microns per coat)	Smoke Grey (Shade No. 692 of IS: 5)	165	
4	Hangers & Supports - CLH & VLH	Abrasive Blast cleaning to Sa 2 1/2 (35-50 microns)	Epoxy Zinc rich primer to IS 14589 Gr.II,% VS = 35 Min	1 (50 microns per coat)	-----	-----	-----	Aliphatic Acrylic Polyurethane paint ,%VS = 40 min	2 (35 microns per coat)	Phirozi Blue Shade No.176 of IS 5	120	Refer Note 2
5	Pipe Clamps.	SSPC-SP3/ Power Tool Cleaning	Red Oxide - Zinc Phosphate (Alkyd base to IS: 12744)	2 (25 Microns per coat)	----	----	----	Synthetic enamel Long oil Alkyd to IS: 2932	2 (35 microns per coat)	Smoke Grey (Shade No. 692 of IS: 5)	120	Refer Note 1
6	Stainless steel / Galvanized items	No paint										
7	Internal surface coating for ECW Tank	Blast cleaning to Sa2½ with surface profile 35-50 microns	Epoxy Zinc rich primer to IS 14589 Gr.II,% VS = 35 Min	2 (35 microns per coat)	-----	-----	-----	Epoxy based Polyamide cured finish paint	2 (65 microns per coat)	Smoke Grey Shade No 692 of IS 5	200	

Note 1 - Smoke grey shade for Carbon Steel ; White shade for Alloy Steel Clamps.

2 - For components other than CLH coming in H&S PGMAs shall be painted as per Sl.No:5 above. Plates, Pipes & Tubing Cut to size at site : Shall follow 2 coats of 60 microns of Red oxide Zinc Phosphate Primer (Alkyd Base) to IS 12744 .

3 - TANKS : All are atmospheric tanks. (i) CW STORAGE TANK, (ii) IMPURE CONDENSATE TANK (iii) FLASH TANK & (iv) FLASH TANK & DRAIN TANK

PREPARED BY : VIVEKANANDA YELLU, DM/QA	APPROVED BY: C VAITHIANATHAN , AGM/QA	For Customer use

Executive Director
Thermal Projects Construction
TSGENCO, Vidyut Soudha,
Khairatabad, Hyderabad-500 082.

VOLUME : IIA

SECTION-X

PAINTING

CONTENT

VOLUME : IIA

SECTION-X

PAINTING

1.00.00 **GENERAL**

All exposed metallic surfaces subject to corrosion shall be protected by shop application of suitable coatings. Surfaces not easily accessible after shop assembly shall be treated before-hand and protected for life of the equipment. Surfaces to be finish painted after installation shall be shop painted with at least two (2) coats of primer. Steel surfaces, which are not to be painted, shall be coated with suitable rust preventive compound subject to the approval of the Owner.

All paints shall be used in accordance with the manufacturer's instructions. No thinners or other substance shall be added to the coating material without the approval of the Engineer. The quality and vendor of the paints shall require approval of the Owner.

All paints, when applied in a normal full coat, shall be free from runs, sags, wrinkles, patchiness, brush marks or other defects.

All primers shall be well marked into the surface, particularly in areas where pitting is evident, and the first priming coat shall be applied as soon as possible after cleaning, within four hours maximum. The paint shall be applied by brush, roller or airless spray, according to the manufacturer's instructions. Spray painting shall be carried out by operators trained and thoroughly experienced in the use of the equipment. If the drying interval between successive coats, which should not exceed one week, has been so long as to endanger the adhesion of the following coat, the paint already applied shall be lightly rubbed down with fine abrasive paper before putting on the next coat.

Paint spraying on large surfaces shall not normally be done indoors, except with the approval of the Engineer. Spray guns shall not be used outdoors in windy weather or near unprotected surfaces of a contrasting colour and under no circumstances shall spray guns be used where spray may be carried into or onto exposed electrical equipment.

Paint containers shall not be opened until required and the paint shall be mechanically mixed thoroughly before use, and agitated occasionally during use.

Electrical equipment shall be shop finished with one or more coats of primer and two coats of high-grade oil resistant enamel. The interior of all panels' cabinets and enclosures shall be finished with gloss white enamel.

The Contractor shall furnish sufficient touch-up paint for one complete finish coat on all exterior factory surfaces of each item of equipment. The touch-up paint shall be of the same type and colour as the factory applied paint and shall

be carefully packed to avoid damage during shipment. Complete painting instructions shall be furnished.

Shop primer for steel and iron surfaces which will have a continuous operating temperature below 35°C shall be selected by the Contractor, in accordance to the relevant standard. Special high temperature primer shall be used on surface exposed to operating temperature above 35°C.

The colour scheme shall be submitted during execution of contract for approval by the Purchaser/Engineer.

2.00.00 PREPARATION

Oil and grease shall be removed from the surface by washing with a suitable detergent, rinsing with clean water, and drying.

Surfaces to be shot blasted shall be cleaned to Swedish Standard SA 2.5 or equivalent, and all dust remaining after cleaning shall be removed.

The priming coat shall be applied without delay.

3.00.00 DAMAGED PAINTWORK

Any damaged paintwork shall be made good as follows:

a) The damaged area, together with an area extending 25mm around its boundary, shall be cleaned down to bare metal.

b) A priming coat shall be immediately applied, followed by a full paint finish equal to that originally applied and extending 50mm around the perimeter of the original damage.

c) The repainted surface shall present a smooth surface. This shall be obtained by carefully chamfering the paint edges before and after priming.

4.00.00 PAINTING SYSTEMS

The requirements for the dry film thickness (DFT) of paint and the materials to be used shall be as stated below, unless otherwise specified elsewhere in this specification.

a) Surfaces Subject To Weathering

All surfaces shall have a minimum of four coats of paint made up as follows:

Primer coat	:	35 micron DFT
Tie coat	:	35 micron DFT

Finishing coat (2 Nos.) : 35 micron DFT per coat

The total minimum DFT shall be 140 micron.

b) Surfaces Inside Buildings

All surfaces shall have a minimum of three coats of paint made up as follows:

Primer coat : 35 micron DFT

Tie coat : 35 micron DFT

Finishing coat (2 Nos.) : 25 micron DFT per coat

The total minimum DFT shall be 120 micron.

For type and colour of primer & finish coat of the equipment refer to Annexure-I & II.

For detail painting on building & structural steel elements refer Volume VII of this specification.

5.00.00 COLOUR CO-ORDINATION & FINISH

5.01.00 Exterior surfaces throughout the plant shall be finished in colours and textures which will blend harmoniously together and with the surrounding landscape.

5.02.00 Interior surfaces throughout the plant shall be finished in colours and textures which will blend harmoniously together and which will be conducive to; the comfort, well-being and high productivity of the operators. Operating plant and services provided shall be colour coded for ease of identification.

5.03.00 All finishes shall be durable and as far as possible maintenance free. Finishes shall be easily cleaned.

5.04.00 Final colours and finishes shall be to the Approval of the Owner.

ANNEXURE-1: COLOUR SCHEME FOR POWER PLANT & EQUIPMENT

SL. No.	Name of Equipment	Colour	Remarks
	MAIN PLANT		
1.	Main turbine	Opaline Green Semi Glossy finish	
2.	Main generator	Opaline green Semi Glossy finish	
3.	Condenser	Deep Orange	
4.	Ejectors (Main, starting and priming and vacuum pumps	Aluminium Cladding	Individual equipment to be identified by name & no.
5.	Heat exchangers (Eg.: deaerator LP heaters, HP heaters, gland steam condenser,	Aluminium Cladding	-do-
6.	Turbine oil cooler stator water cooler etc.)	Golden Yellow	-do-
7.	Flash tanks (HP, LP Etc.	Aluminium	-do-
8.	Pumps e.g. :	X	
	i) Boiler feed pumps	Deep Orange	However, individual pump to be identified by name & no.
	i) Condensate extraction pumps	Deep Orange	
	iil) Lube oil Transfer	Light Grey	

Sl. No.	Name of the Equipment	Colour	Remarks
9.	Turbine oil system		
	i) Main oil tank	Brown Glow	Oil tanks to be identified by their name
	ii) Central oil tank	Al. paint	
	iii) Oil purifier & Polishing filter	Light Grey	
10.	Boiler steel supporting structure	Light Grey	
11.	Boiler coating	Al. Cladding	
12.	Super heaters (exposed portions, if any)	Light Admirality Grey	
13.	Metal structures	Light Grey	
14.	Hand rails	Mint. Green	
15.	Pipe supports	Light Grey	
16.	Gratings (non-galvanized)	Black	
17.	Air ducts	Light Admirality Grey	Primary air, secondary air, roar air, ignitor air, scanned air etc. with hot or cold indication to be identified by suitable legend
18.	FD Fan PA fan, scanner (booster) air fan, igniter air fan, seal air fan	Light Admirality Grey	-do-
19.	Flue gas ducts	Dove grey	
20	ID Fans	-do-	

Sl. No.	Name of the Equipment	Colour	Remarks
21.	Coal mills and associated feeders	Quaker Grey	
22.	Mill reject system	Air craft Grey Green	
	FUEL OIL HANDLING SYSTEM		
23.	LDO storage tank	Al. paint	
24.	Furnace oil storage	Covered with G.I. sheet cladding	
25.	Pumps, filters and valves	Light brown	
	INSTRUMENT AND SERVICE PLANT AIR SYSTEM		
26.	Compressors with inter and after coolers	Sky blue	Identifying legends to be used
27.	Heaters/Drivers	Dove Grey	
28.	Air receivers	Sky blue	
	MISCELLANEOUS EQUIPMENTS		
29.	Cranes	Smoke Grey	
	Mono rails & chain pulley systems	Smoke Grey	
30.	Hooks	Black X	
31,	Tanks	Galvanized mesh	X-same colour as for the relevant piping
32.	Fencing	Aluminium Paint	
33.	Lighting poles		

Sl. No.	Equipment	Colour	Remarks
34.	Chimney	Half white & signal Red	Entire outside shell shall be painted with alternate bands of signal red and white colour, (out of which top 50m shall be painted with heat and acid resistance paint and balance with water proof cement paint conforming tolS:5410)
	ELECTRICAL COMPONENTS		
35.	Main generator		
	Lub oil system	X	X-same colour as for the relevant piping
	Hydrogen system	X	-do-
36.	Diesel generator set		
	Diesel engine	Smoke grey	
	Generator	-do-	
37.	L.T. Transformers		
	Indoor	Opaline Green Semi Glossy finish	
38.	Outdoor 33 KV class transformers	-do-Light grey	
39.	Generator bus duct		
	Inside of main plant bldg.	Opaline Green Semi Glossy finish	
	Outside of main plant bldg.	- do -	
40.	Generator transformer	Light grey	
41.	Battery charger	Opaline Green: Semi Glossy finish	

Sl. No.	Name of the Equipment	Colour	Remarks
42.	Mimic flow diagram		
	400 KV	Dark Violet	
	220 KV	Golden Yellow	
	132 KV	Sky Blue Signal	
	33.0 KV	red Solmon Pink	
	11.0 KV	Canary Yellow	
	11.0 KV	Aircraft Blue	
	6.6 KV	Middle brown	
	415V		
43	Unit Control Board (Control Room)	Opaline Green Semi Glossy finish	
44.	Mimic Relay Panel for CHP	Smoke grey	
45.	Motors		
	Indoor	Smoke Grey	
	Outdoor	Light grey	
46.	LT Switchgear (Indoor)	Glossy White	
	LT Switchgear interior	Opaline Green Semi Glossy finish	
	LT switchgear exterior	-do-	
	MCC	-do-	
	D.C. Distribution board	-do-	
	L.T. busduct inside of enclosure	-do-	
	L.T. busduct outside of enclosures		
47.	6.6 KV SWGH	Opaline Green Semi Glossy finish	
	- 6.6 KV busduct inside of main plant bldg.		

Sl. No.	Name of the Equipment	Colour	Remarks
48.	Common system and Station aux. electrical panel (Control room)	Opaline Green Semi Glossy finish	
49.	Control modules and console inserts	Smoke Grey	
50.	Electronic system cabinets, computer system cabinets, BMS, ATRS, EHC system cabinet etc. (Control equipment room)	Opaline Green semi Glossy finish	
51.	All locally mounted C&I systems panel cabinets (Local) (External)	-do-	
52.	Internal colour for all panels and cabinets as listed above	Glossy White	
53.	Lighting Package Equipment		
	- Inside	Glossy White *	
	- Outside	Opline Green Semi Glossy finish	
	220 KV SWITCHYARD EQUIPMENTS		
54.	Control and Relay Panels (Control equipment room and switchyard control room)	Opaline Green Semi Glossy finish	
	ii) PLCC Cabinets	Opaline Green Semi Glossy finish	
55.	CTs, PTs, Lighting arrestors, and Marshalling boxes	Light Admirality Grey	

Sl. No.	Name of the Equipment	Colour	Remarks
56.	Porcelain parts like insulators	Dark Brown	
57.	Generator Protection (Control equipment room)	Opaline Green panel Semi Glossy finish	
58.	All other structures and equipments	Galvanised	

ANNEXURE-2 – PIPELINES

Sl. No.	Name of the Equipment	Colour	Legend	Remarks
1.	Water			
a)	Condensate	Satin Blue	MC	
i)	LP bypass attemperation	Opaline Green with semi glossy finish	LPBA	
ii)	Condensate make-up line to condenser from surge tank and from DM supply header	-do-	CCM	
b)	Boiler feed	Al. Cladding	BFD	
	HP bypass	Opaline Green	HPBA	
i)	attemperation	Semi glossy finish		
ii)	Super-heater attemperation	-do-	SHA	
III)	Reheater attemperation	-do-	RHA	
iv)	Aux. PRDS attemperation	Al. Cladding	APRD	
c)	Heater drips	-do-	HD	
d)	Drains back to cyde cycle	-do-	D	
e)	Drains to waste	-do-	W	
f)	Cooling/Circulating			
	- Pump Inlet	Phiroza Blue	CW	
	- Pump Outlet	Sky Blue		
g)	Aux. Clarified water			
	- Pump Inlet	Phiroza Sky Blue	ACW	
	- Pump Outlet	Sky Blue		

Sl. No.	Name of the Equipment	Colour	Legend	Remarks
h)	Demineralised water (cooling purposes)	Smoke Grey	DMCW	
i)	Drinking water	G.I. Line	PW	
j)	Blowdown	Al. Cladding	BD	
k)	Ash water piping	HP-Green	ASH-HP	
	(both HP & LP system)	LP-Sky Blue	ASH-LP	
2.	Steam			
a)	Main	Aluminium*	MS	*Aluminiurn is to be used only in cases where the pipes are not already clad with aluminium sheets.
b)	Auxiliary	-do-	AS 1EX	
c)	Bled (extraction)	-do--	2 EX	
d)	Hot reheat	-do-	HR	
e)	Cold reheat	-do-	CR	
f)	HP Bypass	-do-	HPB	
g)	LP Bypass	-do-	LPB	
h)	Exhaust/vent (open to atmosphere) and safety valve	Al. Paint	V/SVE	Hazard mark may be given
3.	Air			
a)	Instrument	Dark Blue		
b)	Service/ Plant	Light Blue		
c)	Vacuum			

Sl. No.	Name of the Equipment	Colour Legend		Remarks
4.	Air-steam Mixture			* Aluminium is to be used only in cases where the pipes are not already clad with aluminium sheets
a)	From turbine glands to gland steam condenser	Aluminium		
b)	From Condenser to ejectors	-do-		
c)	From Heater Shells to Condenser	Aluminium		
5.Gas				
a)	Hydrogen	Signal Red	H_2	
b)	Chlorine	Greenish Yellow	CL	
c)	Carbon dioxide	Black	$C0_2$	
6. Oils				
		1. Before Filter -Dark Yellow	CRO	
		2. After Filter -Light Yellow	CRO	
b)	Furnace oil	Aluminium Cladding	FO	
c)	Trip Oil	Red	TRP-0	
d)	Auxiliary Trip Oil	Red & While Bands	ATRO	
e)	Primary Oil	Greenish Yellow	PRO	
f)	Secondary Oil	Blue	SERO	
g)	Auxiliary Secondary oil	Red & Blue Bands	Aux. SE-0	
h)	Transformer oil	Smoke Grey	TRO	
7.	Pulverized fuel	Grey	PF	
8.	Fire Installation	Fire red	FIRE	
a)	Control Fluid			

Sl.No.	Name of the Equipment	Colour	Legend	Remarks
9.	Chemical Feed			
a)	HP dosing to boiler (Phosphate)	Light Grey	HPDO	
b)	LP dosing to Condensate (Hydrazine)	S.S. Tube (No Paint)	LPDO	

GUIDE LINES FOR HEAT TREATMENT

IMPORTANT NOTE

THIS GUIDELINES FOR HEAT TREATMENT PROVIDES BROAD BASED GUIDELINES FOR CARRYING OUT HEAT TREATMENT WORKS AT SITES. HOWEVER, SITES SHALL ENSURE ADHERENCE TO THE PRIMARY DOCUMENTS LIKE CONTRACT DRAWINGS, FIELD WELDING SCHEDULES, WELDING PROCEDURE SPECIFICATIONS, PLANT / CORPORATE STANDARDS, STATUTORY DOCUMENTS, CONTRACTUAL OBLIGATIONS, AS APPILCABLE AND SPECIAL INSTRUCTIONS, IF ANY, ISSUED BY RESPECTIVE MANUFACTURING UNITS SPECIFIC TO THE PROJECTS.

Table of Contents

CHAPTER-1
HEAT TREATMENT PROCEDURE - BOILER AND AUXILIARIES

1.0 SCOPE:

1.1 This procedure provides information, method and control for Pre-Heat, Post Heat and Post Weld Heat Treatment (PWHT) of welds of boiler and piping components at sites.

2.0 DOCUMENTS:

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

- ASME Sec I & Sec IX
- ASME B31.1
- Indian Boiler Regulations
- AWS D1.1
- BHEL Welding Manual (AA/CQ/GL/011/ Part I-WM – Latest)

2.2 The following are to be referred as Primary Documents:

- Contract drawings
- Field Welding Schedule or equivalent
- Plant / Corporate standards, wherever supplied
- Welding procedure specification
- Contractual obligations, if any

2.2.1 Where parameter for Pre-Heat, Post Heat and PWHT are not available in the primary documents, reference may be made to this procedure.

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

3.0 PROCEDURE:

3.1 **Preheating & Post heating**:

3.1.1 Prior to start of preheating, ensure that surfaces are clean and free from grease, oil and dirt. Preheating temperature shall be maintained as per applicable WPS. Preheating shall be checked and recorded, using thermal chalks/ crayons or pyrometers in case of tubes other than T91/T92/T23. For all other components including T91/T92/T23 tube joints, the preheat temperature shall be ensured by using a calibrated chart recorder and two calibrated thermocouples fixed at 0° and 180° positions on both sides of the joint. Preheating shall be checked at a distance of 1.5 times the part thickness or 75mm (whichever is greater) from weld end. The thermocouple shall be fixed using the capacitor discharge welding machine. The preheating arrangements shall be inspected and approved by site engineer.

3.1.1.1 Bunching of tubes for Preheating:

Where a bunch of closely placed tube welds (e.g. Super Heater / Reheater Coils) requires to be preheated, the same may be grouped together as if they form a single component. The maximum number of tubes bunched together in such cases shall be limited to 12. Each joint

within the bunch shall have at least one thermocouple fixed near the joint for preheat monitoring.

3.1.2 When parts of two different thicknesses are welded together, the preheating requirements of the thicker part shall govern.

3.1.3 When parts of two different P numbers are joined together, the material requiring higher preheat shall govern (please refer Tables A2.1 to A2.7 of Welding Manual, AA/CQ/GL/011/ PART I-WM – Latest, for P numbers).

3.1.4 In case of any power interruption during welding, the joint shall be wrapped with dry thermal insulating blankets to ensure slow and uniform cooling. **Requirement of uninterrupted power supply shall be ensured for materials like Gr.91, 92 & 23 and BS EN 10025**

3.1.5 Preheating & Post Heating Methods:

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

a) Electrical resistance heating
b) Induction heating
c) LPG burners

3.1.5.2 Preheating/post heating using cutting/ heating torches with oxy-acetylene flame is not permitted.

3.1.6 In addition, the following requirements shall also be followed:

3.1.6.1 Alternate burner arrangements shall be made for preheating/post heating during power failure to maintain the required temperature.

3.1.6.2 Two additional spare thermocouples shall be fixed for emergency use.

3.1.6.3 Preheating/Post heating shall be done locally BY heating a circumferential band covering the parent material away from the weld groove by induction or electrical resistance heating. The heating element (Coil/Finger/Ceramic Pad) placed on the heating band shall be closely packed without any gaps between the element. The area shall be free of grease, oil etc. prior to preheating/post heating.

3.2 Post Weld Heat Treatment (PWHT):

3.2.1 PWHT shall be done by locally heating a circumferential band covering the entire weld and adjacent area of base metal, by induction or electrical resistance heating. The heating element (coil/ finger element/ pad) placed on the heating band shall be closely packed without any gaps between the elements. The area shall be free of grease, oil etc. prior to PWHT.

3.2.1.1 Unless otherwise specified in the FWS/WPS, the PWHT parameters shall be as per the Tables 1.1, 1.2, 1.3, 1.4.

3.2.2 **Heating and Insulation band for PWHT:**

3.2.2.1 When heat treating butt joints, width of the circumferential heating band on either side of the weld must be at least 3 times the width of the widest part of the weld groove; but not less than twice the thickness of the thicker part being welded. When heat treating nozzles and attachment welds, the width of the heating band beyond the welding to be heat treated on either side of weld shall be at least 3 times the base material thickness. The heating band shall extend axially around the entire vessel. Width of the insulation band on either side shall be at least twice the width of the heating band.

3.2.2.2 In case of fin welded panels where circumferential winding of the coil is not possible heating elements shall be placed on both sides of the panels

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

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

3.2.5 In case of interruption during PWHT, the following actions shall be taken depending on the stage during which interruption has occurred.

1) During heating cycle

Repeat the whole operation from beginning.

2) During soaking

Heat treat subsequently for balance soaking. If the balance soaking time required is less than 15 minutes, soaking time shall be maintained for 15 minutes minimum.

3) During cooling (above 300 °C).

If the Rate of Cooling (ROC) during interruption meets the specified rate, cool subsequently at the required rate. Otherwise, reheat to the soaking temperature, hold for 15 minutes and then cool at the specified rate.

3.2.6 **Fixing of thermocouple (TC) during preheating, post heating and PWHT:**

3.2.6.1 Thermocouples shall be fixed on the job using capacitor discharge welding method. Thermocouple leads shall be attached within 6 mm of each other. A Welding Procedure Specification shall be prepared, describing the low-energy capacitor discharge equipment, the combination of materials to be joined, and the technique of application. No preheating is required. Also Qualification of the welding procedure is not required. The energy output of the welding process shall be limited to 125 W-sec. After temporary attachments are removed, the areas shall be examined by LPI.

Following are the equipment / facilities for heating cycles.

(1) Thermo couples: Ni-Cr / Ni-Al of 0.5 mm gauge size (K-Type).

(2) Temperature Recorders: 6 Points / 12 Points/ 24 Points.

3.2.6.2 Following are guidelines regarding number and placement of thermocouples:

- Minimum of two thermocouples shall be placed for each joint, 180° apart.
- Thermocouples shall be located at a distance of approximately 1.5 times the parent metal thickness from the weld centre.
- Additionally, one point of the temperature recorder shall be used for recording ambient temperature.
- For placement of thermocouples on P91/P92/F91/F92/C12A Figure 1.1 shall be referred for preheating and Figure 1.2 shall be referred for PWHT.

3.2.6.3 Thermocouple leads shall be suitably insulated to protect the ends from direct radiation from heating elements.

3.2.6.4 The temperature variation between any two thermocouples shall be within 50°C for temperature above 300°C during heating and cooling.

3.2.7 **Bunching of tubes for PWHT:**

3.2.7.1 Where a bunch of closely placed tube welds (e.g. Super Heater / Reheater Coils) require to be Post weld heat treated, the same may be grouped together as if they form a single component. The maximum number of tubes bunched together in such cases shall be limited to 12. Each joint within the bunch shall have at least one thermocouple fixed near the joint for PWHT temperature monitoring.

3.2.8 **Soaking Time:**

3.2.8.1 Unless otherwise specified in the FWS/WPS, the soaking time shall be calculated as 2.5 minutes per mm of thickness with 30 minutes minimum for tube welds and 60 minutes minimum for other welds. For P1 material, the soaking time shall be calculated as 2.5 minutes per mm of thickness upto 50mm with an additional 15 minutes for every 25mm thickness above 50mm.

3.2.8.2 The following guidelines shall be used to determine the thickness and subsequent selection of the soaking time of PWHT:

(a) For full penetration butt welds, the nominal thickness is the thinner of the parts being joined.

(b) For full penetration corner welds, the nominal thickness is the depth of the weld.

(c) For partial penetration groove and material repair welds, the nominal thickness is the depth of the weld. The total depth of partial or full penetration groove welds made from both sides shall be taken as the sum of the depth of both sides at a given location.

(d) For fillet welds, the nominal thickness is the weld throat. When a fillet weld is used in conjunction with a groove weld, the nominal thickness is the total of groove depth and fillet throat thickness.

3.2.8.3 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.

3.2.9 **Heating and Cooling Rates:**

3.2.9.1 Wherever not specified, the heating rate above 300°C and cooling rate after soaking upto 300°C shall be as follows: This is applicable for all materials except Gr.91/Gr.92 materials for which Cl. 3.2.11.3 shall be referred.

Thickness of Material	**Maximum Heating Rate Above 300°C**	**Maximum Cooling Rate Upto 300°C**
≤ 25 mm	220°C/hour	220°C/hour
> 25 ≤ 50 mm	110°C/hour	110°C/hour
> 50 ≤ 75 mm	75°C/hour	75°C/hour
> 75mm	55°C/hour	55°C/hour

3.2.10 **PWHT Job Card:**

3.2.10.1 Prior to start of PWHT operations, a job card shall be prepared including details of weld reference, soaking time, soaking temperature, maximum rates of heating and cooling, temperature recorder details and date of PWHT as per Annexure I of this manual except Gr.91/Gr.92/Gr.23 materials. For P91/P92/F91/F92/C12A/T91/T92/T23 materials Annexures II, III, IV in Chapter A1 of Welding Manual - AA/CQ/GL/011/ PART I-WM – Latest, as applicable, shall be referred.

3.2.10.2 Obtain the clearance for post weld heat treatment cycle from the site engineer.

3.2.10.3 On completion of PWHT, the actual parameters shall be recorded on the job card.

3.2.10.4 A chart number shall be given to each chart and attached to the job card.

3.2.11 **Heat Treatment of P91/P92/F91/F92/C12A welds:**

3.2.11.1 A minimum of four thermocouples shall be placed such that at least two are on the weld and the other two on the base material on either side of the weld within the heating band, 180° apart, at a distance of 50mm (approximately) from the center of the weld joint as per Figure 1.2. Two standby thermocouples shall also be provided on the weld (to be used in case of any failure of the thermocouple).

3.2.11.2 The PWHT temperature shall be 740-770°C and the soaking time shall be 2.5 minutes per mm of weld thickness, subject to a minimum of one hour. All records shall be reviewed by site Engineer prior to PWHT clearance. Heating shall be done by Induction heating only. However for thickness upto 32 mm, Resistance heating may also be used.

3.2.11.3 The rate of heating / cooling (above 300 ° C):-

Thickness up to 50 mm - 110°C / hour (max)

Thickness 50 to 75mm - 75°C / hour (max)

Thickness above 75mm - 55°C / hour (max)

3.2.11.4 Welding and PWHT shall be monitored every one hour by site engineer. Job card for PWHT shall be maintained as per Annexure II, Chapter A1 of Welding Manual - AA/CQ/GL/011/ PART I-WM – Latest.

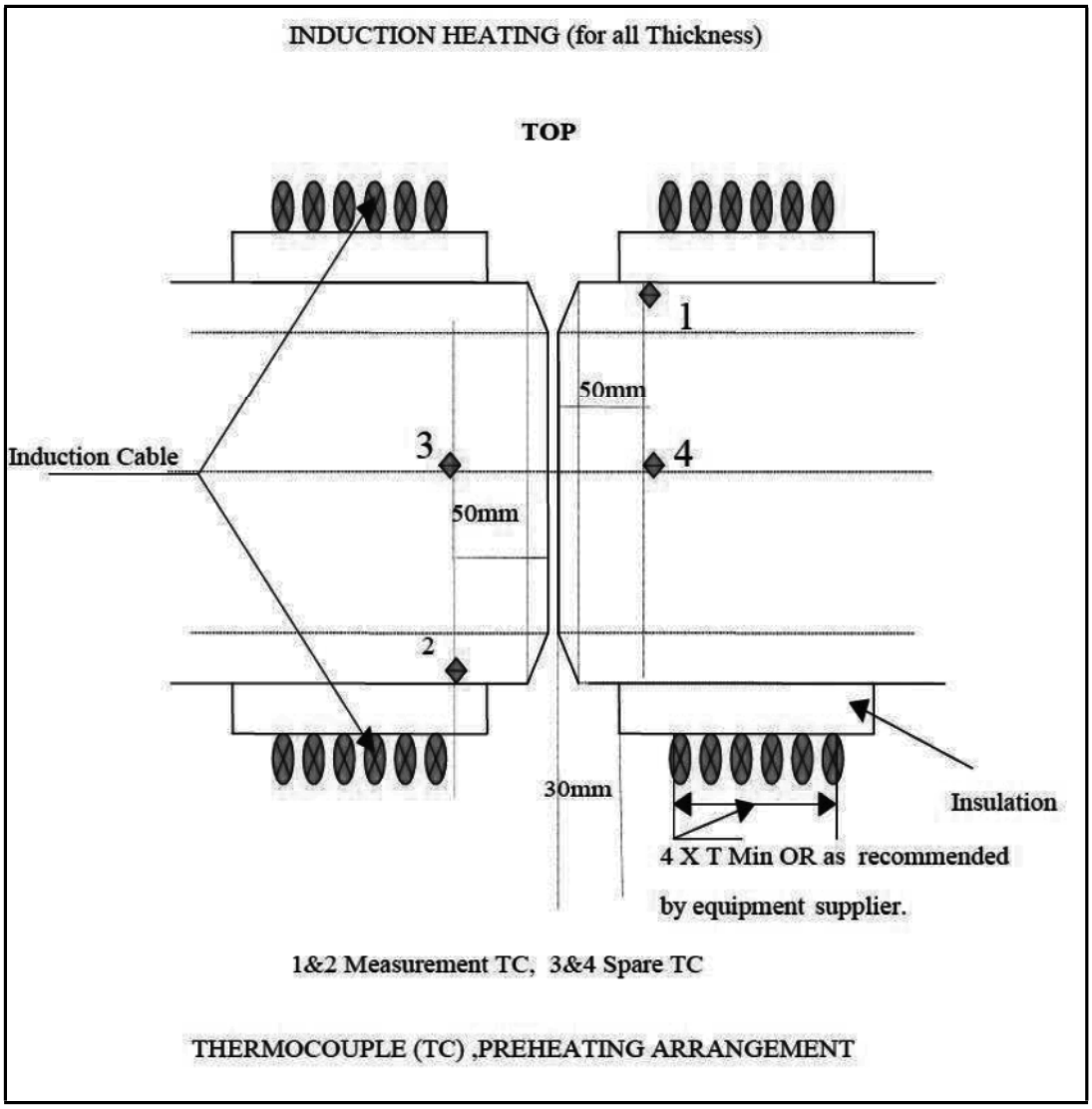


Figure 1.1: Placement of Thermocouples on P91/P92/F91/F92/C12A materials for Preheating

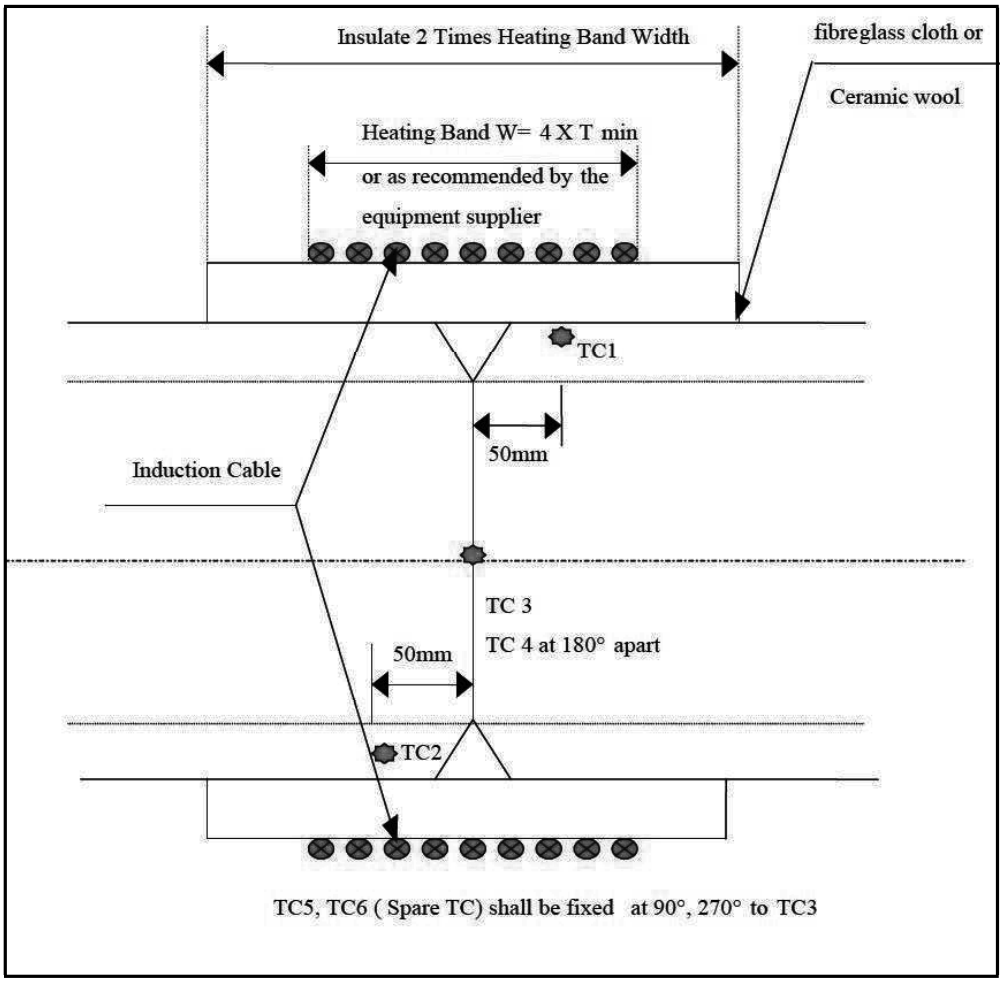


Figure 1.2: Placement of Thermocouples on P91/P92/F91/F92/C12A materials for PWHT

3.2.12 **Heat Treatment of T91/T92/T23 welds:**

3.2.12.1 Heat treatment controls of T91/T92 welds shall be as detailed in Cl. 3.2.1 to Cl.3.2.10 of this Manual.

3.2.12.2 Figure 1.2 & 1.3 of this manual shall be referred for Resistance heating coil arrangement for Preheating and PWHT of T91/T92 tube assembly.

3.2.12.3 The PWHT temperature shall be 730-760°C and the soaking time shall be 2.5 minutes per mm of weld thickness, subject to a minimum of 30minutes. All records shall be reviewed by site Engineer prior to PWHT clearance.

3.2.12.4 The rate of heating / cooling (above 300 ° C) for T91/T92 welds shall not exceed 140°C/hour.

3.2.12.5 Heat treatment controls of T23 welds shall be as detailed in Chapter B4 of Welding Manual - AA/CQ/GL/011/ PART I-WM – Latest.

3.3 **Heat Treatment of Components /Systems other than Boiler and Piping:**

3.3.1 Preheating, post heating and PWHT methodologies and parameters shall be as recommended by the concerned equipment suppliers.

3.4 **Heat Treatment Operator Requirements:**

The operator for the Heat Treatment shall be a qualified technician and shall be conversant in the operation & maintenance of heat treatment machines & process. He shall be trained by the concerned Site Engineer in order to operate and maintain the equipment and carry out the process properly.

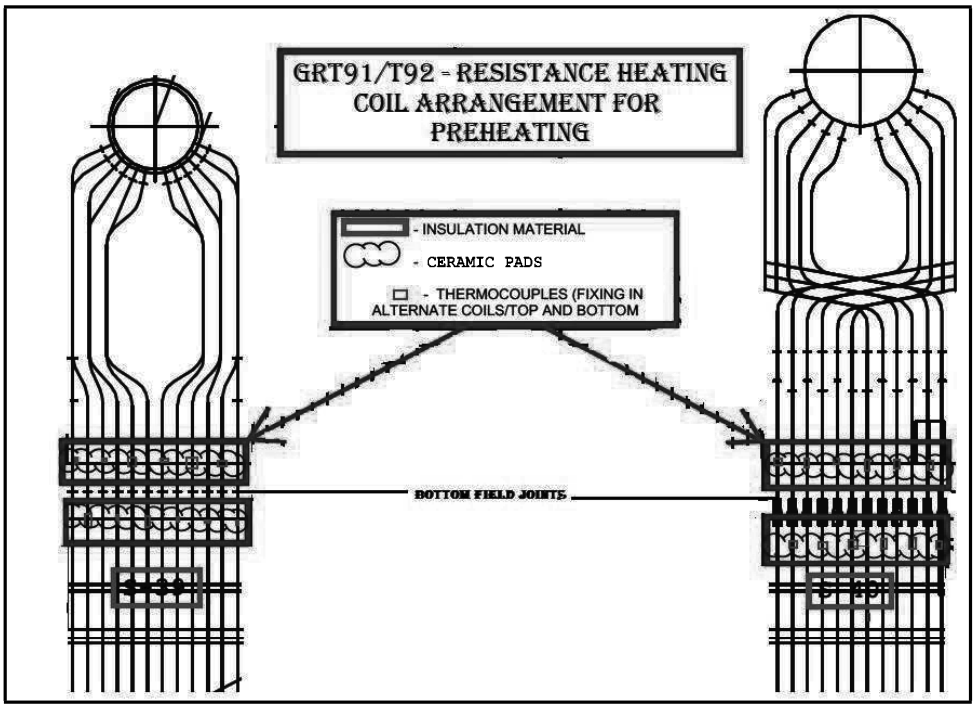


Figure 1.3: Resistance heating Coil arrangement for Preheating of T91/T92 tube assembly

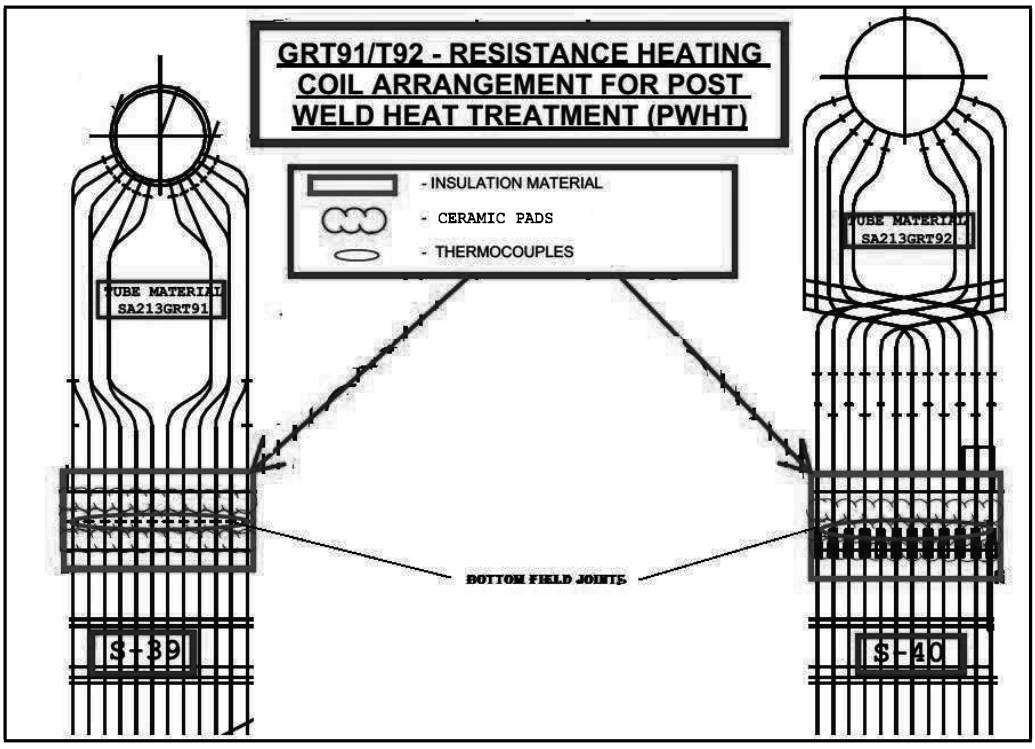


Figure 1.4: Resistance heating Coil arrangement for PWHT of T91/T92 tube assembly

3.5 **List of Tables:**

- Table-1.1: Weld preheat and PWHT for tubes and pipes outside diameter $\leq$ 102 mm.
- Table-1.2: Weld preheat and PWHT for Boiler Header welds.
- Table-1.3: Weld preheat and PWHT for pipes outside diameter > 102 mm.
- Table-1.4: Pre-heat and PWHT for Non-Pressure Parts including Structural.

4.0 RECORDS:

Relevant records like Job card and HT Charts shall be maintained by the Site Engineer till the closure of the project. The records may be handed over to the customer at the time of project closure if required by the contract

ANNEXURE I: PWHT JOB CARD

POST WELD HEAT TREATMENT (PWHT) JOB CARD

Project: _____

Card No. : _____ 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. Chart speed: _____ mm / hour

NDE Cleared on : _____ 5. Calibration Due on : _____

Report No. : _____

Thermocouple Locations :

Minimum 2

Distance of TC from the weld centre =

Heating Band =

Insulation Band =

Date of PWHT Chart No. : _____

Start Time : _____ End Time :

	Required	Actual		
Rate of Heating (Max) °C/h				
Soaking Temperature °C				
Soaking Time (Minutes)				
Rate of cooling (Max)° C				

Ambient temperature recorded on the PWHT Chart: _____

TABLE – 1.1
WELD PRE HEAT AND PWHT FOR TUBES & PIPES
OUTSIDE DIAMETER ≤ 102 mm
(Applicable for Butt Welds and Socket Welds)

P. No. of Material	Thickness (mm)	Preheat (°C)	PWHT (°C)
P1 Gr 1	≤ 19	Nil	Nil
P1 Gr 2 (C ≤0.25%)	≤ 19	Nil	Nil
P1 Gr 2 (C > 0.25%)	≤ 9	Nil	Nil
	> 9	Nil	595-625
P3 Gr 1	≤ 13	Nil	Nil
P3 Gr 2	> 13	100 (Note 1)	620 - 650
P4 Gr 1	≤ 13	150	Nil
	> 13	150	650 - 670
P5 A Gr 1	≤ 8	150	Nil
	> 8	150	680 -710
P15 E Gr 1 (Gr. 91 & Gr.92)	All	220	730 - 760
SA 213 T23	All	220	730 - 760
P8	All	Nil	Nil

Note 1: Pre-heating is necessary for t >16mm.

TABLE – 1.2
WELD PREHEAT AND PWHT FOR BOILER HEADER WELDS
(Applicable For Welding of Header to Header Joints)

P. No. of Header Material	Thickness (mm)	Preheat °C	Post Heating °C	PWHT °C
P1Gr 1	$t \leq 19$	Nil	Nil	Nil
	$19 < t \leq 25$	Nil	Nil	595 - 625
	$25 < t \leq 75$	100	Nil	595 - 625
	$t > 75$	150	Nil	595 - 625
P1Gr 2	$t \leq 19$	Nil	Nil	620 – 635
	$t > 19$	150	150 for 2 hours	620 – 635
P4 Gr 1	All	150	Nil	650 - 670
P5 A	All	150	250 for 2 hours	680 - 710
P15E Gr1 (Gr 91 & Gr 92)	All	220	Nil	740 - 770
P15 E Gr1 + P5 A	All	220	Nil	730-760
T23	All	220	250 for 1 hour	730 - 760

TABLE – 1.3
WELD PREHEAT AND PWHT FOR PIPES
OUTSIDE DIAMETER >102 MM

P No. of Material	Thickness (mm)	Butt Welds		Stub and Attachment welds				Post heat °C
		Preheat °C	PWHT °C	Throat ≤ 19 mm		Throat > 19 mm		
				Preheat °C	PWHT °C	Preheat °C	PWHT °C	
P1 Gr 1	≤ 19	Nil	Nil	Nil	Nil	Nil	595 - 625	Nil
	>19≤25	Nil	595 - 625	Nil	595 - 625	Nil	595 - 625	Nil
	>25≤75	150	595 - 625	150	595 - 625	150	595 - 625	Nil
	>75	150	595 - 625	150	595- 625	150	595 - 625	Nil
P1 Gr 2	≤9	Nil	Nil	Nil	Nil	Nil	595 - 625	Nil
	>9≤19	Nil	595 - 625	Nil	595 - 625	Nil	595 - 625	Nil
	>19	150	595 - 625	150	595 - 625	150	595 - 625	150 for 2 hrs
P4 Gr 1	All	150	640-670	150	640- 670	150	640- 670	Nil
P5 A	All	150	680 - 710	150	680- 710	150	680- 710	250 for 2 hrs
P15 E Gr1	All	220	740-770	220	740- 770	220	740- 770	NA
P15 E Gr1 + P5 A	All	220	730-760	220	730- 760	220	730- 760	NA

For butt welds of different P group combinations, PWHT temperature may be as follows:

P1 + P3 - 620 to 650°C

P1 + P4 - 640 to 670°C

P4 + P5A- 680 to 710°C

(For other P Group combinations, refer to Manufacturing unit)

TABLE – 1.4

PREHEAT AND PWHT FOR NON PRESSURE PARTS INCLUDING STRUCTURALS

P. No. of Material / Material Specification	Gas Cutting		Welding		
	Thickness (mm)	Preheat °C	Thickness (mm)	Preheat (°C)	PWHT (°C)
P1 / IS 2062 E250 BR, E350 BR,E350C	> 50	Nil 100	> 63	Nil 100 150	595-625 1.0 All butt welds > 50 mm thick 2.0 For Ceiling girders if thickness > 50 mm 3.0 No HT required for web to flange fillet welds.
BS EN 10025 Gr 420 N (Ceiling Girder)	All	220	All	220	620 – 650
P3 Gr 1 and Gr 2	T>25	150	All	150	620-650 a) All butt welds in tension member b) All butt welds of fabricated components > 16mm thick and fillet welds with throat thickness > 13 mm
P4 Gr 1	All	150	All	150	650-680 a) All butt welds in tension member b) All butt welds of fabricated components > 16mm thick and fillet welds with throat thickness > 13 mm
P5A Gr 1	All	150	All	150	680-710 All welds (Note 2)
P15E Gr.1	Not permitted	Not permitted	All	220	740-770

NOTE:

1. All gas cut edges shall be ground for a width of 3mm to remove the HAZ.
2. All welds of P5A material shall be post heated at 250°C for 2 hours immediately after welding.

.

GUIDELINES
FOR
WELDING

IMPORTANT NOTE

THIS GUIDELINES FOR WELDING PROVIDES BROAD BASED GUIDELINES FOR CARRYING OUT WELDING WORK AT SITES. HOWEVER, SITES SHALL ENSURE ADHERENCE TO THE PRIMARY DOCUMENTS LIKE CONTRACT DRAWINGS, FIELD WELDING SCHEDULES, WELDING PROCEDURE SPECIFICATIONS, PLANT / CORPORATE STANDARDS, STATUTORY DOCUMENTS, CONTRACTUAL OBLIGATIONS,AS APPILCABLE ANDSPECIAL INSTRUCTIONS, IF ANY, ISSUED BY RESPECTIVE MANUFACTURING UNITS SPECIFIC TO THE PROJECTS.

INDEX

CHAPTER–A1
WELDING - GENERAL

A1: WELDING-GENERAL

1.0 SCOPE:

1.1 This manual deals with activities and information related to welding at site. Where specific documents are supplied by the Manufacturing Units (MUs)/Engineering Centers (ECs), the same shall be adopted.

2.0 DOCUMENTS REFERRED:

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

1. AWS D1.1
2. AWS D1.6
3. ASME sections I, II (A&C), V & IX
4. ASME B31.1
5. IBR
6. BHEL Manufacturing Units/Engineering Centers Standards & practices

3.0 PROCEDURE:

3.1 The following documents shall be referred as primary documents

1. Contract drawings
2. Field Welding Schedule or equivalent
3. Plant / Corporate standards, wherever applicable
4. Statutory documents
5. Welding Procedure Specifications
6. Contractual obligations, if any.

4.0 WELDER QUALIFICATION:

4.1 Ensure, personnel qualified as per statutory requirements are engaged, where required.

4.2 For welding not under the purview of statutory requirements, qualification of welders shall be as in this manual.

4.3 Monitor performance of qualified butt welders as in this manual.

4.4 Ensure selection, procurement, storage, drying & issue of welding consumables, as detailed in this manual.

4.5 List of approved vendors of general purpose welding electrodes as provided by BHEL-Tiruchy Unit shall be used for selection of brands at sites. Alternatively specific contractual requirements, if any may be followed.

4.6 Where Tiruchy list does not cover site requirements, such specific cases may be referred toconcerned unit and Head (Quality) of the region.

4.7 Welding in-charge shall assign a unique identification for all the butt welds coming under the purview of statutory regulations. Such identification may be traceable through documents like drawings, sketches etc.

4.8 A welding "job card" incorporating the welding parameters and heat treatment requirements is recommended to be issued for all critical welds like pressure part welds, piping welds and

ceiling girder welds. The formats of the job card are enclosed for illustration in Annexure I, II, III and IV.

5.0 SELECTION OF ARGON GAS FOR GTAW:

5.1 USE OF ARGON GAS AT SITES:

In the welding process, Argon is used for **SHIELDING** and **PURGING (BACKING)** purpose. The welding process when exposed to air, most metals exhibit a strong tendency to combine with Oxygen, and to lesser extent with Nitrogen, especially when in the molten condition. The rate of oxide formation will vary with different metals, but even a thin film of oxide on the surface of metals to be welded can lead to difficulties. For the most part, the oxides are relatively weak, brittle materials that in no way resemble the metal from which they are formed. A layer of oxide can easily prevent the joining of two pieces by welding.

Argon is a shielding gas used in Gas Tungsten Arc Welding (GTAW). It is also used for purging (backing) during the root welding of Gr.91/Gr.92/Stainless steel materials. Argon protects welds against oxidation as well as reduces fume emissions during welding. The compressed argon is supplied in cylinders. The cylinder used for argon will have the body colour of BLUE without band, size of 25 cm dia. &1.5 m length, capacity of 6.2 m^3 and pressure of 137 Kg/Cm^2 when fully charged at 15°C (approximately).

5.2 PURITY LEVEL OF ARGON

As per IS 5760: 1998 there are 3 grades of argon, namely:

- **Grade 1:** Ultra high purity argon for use in electronics and allied industries and indirect reading vacuum spectrograph.
- **Grade 2:** High purity argon for use in lamp and allied industries.
- **Grade 3:** Commercial grade argon for use in welding industry and for other metallurgical operations.

Accordingly the argon shall comply with the requirements given below:

Sl. No.	CHARACTERISTIC	REQUIREMENT		
		Grade 1	Grade 2	Grade 3
i.	Oxygen, ppm, Max.	0.5	5.0	10.0
ii.	Nitrogen, ppm, Max.	2.0	10.0	300
iii.	Hydrogen, ppm, Max.	1.0	2.0	5.0
iv.	Water vapors, ppm. Max.	0.5	4.0	7.0
v.	Carbon dioxide, ppm, Max.	0.5	0.5	3.0
vi.	Carbon monoxide, ppm, Max.	0.5	0.5	2.0
vii.	Hydrocarbons, ppm, Max.	0.2	0.5	-

5.3 PURCHASE SPECIFICATION FOR ARGON:

Argon gas as per Grade 2 of IS-5760: 1998 with Argon purity level of min. 99.99%. The supply should accompany Test Certificate for the batch indicating compliance to the above requirements.

5.4 HEAT TREATMENT:

5.4.1 Preheat, inter pass, post heat and Post Weld Heat Treatment (PWHT) requirements shall be as per applicable documents; where these are not supplied, reference may be made to Welding / Heat Treatment Manual.

5.4.2 Prior to PWHT operation, a "job card" containing material specification, weld reference, size, rate of heating, soaking temperature, soaking time and rate of cooling shall be prepared referring to applicable documents, and issued.

5.4.3 The PWHT chart shall contain the chart number,Weld Joint No., Temperature recorder details (like Sl. No. make, range, chart speed), date of PWHT, start and end time of operation.

5.4.4 The chart shall be evaluated and results recorded on the PWHT job card. Refer Heat Treatment Manual (Document No. AA/CQ/GL/011/ Part II-HTM- Latest) for details.

6.0 EQUIPMENT & INSTRUMENTS:

6.1 Equipment/accessories used shall be assessed for fitness prior to use.

6.2 Use calibrated thermocouples, temperature measuring instruments and recorders.

6.3 Preheating shall be checked and ensured using temperature indicating crayons.

7.0 INSPECTION:

7.1 Inspection of welding shall be done as per Chapter A5 of this manual and records maintained as appropriate.

7.2 Weld log containing the following information shall be prepared for all completed systems.

Project / Unit reference
Drawing No.
Weld Joint No.
FWS/ Equivalent
Material specification
Consumable used
Welder code
Date of welding
NDE report No. and results (including repair details)
PWHT Chart No. and results
Remarks, if any.

8.0 SAFETY:

8.1 Safe access to weld area shall be provided.

8.2 Adequate protection shall be provided against wind and rain water entry during welding.

9.0 RECORDS:

9.1 All records, as required, shall be maintained by welding in-chargeand handed over to the appropriate authority at the end of the project closure.

Annexure – I: Welding Job Card

Welding Job Card

Project	:		
Unit No.	:	Area: Boiler/TG/PCP:	
Job Card No.	:	Date	:
FWS Number	:		
Joint No.	:		
Drawing No.	:		
System Description	:		
Size (Dia. x thick)	:		
Material Specification	:		
Consumable used	:		
Welder No.(s)	:		
Date of welding	:		
Filler wire Specification	:		
Electrode Specification	:		
Preheat temperature	:		
Inter pass temperature	:		
Post Heat temperature	:		
PWHT temperature	:		

Welding engineer

Filler wire/Electrode consumption

SMAW	ϕ 2.5 mm	:
	ϕ 3.15 mm	:
	ϕ 4.0 mm	:
Date of LPI for RG Plug		:
Remarks		:
Date of Return		:

Annexure – II: Welding Job Card for P91/P92 Welds

JOB CARD (WELDING, HEAT TREATMENT & ND EXAMINATION) FOR P91/P92 WELDS												
Card No.:								**Date:**				
Project:				**Unit No.**				**Contractor:**				
System:								Drawing No.				
PGMA:								DU No.:			Joint No.:	
Material Specification:			+					OD (mm):			Thick(mm)	
Filler metal:	GTAW							SMAW				
Joint fit-up:	Min. WT:		Root gap:			Root mismatch:			Log sheet filled:		Y / N	
No. of T/Cs:		Location:				Distance from EP edge:				mm		
Welders' ID:						M/c No.:						
Preheat Temp.:		°C Minimum				Rate of heating:			°C per hour			
Purging flow rate:			Litres / min.			Purging time:				Minutes		
Shielding flow rate:			Litres / min. for GTAW			Distance bet. dams:				Metres		
Interpass Temp.:		° C Maximum				Rate of cooling:			°C per hour			
Holding Temp. before PWHT:		° C for min. 1 hour										
PWHT:		° C				Rate of heating / cooling:			°C per hour			
Soaking time		Minutes (2.5 minutes per mm)				Cooling to:			300° C			
Preheating started at		Hrs. on				Preheating completed at			Hrs.			
Root welding started at		Hrs.				Root welding completed at			Hrs.			
Welding started at		Hrs.				Welding completed at			Hrs.			
Interpass temp. maintained between		°C and		°C								
Holding temp. reached at		Hrs.				Holding completed at			Hrs.			
No. of T/Cs:		Location										
PWHT started at		Hrs. on		.		Soaking started at			Hrs.			
Soaking completed at		Hrs.				300°C reached at			Hrs.			
UT Equipment used:						Calibration validity:						
UT carried out on						Result : OK / Not OK						
MPI Equipment used:						Calibration validity:						
MPI carried out on						Result: OK / Not OK						
Hardness test Equipment used:						Calibration validity:						
Hardness test carried out on						Value:						
History of interruption if any, with time:												
Contractor				**BHEL**					**Customer**			

Annexure – III: Welding Job Card for T91/T92 Welds

JOB CARD (WELDING, HEAT TREATMENT & ND EXAMINATION) FOR T91/T92 WELDS									
Card No.:							**Date:**		
Project			**Unit No.**				**Contractor:**		
System:					Drawing No.				
PGMA:					DU No.:			Joint No.:	
Material Specification:		+			OD (mm):			Thick(mm)	
Filler metal:	GTAW				SMAW				
Joint fit-up:	Min. t:		Root gap:		Root mismatch:		Log sheet filled:		Y / N
No. of T/Cs:		Location :			Distance from EP edge:			mm	
Welders' ID:					M/c No.:				
Preheat Temp.:	°C Minimum				Rate of heating:		°C per hour		
Purging flow rate:		Litres / min.			Purging time:				Minutes
Shielding flow rate:		Litres / min. for GTAW			Distance bet. dams:				Metres
Interpass Temp.:	° C Maximum				Rate of cooling:		°C per hour		
PWHT:	° C				Rate of heating / cooling:		°C per hour		
Soaking time		Minutes (2.5 minutes per mm)			Cooling to:		300° C		
Preheating started at Hrs.		Hrs. on			Preheating completed at				
Root welding started at Hrs.		Hrs.			Root welding completed at				
Welding started at Hrs.		Hrs.			Welding completed at				
Interpass temp. maintained between		°C and		°C					
Holding temp. reached at		Hrs.			Holding completed at		Hrs.		
No. of T/Cs:		Location							
PWHT started at	Hrs. on		.		Soaking started at		Hrs.		
Soaking completed at		Hrs.			300°C reached at		Hrs.		
RT carried out on					Result : OK / Not OK				
Hardness test Equipment used					Calibration validity:				
Hardness test carried out on					Value:				
History of interruption if any, with time:									
Contractor			**BHEL**				**Customer**		

Annexure – IV: Welding Job Card for T23 Welds

JOB CARD (WELDING, HEAT TREATMENT & ND EXAMINATION) FOR T23 WELDS												
Card No.:								**Date:**				
Project:				**Unit No.**				**Contractor:**				
System:						Drawing No.						
PGMA:						DU No.:			Joint No.:			
Material Specification:			+			OD (mm):			Thick(mm)			
Filler metal:	GTAW					SMAW						
Joint fit-up:	Min. t:		Root gap:			Root mismatch:			Log sheet filled:	Y / N		
No. of T/Cs:		Location:				Distance from EP edge:				mm		
Welders' ID:						M/c No.:						
Preheat Temp.:	°C Minimum					Rate of heating:			°C per hour			
Purging flow rate:		Litres / min.				Purging time:				Minutes		
Shielding flow rate:		Litres / min. for GTAW				Distance bet. dams:				Metres		
Interpass Temp.:	° C Maximum					Rate of cooling:			°C per hour			
Holding Temp.:	° C for min. 1 hour. for post heating											
PWHT:	° C					Rate of heating / cooling:			°C per hour			
Soaking time		Minutes (2.5 minutes per mm)				Cooling to:			300° C			
Preheating started at		Hrs. on				Preheating completed at				Hrs.		
Root welding started at		Hrs.				Root welding completed at				Hrs.		
Welding started at		Hrs.				Welding completed at				Hrs.		
Interpass temp. maintained between		°C and		°C								
Holding temp. reached at		Hrs.				Holding completed at			Hrs.			
No. of T/Cs		Location										
PWHT started at		Hrs. on		.		Soaking started at			Hrs.			
Soaking completed at		Hrs.				300°C reached at			Hrs.			
RT carried out on						Result : OK / Not OK						
Hardness test Equipment used						Calibration validity:						
Hardness test carried out on						Value:						
						Result:	OK / Not OK					
History of interruption if any, with time:												
Contractor			**BHEL**						**Customer**			

CHAPTER–A2
BASE MATERIALS

1.0 SCOPE:

1.1. This chapter contains tabulations of chemical compositions and mechanical properties of various materials generally used at BHEL sites.

2.0 CONTENTS:

CHEMICAL COMPOSITION AND MECHANICAL PROPERTIES

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,refer the relevant Material Specification Standard. In case it is not available at site, same shall be referred to Head quality of the region.

TABLE-A2.1: PIPES (ASME)

Sl. No.	P. No. /Group No.	MaterialSpecification	Chemical Composition (%)										Mechanical Properties (Min.)		
			C	Mn	P	S	Si	Ni	Cr	Mo	V	W	T.S MPa	Y.S MPa	% E Min.
1	P 1 / 1	SA 106 Gr. B (Remarks: Carbon restricted to 0.25% Max.)	0.30 Max.	0.29-1.06	0.035 Max.	0.035 Max.	0.10 Min.	0.40 Max.	0.40 Max.	0.15 Max.	0.08 Max	-	415	240	30
2	P 1 / 2	SA 106 Gr. C (Remarks: Carbon restricted to 0.25% Max.)	0.35 Max.	0.29-1.06	0.035 Max.	0.035 Max.	0.10 Min.	0.40 Max.	0.40	0.15 Max.	-	-	485	275	30
3	P4/1	SA 335 P 11	0.15 Max	0.30–0.60	0.025	0.025	0.50–1.00	-	1.00–1.50	0.44–0.65	-	-	380	205	30
4	P 4 / 1	SA 335 P 12	0.15 Max.	0.30-0.61	0.025 Max.	0.025 Max.	0.50 Max.	-	0.80-1.25	0.44-0.65	-	-	415	220	30
5	P 5A / 1	SA 335 P 22	0.15 Max.	0.30-0.60	0.025 Max.	0.025 Max.	0.50 Max.	-	1.90-2.60	0.87-1.13	-	-	415	205	30
6	P 15E /1	SA 335 P91	0.08-0.12	0.30-0.60	0.02 Max.	0.01 Max.	0.20-0.50	0.40 Max.	8.00-9.50	0.85-1.05	0.18-0.25	-	585	415	20
7	P15E/1	SA 335 P 92	0.13 Max	0.30-0.60	0.020	0.010	0.50 max	0.40 max	8.50-9.50	0.0-	0.15-0.25	1.5-2.0	620	400	20

TABLE-A2.2: TUBES(ASME)

Sl. No.	P. No. /Group No.	MaterialSpecification	Chemical Composition (%)										Mechanical Properties (Min.)		
			C	Mn	P	S	Si	Ni	Cr	Mo	V	W	T.S MPa	Y.S MPa	% E Min.
1	P 1 / 1	SA 192	0.06-0.18	0.27-0.63	0.035 Max.	0.035 Max.	0.25 Max.	-	-	-	-	-	325	180	35
2	P 1 / 1	SA 210 Gr A1 (Remarks: Carbon restricted to 0.25% Max.)	0.27 Max.	0.93 Max.	0.035 Max.	0.035 Max.	0.10 Max.	-	-	-	-	-	415	255	30
3	P 1 / 1	SA 179	0.06-0.18	0.27-0.63	0.035 Max.	0.035 Max.	-	-	-	-	-	-	325	180	35
4	P 1 / 2	SA 210 Gr C (Remarks: Carbon restricted to 0.30% Max.)	0.35 Max.	0.29-1.06	0.035 Max.	0.035 Max.	0.10 Max.	-	-	-	-	-	485	275	30
5	P 3 / 1	SA 209 T1	0.10-0.20	0.30-0.80	0.025 Max.	0.025 Max.	0.10-0.50	-	-	0.44-0.65	-	-	380	205	30
6	P 4 / 1	SA 213 T11	0.05-0.15	0.30-0.60	0.025 Max.	0.025 Max.	0.50-1.00	-	1.00-1.50	0.44-0.65	-	-	415	205	30
7	P 4 / 1	SA 213 T12	0.05-0.15	0.30-0.61	0.025 Max.	0.025 Max.	0.50 Max.	-	0.80-1.25	0.44-0.65	-	-	415	220	30
8	P 5 A / 1	SA 213 T22	0.05-0.15	0.30-0.60	0.025 Max.	0.025 Max.	0.50 Max.	-	1.90-2.60	0.87-1.13	-	-	415	205	30

TABLE-A2.2: TUBES(ASME) (Contd…)

Sl. No.	P. No. / Group No.	Material Specification	Chemical Composition (%)										Mechanical Properties (Min.)		
			C	Mn	P	S	Si	Ni	Cr	Mo	V	W	T.S MPa	Y.S MPa	% E Min.
9	P 5 B / 1	SA 213 T5	0.15 Max.	0.30-0.60	0.025 Max.	0.025 Max.	0.50 Max.	-	4.00-6.00	0.45-0.65	-	-	415	205	30
10	P 5 B / 1	SA 213 T9	0.15 Max.	0.30-0.60	0.025 Max.	0.025 Max.	0.25-1.00	-	8.00-10.00	0.90-1.10	-	-	415	205	30
11	P 1 5 E / 1	SA 213 T91	0.07-0.14	0.30-0.60	0.02 Max.	0.01 Max.	0.20-0.50	0.40 Max.	8.00-9.50	0.85-1.05	0.18-0.25	-	585	415	20
12	P 8 / 1	SA 213 TP 304 H	0.04-0.10	2.00 Max.	0.045 Max.	0.03 Max.	1.00 Max.	8.00-11.00	18.00-20.00	-	-	-	515	205	35
13	P8/1	SA 213 TP 321H	0.04-0.10	2.00 Max.	0.045 Max.	0.03 Max.	1.00 Max.	9.00-12.00	17.00-19.00	-	-	-	515	205	35
15	P 8 / 2	SA 213 TP 347 H	0.04-0.10	2.00 Max.	0.045 Max.	0.03 Max.	1.00 Max.	9.00-13.00	17.00-19.00	-	-	-	515	205	35
15	Code case 2199	SA213 T23	0.04-0.10	0.10-0.60	0.030	0.010	0.050	--	1.90-2.60	0.05-0.30	0.20-0.30	1.45-1.75	510	400	20
16	15E/1 (Code case 2169)	SA213 T92	0.07-0.13	0.30-0.60	0.020	0.010	0.50	0.40	8.5-9.5	0.30-0.60	0.15-0.25	1.5-2.0	620	440	20
17	P8/1 (Code case 2328 - S30432)	SA 213 UNS S30432 (Super 304H)	0.07-0.13	1.00	0.040	0.010	0.30	7.5-10.5	17.0-19.0	-	-	-	590	235	35

TABLE A2.3: FORGINGS (ASME)

Sl. No.	P. No. / Group No.	Material Specification	Chemical Composition (%)										Mechanical Properties (Min.)		
			C	Mn	P	S	Si	Ni	Cr	Mo	V	W, Cb	T.S MPa	Y.S MPa	% E Min.
1	P 1 / 2	SA 105 (Remarks: Carbon restricted to 0.25% Max.)	0.35 Max.	0.60-1.05	0.035 Max.	0.04 Max.	0.1 - 0.35	0.40 Max.	0.30 Max.	0.12 Max.	0.08 Max	-	485	250	30
2	P 4 / 1	SA 182 F11 Class 3	0.10-0.20	0.30-0.80	0.04 Max.	0.04 Max.	0.50 - 1.00	-	1.00-1.50	0.44-0.65	-	-	515	310	20
3	P 4 / 1	SA 182 F 12 Class 2	0.10-0.20	0.30-0.80	0.04 Max.	0.04 Max.	0.10 - 0.60	-	0.80-1.25	0.44-0.65	-	-	485	275	20
4	P 5 A / 1	SA 182 F 22 Class 3	0.15 Max.	0.30-0.60	0.04 Max.	0.04 Max.	0.50 Max.	-	2.00-2.50	0.87-1.13	-	-	515	310	20
5	P 1 5 E / 1	SA 182 F91	0.08-0.12	0.30-0.60	0.02 Max.	0.01 Max.	0.20 - 0.50	0.40 Max.	8.00-9.50	0.85-1.05	0.18-0.25	-	620	415	20
6	P 1 5 E / 1	SA 182 F92	0.7-0.13	0.30-0.60	0.02 Max.	0.01 Max.	0.50 Max.	0.40 Max.	8.50-9.50	0.30-0.60	0.15-0.25	W:1.50-2.00; Cb: 0.04-0.09	620	440	20

TABLE A2.4: CASTINGS (ASME)

Sl. No.	P. No. /Group No.	Material Specification	Chemical Composition (%)								Mechanical Properties (Min.)		
			C	Mn	P	S	Si	Ni	Cr	Mo	MPa	MPa	% EMin.
1	P 1 / 2	SA 216 WCB (Remarks: Carbon restricted to 0.25% Max.)	0.30 Max.	1.00 Max.	0.04 Max.	0.045 Max.	0.60 Max.	0.50 Max.	0.50 Max.	0.20 Max.	485	250	22
2	P 1 / 2	SA 216 WCC	0.25 Max.	1.20 Max.	0.04 Max.	0.045 Max.	0.60 Max.	0.50 Max.	0.50 Max.	0.20 Max.	485	275	22
3	P 4 / 1	SA 217 WC6	0.20 Max.	0.50-0.80	0.04 Max.	0.045 Max.	0.60 Max.	-	1.00-1.50	0.45-0.65	485	275	20
4	P 5 A / 1	SA 217 WC 9	0.18 Max.	0.40-0.70	0.04 Max.	0.045 Max.	0.60 Max.	-	2.00-2.75	0.90-1.20	485	275	20
5	P 8 / 1	SA 351 CF 8	0.08 Max.	1.50 Max.	0.04 Max.	0.04 Max.	2.00 Max.	8.00-11.00	18.00-21.00	0.50 Max.	485	205	35
6	P 8 / 1	SA 351 CF 8M	0.08 Max.	1.50 Max.	0.04 Max.	0.04 Max.	1.50 Max.	9.00-12.00	18.00-21.00	2.00-3.00	485	205	30
7	P 8 / 1	SA 351 CF 8C	0.08 Max.	1.50 Max.	0.04 Max.	0.04 Max.	2.00 Max.	9.00-12.00	18.00-21.00	0.50 Max.	485	205	30
8	P 8 / 2	SA 351 CH 20	0.04-0.20	1.50 Max.	0.04 Max.	0.04 Max.	2.00 Max.	12.00-15.00	22.00-26.00	0.50 Max.	485	205	30
9	P15E / 1	SA 217 C12A	0.08-0.12	0.30-0.60	0.030 Max.	0.010 Max.	0.20-0.50	0.40 Max.	8.00-10.00	0.85-1.05	585	415	18

TABLE A2.5: PLATES/SHEETS

Sl. No.	P. No./ Group No.	Material Specification	Thickness mm	C	Mn	P	S	Si	Ni	Cr	Mo	V	T.S (MPa)	Y.S (MPa)	%E Min.
1	P 1 / 1	ASTM A36	20 incl.	0.25	-	0.04	0.05	0.40	-	-	-	-	400	250	20
			20-40 incl.	0.25	0.80-1.20			0.40	-	-	-	-			
			40-65 incl.	0.26	0.80-1.20			0.40	-	-	-	-			
			65-100 incl.	0.27	0.85-1.20			0.15-0.40	-	-	-	-			
			over 100	0.29	0.85-1.20			0.15-0.40	-	-	-	-			
2	P 1 / 1	SA 516 Gr 60	12.5 incl	0.21	0.55-0.98	0.035	0.035	0.13-0.45	-	-	-	-	415	220	25
			12.5-50 incl	0.23	0.79-1.30				-	-	-	-			
			50-100 incl	0.25					-	-	-	-			
			100-200 incl	0.27					-	-	-	-			
			over 200	0.27					-	-	-	-			
3	P 1 / 2	SA516 Gr70	12.5 incl	0.27	0.79-1.30	0.035	0.035	0.13-0.45	-	-	-	-	485	260	21
			12.5-50 incl	0.28					-	-	-	-			
			50-100 incl	0.3					-	-	-	-			
			100-200 incl	0.31					-	-	-	-			
			over 200	0.31					-	-	-	-			
4	P 1 / 2	SA299 Gr.A	<25	0.26	0.84-1.52	0.035	0.035	0.13-0.45	-	-	-	-	515	275	19
			>25	0.28	0.84-1.62				-	-	-	-			
5	P 1 / 2	SA515 Gr70	<25	0.31	1.30	0.035	0.035	0.13-0.45	-	-	-	-	485	260	21
			25-50 incl	0.33					-	-	-	-			
			50-100 incl	0.35					-	-	-	-			
			100-200 incl	0.35					-	-	-	-			
			>200	0.35					-	-	-	-			
6	P311	SA204 Gr A	<25 incl	0.18	0.98	0.025	0.025	0.13-0.45	-	-	0.41-0.64	-	450	255	23
			>50 incl	0.21					-	-		-			
			>100 incl	0.23					-	-		-			
			>100	0.25					-	-		-			
7	P312	SA204 Gr B	<25 incl	0.20	0.98	0.025	0.025	0.13-0.45	-	-	0.41-0.64	-	485	275	21
			>50 incl	0.23					-	-		-			
			>100 incl	0.25					-	-		-			
			>100	0.27					-	-		-			
8	P411	SA 387 Gr 12 Class 2	<125 incl	0.04-0.17	0.35-0.73	0.025	0.025	0.13-0.45	-	0.74-1.21	0.40-0.65	-	450	275	22
			>125	0.17											
9	P5N1	SA387 Gr 22 Class 2	<125 incl	0.04-0.15.	0.25-0.66	0.025	0.025	0.50.	-	1.88-2.62	0.85-1.15	-	515	310	18
			>125	0.17											
10	P15El1	SA387 Gr 91	all thickness	0.06-0.15	0.25-0.66	0.025	0.012	0.18-0.56	0.43	7.90-9.60	0.80-1.10	0.16-0.27	585	415	18

TABLE A2.5: PLATES/SHEETS (Contd...)

Sl. No.	P.No./ Group No.	Material Specification	Thickness mm	C	Mn	P	S	Si	Ni	Cr	Mo	V	T.S (MPa)	Y.S (MPa)	%E Min.
11	P811	SA240 TYPE 304	all thickness	0.07	2	0.045	0.03	0.75	8.00-10.50	17.5.-19.5.0	-		515	205	40
12	P 1 /1	ASTM A572 Gr50	<40 incl	0.23	1.35	0.04	0.05	0.4 0	-	-	-		450	345	17
			>40					0.15-0.40	-	-	-	0.01-0.1			
13	P 1 /1	IS 2062 E250 Gr.A	all thickness	0.23	1.5	0.045	0.045	0.4	-	-	-	-	410	230	23
14	P 1 /1	IS 2062 E250 Gr.BR BO	all thickness	0.22	1.5	0.045	0.045	0.4	-	-	-	-	410	230	23
15	P 1 /1	IS 2062 E250 GrC	all thickness	0.2	1.5	0.04	0.04	0.4	-	-	-	-	410	230	23
16	P 1 /1	IS 2062 E350 Gr A.BR,BO	all thickness	0.2	1.55	0.045	0.045	0.45	-	-	-	-	490	320	22
17	P 1 /1	IS 2062 E350 GrC	all thickness	0.2	1.55	0.04	0.04	0.45	-	-	-	-	490	320	22
18	P 1 /1	IS 2062 E450BR	all thickness	0.22	1.65	0.045	0.045	0.45	-	-	-	-	570	450	20
19	P 1 /1	BSEN10025 Gr 420N	all thickness	0.2	1.0-1.7	0.03	0.025	0.6	0.8	0.3	0.1	0.2	500	320	18

TABLE A2.6: PIPES (OTHER SPECIFICATION)

Sl. No.	Equivalent P. No. /Group No.	Material Specification	Chemical Composition (%)									Mechanical Properties (Min.)		
			C	Mn	P	S	Si	Ni	Cr	Mo	V	T.S Kg / mm^2	Y.S Kg / mm^2	% EMin.
1	P1/1	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	P1/1	DIN St. 45.8	0.21 Max.	0.45-1.20	0.04 Max.	0.04 Max.	0.10-0.35	-	-	-	-	41.80-54.10	26	21
3	P1/1	BS 3602 / 410	0.21 Max.	0.40-1.20	0.045 Max.	0.045 Max.	0.35 Max.	-	-	-	-	41.82-56.10	25	22
4	P1/1	BS 3602 / 460	0.22 Max.	0.80-1.40	0.045 Max.	0.045 Max.	0.35 Max.	-	-	-	-	46.90-61.20	28.60	21
5	P4/1	BS 3604 620-460 HFS or CDS 620-440	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	-	46.90-62.22	18.36	22
			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	-	44.90-60.20	29.58	22
6	P5/1	BS 3604 622 HFS or CDS	0.08-0.15	0.40-0.70	0.04 Max.	0.04 Max.	0.50 Max.	-	2.00 2.50	0.90-1.20	-	48.80	26.80	17
7	-	BS 3604 HFS 660 Or CDS 660	0.15 Max.	0.40-0.70	0.04 Max.	0.04 Max.	0.10-0.35	-	0.25-0.50	0.50-0.70	0.22-0.30	47.30	30	17
8	P5B/2	X20CrMoV121D IN17175	0.17-0.23	≤ 1.00	0.030 Max.	0.030 Max.	≥ 0.50	0.30-0.80	10.00-12.50	0.80-1.20	0.25-0.35	70-86	50	17

TABLE A2.7: TUBES (OTHER SPECIFICATIONS)

Sl. No.	Equivalent P. No. /Group No.	Material Specification	Chemical Composition (%)									Mechanical Properties (Min.)		
			C	Mn	P	S	Si	Ni	Cr	Mo	V	T.S Kg / mm^2 (MPa)	Y.S Kg / mm^2 (MPa)	% E Min.
1	P1/1	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	P1/1	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	P1/1	BS 3059 / 360	0.17 Max.	0.40-0.80	0.045 Max.	0.045 Max.	0.35 Max.	-	-	-	-	36.70-51.00	22	24
4	P1/1	BS 3059 / 440	0.12-0.18	0.90-1.20	0.040 Max.	0.035 Max.	0.10-0.35	-	-	-	-	44.88-59.20	25	21
5	P3/1	15 Mo3 DIN17175	0.12-0.20	0.40-0.80	0.035 Max.	0.035 Max.	0.10-0.35	-	-	0.25-0.35	-	45.90-61.20	27.50	22
6	P4/1	13 Cr Mo 4-5DIN17175	0.10-0.18	0.40-0.70	0.035 Max.	0.035 Max.	0.10-0.35	-	0.70-1.10	0.45-0.65	-	44.88-60.18	29.60	22
7	P4 /1	BS 3059 / 620	0.10-0.15	0.40-0.70	0.040 Max.	0.040 Max.	0.10-0.35	-	0.70-1.10	0.45-0.65	-	46.90-62.20	18.40	22
8	P5/1	10 Cr Mo 9-10DIN17175	0.08-0.15	0.40-0.70	0.035 Max.	0.035 Max.	0.50 Max.	-	2.00-2.50	0.90-1.20	-	45.90-61.20	28.60	20
9	P5/1	BS 3059 (622) - 440	0.08-0.15	0.40-0.70	0.04 Max.	0.04 Max.	0.50 Max.	-	2.00-2.50	0.90-1.20	-	44.90-60.18	17.85	20
10	P5/1	BS 3059 (622) - 490	0.08-0.15	0.40-0.70	0.040 Max.	0.040 Max.	0.50 Max.	-	2.00-2.50	0.90-1.20	-	49.98-65.00	28.05	20
11	-	14 Mo V 63 DIN17175	0.10-0.18	0.40-0.70	0.035 Max.	0.035 Max.	0.10-0.35		0.30-0.60	0.50-0.70	0.22-0.32	46.90-62.22	32.60	20
12	P5B/2	X20CrMoV121 DIN17175	0.17-0.23	≤ 1.00	0.030 Max.	0.030 Max.	≥ 0.50	0.30-0.80	10.00-12.50	0.80-1.20	0.25-0.35	70-86	50	17

CHAPTER A3: WELDING MATERIAL SPECIFICATION AND CONTROL

SECTION A3.1-WELDING MATERIAL SPECIFICATION AND CONTROL

1.0 SCOPE:

1.1. This chapter details out the welding material specification and controls at sites.

2.0 CONTENTS:

1. Table- A3.1 - Weld Metal Chemical Composition.
2. Table - A3.2 - Mechanical property requirement for all-weld metal.
3. Receipt inspection of welding electrodes/filler wires.
4. Storage and identification of welding electrodes/filler wires.
5. Drying and holding of welding electrodes.
6. Selection and issue of welding electrodes/filler wires.
7. Table-A3.3 - Selection of GTAW filler wire, SMAW electrodes for butt welds in tubes, pipes, headers.
8. Table-A3.4 - Selection of electrodes for welding attachments to tubes.
9. Table-A3.5 - Selection of electrodes, preheat, PWHT for attachment to attachment welds.
10. Table-A3.6 -Selection of electrodes for welding nozzle attachments, hand hole plate, RG plug etc. to headers, pipes.
11. Table-A3.7 –Selection of filler wire and electrodes for non-pressure parts(including structures)
12. Table-A3.8 -A numbers
13. Table-A3.9 -F numbers
14. SFA Classification

3.0 For welding consumables not covered in this chapter, relevant details may be obtained from the concerned Manufacturing Units.

Table-A3.1
WELD METAL CHEMICAL COMPOSITION

Electrode/ Consumable	SFA No.	Weight, %										Other Elements %[a]
		C	Mn	Si	P	S	Ni	Cr	Mo	V	Cu	
E 6010	5.1	0.20	1.20	1.00	NS	NS	0.30	0.20	0.30	0.08	NS	Combined Limit for Mn+Ni+Cu+Mo+V=1.75
E 6013	5.1	0.20	1.20	1.00	NS	NS	0.30	0.20	0.30	0.08	NS	
E 7018	5.1	0.15	1.60	0.75	0.035	0.035	0.30	0.20	0.30	0.08	NS	
E 7018-1	5.1	0.15	1.60	0.75	0.035	0.035	0.30	0.20	0.30	0.08	NS	
E 7018-A1	5.5	0.12	0.90	0.80	0.03	0.03	NS	NS	0.40-0.65	NS	NS	
E 8018-B2	5.5	0.05-0.12	0.90	0.80	0.03	0.03	NS	1.00-1.50	0.40-0.65	NS	NS	
E 9018-B3	5.5	0.05-0.12	0.90	0.80	0.03	0.03	NS	2.00-2.50	0.90-1.20	NS	NS	
E 9015-B91	5.5	0.08-0.13	1.20	0.30	0.01	0.01	0.80	8.00-10.50	0.85-1.20	0.15-0.30	0.04-0.25	
E9015-B92	5.5	0.08-0.15	1.20	0.60	0.020	0.015	1.0	8.0-10.0	0.30-0.70	0.15-0.30	0.25	W: 1.50-2.00; Nb: 0.02-0.08 B:0.006; Al: 0.04; N: 0.03-0.08
E9018-B23/ E9015-B23	5.5	0.04-0.12	1.00	0.60	0.015	0.015	0.5	1.9-2.9	0.30	0.15-0.30	0.25	W: 1.50-2.00; Nb: 0.02-0.10 B:0.006; Al: 0.04; N: 0.05
E 308	5.4	0.08	0.50-2.50	1.00	0.04	0.03	9.00-11.00	18.00-21.00	0.75	NS	0.75	
E 308-L	5.4	0.04	0.50-2.50	1.00	0.04	0.03	9.00-11.00	18.00-21.00	0.75	NS	0.75	

Table-A3.1 (Contd...)
WELD METAL CHEMICAL COMPOSITION

Electrode/ Consumable	SFA No.	Weight, %										Other Elements %[a]
		C	Mn	Si	P	S	Ni	Cr	Mo	V	Cu	
E 309	5.4	0.15	0.50-2.50	1.00	0.04	0.03	12.00-14.00	22.00-25.00	0.75	NS	0.75	
E 309-L	5.4	0.04	0.50-2.50	1.00	0.04	0.03	12.00-14.00	22.00-25.00	0.75	NS	0.75	
E 347	5.4	0.08	0.50-2.50	1.00	0.04	0.03	9.00-11.00	18.00-21.00	0.75	NS	0.75	Cb+Ta 8XC Min. to 1.00 Max.
E316	5.4	0.08	0.5-2.5	1.00	0.04	0.03	11.0-14.0	17.0-20.0	2.0-3.0	NS	0.75	
E2209-16	5.4	0.04	0.5-2.0	1.00	0.04	0.03	7.5-9.5	21.5-23.5	2.5-3.5	NS	0.75	N:0.08-0.20
ENiCrFe-3	5.11	0.10	5.0-9.5	1.00	0.03	0.015	59.0 min	13.0-17.0	NS	NS	0.50	Fe: 12.0; Ta+ Cb: 1.0-2.5; Ti: 1.0; others: 0.5
ENiCrFe-7	5.11	0.05	5.0	0.75	0.03	0.015	Rem	28.0-31.5	0.5	NS	0.50	Fe: 7.0-12.0; Ta+ Cb: 1.0-2.5; others: 0.5
ENi-CI	5.15	2.00	2.50	4.00	NS	0.03	85[d] min	NS	NS	NS	2.5[e]	Fe 8.0 Al 1.0 others Total 1.0
ENiFe-CI	5.15	2.00	2.50	4.00	NS	0.03	45[d]-60	NS	NS	NS	2.5[e]	Fe Rem[f] Al 1.0 others Total 1.0
ER70S-2	5.18	0.07	0.90-1.40	0.40-0.70	0.025	0.035	0.15	0.15	0.15	0.03	0.50[b]	Ti 0.05-0.15 Zr 0.02-0.12 Al 0.05-0.15
ER70S-A1	5.28	0.12	1.30	0.30-0.70	0.025	0.025	0.20	NS	0.40-0.65	NS	0.35	Others : 0.50
E8018-G	5.5	0.08	1.0-1.8	0.5	0.025	0.025	0.5-1.20	NS	0.5	NS	NS	

Table-A3.1 (Contd…)
WELD METAL CHEMICAL COMPOSITION

Electrode/ Consumable	SFA No.	Weight, %										Other Elements %[a]
		C	Mn	Si	P	S	Ni	Cr	Mo	V	Cu	
ER80S-B2	5.28	0.07-0.12	0.40-0.70	0.40-0.70	0.025	0.025	0.20	1.20-1.50	0.40-0.65	NS	0.35[c]	Total other Elements 0.50
ER90S-B3	5.28	0.07-0.12	0.40-0.70	0.40-0.70	0.025	0.025	0.20	2.30-2.70	0.90-1.20	NS	0.35[c]	Total other Elements 0.50
ER80S-D2	5.28	0.07-0.12	1.60-2.10	0.50-0.80	0.025	0.025	0.15	NS	0.40-0.60	NS	0.50[c]	Total other Elements 0.50
ER90S-B9	5.28	0.07-0.13	1.20	0.15-0.30	0.01	0.01	0.80	8.00-10.50	0.80-1.20	0.15-0.23	0.20	Total other Elements 0.50
ER 308	5.9	0.08	1.00-2.50	0.30-0.65	0.03	0.03	9.00-11.00	19.50-22.00	0.75	NS	0.75	
ER 309	5.9	0.12	1.00-2.50	0.30-0.65	0.03	0.03	12.00-14.00	23.00-25.00	0.75	NS	0.75	
ER 309-L	5.9	0.03	1.00-2.50	0.30-0.65	0.03	0.03	12.00-14.00	23.00-25.00	0.75	NS	0.75	
ER316L	5.9	0.03	1.0-2.5	0.30-0.65	0.03	0.03	11.0-14.0	18.0-20.0	2.0-3.0	NS	0.75	---
ER 347	5.9	0.08	1.00-2.50	0.30-0.65	0.03	0.03	9.00-11.00	19.00-21.50	0.75	NS	0.75	Cb+Ta 10XC Min. to 1.0 Max.
ER2209	5.9	0.03	0.5-2.0	0.90	0.03	0.03	7.5-9.5	21.5-23.5	2.5-3.5	NS	0.75	N:0.08-0.20

Table-A3.1 (Contd…)
WELD METAL CHEMICAL COMPOSITION

Electrode/ Consumable	SFA No.	Weight, %										Other Elements %[a]
		C	Mn	Si	P	S	Ni	Cr	Mo	V	Cu	
ERNiCr-3	5.14	0.10	2.5-3.5	0.50	0.03	0.015	67.0 min	18.0-22.0	NS	NS	0.50	Fe: 3.0; Cb+Ta: 2.0-3.0; Ti: 0.75; Other: 0.5
ERNiCrFe-7A	5.14	0.04	1.0	0.50	0.02	0.015	Rem.	28.0-31.5	0.50		0.30	Fe: 7.0-11-0; Cb+Ta: 0.5-1.0; Ti: 1.0; Other: 0.5; Co: 0.12; Al: 1.10
YT 304H	--	Proprietary GTAW rod for Super 304H										
THERMANIT 304H Cu	--											
TGS2CW	--	Proprietary GTAW rod for T23										
YT-HCM2S												
2CrWV-TIG	--											
9CRWV TIG	--	Proprietary GTAW rod for Gr.92										
THERMANIT MTS 616	--											

TABLE – A3.1 (Contd...)
WELD METAL CHEMICAL COMPOSITION

Notes:

a) Other elements listed without specified values shall be reported, if intentionally added. The total of these latter unspecifiedelements and all other elements not intentionally added shall not exceed 0.50%.

b) The maximum weight percent of copper in the rod or electrode due to any coating plus the residual copper content in the steel shall be 0.50.

c) The maximum weight percent of copper in the rod or electrode due to any coating plus the residual copper content in the steel shall comply with the stated value.

d) Nickel plus incident Cobalt.

e) Copper plus incident Silver.

f) "Rem" stands for remainder.

g) Manufacturer's certification to have met the requirements of ASME Sec. II Part C is acceptable in cases where the chemical analysis are not reflected.

h) Single values are maximum.

i) NS – Not Specified

TABLE-A3.2
MECHANICAL PROPERTY REQUIREMENTFOR ALL-WELD METAL

Electrode	SFA No.	Tensile Strength Ksi / MPa	Yield Strength at 0.2% of Proof Stress, Ksi/ MPa	Elongation In 2 inch (50.8 mm) %
E6010	5.1	60 / 430	48 / 330	22
E6013	5.1	60 /430	48 / 330	17
E7018	5.1	70 / 490	58 / 400	22
E7018-1[a]	5.1	540	58 / 400	22
E7018-A1	5.5	70 / 490	57 / 390	22
E8018-G[b]	5.5	570	450	19
E8018-B2	5.5	80 /550	67 / 460	19
E9018-B3	5.5	90 /620	77 / 530	17
E9015-B91	5.5	90 /620	77 / 530	17
E9015-B92	5.5	90/620	77/530	17
E9018-B23	5.5	90/620	77/530	17
E308	5.4	80 / 550	-	35
E308L	5.4	75 / 520	-	35
E309	5.4	80 / 550	-	30
E309L	5.4	75 / 520	-	30
E347	5.4	75 / 520	-	30
E316	5.4	75/520	--	30
E2209	5.4	100/690	--	22
ENiCrFe-3	5.11	80/550	--	30
ENiCrFe-7	5.11	80/550	--	30
ENi-CI	5.15	40-65 / 276-448	38-60 / 268-414	3-6
ENiFe-CI	5.15	58-84 / 400 -579	43-63 / 294 -434	6-18

a. These electrodes shall meet the lower temperature impact requirement of average minimum. (27 Joules at – 45° C) and other properties at 620±20°C for 300 minutes.

b. These electrodes shall meet the impact requirement of average minimum (20 Joules at + 25° C) and other properties at 550±10°C for 60 minutes.

Table- A3.2 (Contd...)

MECHANICAL PROPERTY REQUIREMENT FOR ALL-WELD METAL

Electrode	SFA No.	Tensile Strength Ksi / MPa	Yield Strength at 0.2% of Proof Stress, Ksi / MPa	Elongation In 2 inch (50.8 mm) %
ER70S-6	5.18	70/480	58/400	22
ER70S-A1	5.28	75/515	58/400	19
ER80S-B2	5.28	80 / 550	68 / 470	19
ER90S-B3	5.28	90 / 620	78 / 540	17
ER80S-D2	5.28	80 / 550	68 / 470	17
ER90S-B9	5.28	90 / 620	60 / 410	16
ER308	5.9	These values are not required in the test certificate		
ER308L	5.9			
ER309	5.9			
ER309L	5.9			
ER347	5.9			
ER316	5.9			
ER2209-16	5.9			
ERNiCr-3	5.14	80/550	--	
ERNiCrFe-7A	5.14	85/590	--	

NOTE:

a) Single values are minimum.

b) Manufacturer's certification to have met the requirements of ASME-Section II Part C is acceptable in cases where the mechanical properties are not reflected.

c) 1Ksi is approximately equal to 6.89 MPa.

Section A3.2- Receipt Inspection of Welding Electrodes / Filler Wires

1.0 All electrodes/filler wires received at site stores shall be segregated for type and size of electrode.

2.0 Ensure that electrode packets received are free from physical damage.

3.0 Where electrodes are damaged, the same shall be removed from use.

4.0 Only electrodes identified in the "list of approved vendors of welding electrodes" shall be accepted.

5.0 Where filler metals are supplied by manufacturing unit, inspect for damages, if any.

6.0 Ensure availability of relevant test certificates. Refer tables of chemical compositions and mechanical properties for acceptance.

7.0 Endorse acceptance/rejection on the test certificate.

Section A3.3- Storage & Identification of WeldingElectrodes/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 made available 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 usage of wooden racks for storing 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 Identification of filler wires:

2.4.1 On receipt of GTAW filler wires, check AWS No. or brand name embossed and retain the same identification throughout.

Section A3.4-Drying and Holding of Welding Electrodes

1.0 SCOPE:

1.1 This section details activities regarding drying 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.

2.2 It is recommended that not more than two days' requirements electrodes are dried.

3.0 GTAW Filler Wires:

3.1 These wires do not require any drying.

4.0 Covered Electrodes:

4.1 Drying and holding :

4.1.1 Identify drying oven and holding oven.

4.1.2 They shall preferably have a temperature control facility upto 400°C for drying oven and 200°C for holding oven.

4.1.3 A calibrated thermometer shall be provided for monitoring temperature.

4.2 On opening a packet of electrodes, segregate and place them in the drying oven. Mix-up of electrodes shall be avoided.

4.2.1 After loading, raise the drying oven temperature to the desired range as per table in 4.2.5.

4.2.2 Note the time when the temperature reaches the desired range. Maintain this temperature for the duration required as per Table in 4.2.5.

4.2.3 On completion of drying, the electrodes shall be transferred to holding oven immediately and maintained at minimum temperature of 150°C till issue.

4.2.4 The electrode shall not be subjected to more than three cycles of drying.

4.2.5 Maintaina register containing following details:

Sl. No.	Date	AWS number/Specification	Batch No./Size	Dia.	Qty.	Drying temperature Start time	Drying Temperature end time	Remarks

Drying and Holding Parameters

AWS Classification	Drying (*)		Minimum Holding Temperature °C (@)
	Temperature °C	Time (Hours)	
E7018	250 - 300	2	150
E7018-1	250 - 300	2	150
E7018-A1	250 - 300	2	150
E8018-G	250 - 300	2	150
E8018-B2	250 - 300	2	150
E9018-B3	250 - 300	2	150
E9018-B23	250 - 300	2	150
E9015-B91	250 - 300	2	150
E9015-B92	250 - 300	2	150
E308, E309, E310 E316& E347	250 - 300	1	150
ENiCrFe-3	250 - 300	2	150
ENiCrFe-7	250 - 300	2	150

Note: (*) - Guideline has been given however, supplier's recommendations shall be followed.

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

4.2.4 After issue, maintain the electrodes in a portable oven at a minimum temperature of 65°C till use. This is not applicable for E6013 (Rutile) electrodes, however the following instruction shall be followed for E6013 electrodes:

(1) Rutile electrodes require some moisture in the coating and they would not require drying. If they become damp, re-drying at around 120 to 150°C for 1 hour will be sufficient.

(2) These electrodes with potassium silicate binder can be used on both DCEP/DCEN polarities and on AC. E6013 electrodes generally have better arc striking and stability characteristics with an easily detachable slag.

4.3 Unused, returned electrodes shall be segregated and reused only after repeating drying and holding cycles.

Section A3.5- Selection and Issue of Welding Electrodes / Filler Wires

1.0 SCOPE:

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 Field Welding Schedule, drawings, Welding Procedure Specifications as supplied by the concernedmanufacturing units.

2.1.2 Where not specified by the manufacturing units, selection shall be based on the tables enclosed (Table A3.3 to Table A3.7. as applicable).

2.1.3 Where electrodes/ filler wires are not covered in the documents mentioned in 2.1.1 and 2.1.2, refer to the concernedmanufacturing units.

2.2 Issue:

2.2.1 Issue of welding electrodes / filler wires shall be based on authorised welding electrodes issue voucher.

2.2.2 It is recommended to restrict quantity issued to not more than 4 hours' requirements.

2.2.3 Re-dried 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°C.

2.2.5 Unused electrodes shall be segregated and reused only after repeating drying and holding cycles.

Table- A3.3
SELECTION OF GTAW FILLER WIRE, SMAW ELECTRODE FOR BUTT WELDS IN TUBES, PIPES AND HEADERS

Material	Welding Process	P1 Gr 1/ P1 Gr 2	P3 Gr 1	P4 Gr 1	P5A Gr 1	P15 E Gr 1	T23	T92/P92	P8	P8 SA 213 UNS S 30432	DIN14MoV6 3 or equivalent
P1 Gr 1	GTAW	ER 70S-A1									
P1 Gr 2	SMAW	E7018-1 Note 1									
P3 Gr 1	GTAW	ER 70S-A1	ER 70S-A1								
	SMAW	E7018-1	E7018-A1								
P4 Gr 1	GTAW	ER 70S-A1	ER 70S-A1	ER 80S-B2							
	SMAW	E7018-1	E7018-A1	E8018-B2							
P5A Gr 1	GTAW	ER 70S-A1	ER 70S-A1	ER 80S-B2	ER 90S-B3	ER 90S-B3	ER90S-B3				
	SMAW	E7018-1	E7018-A1	E8018-B2	E9018-B3	E9018-B3	E9018-B3				
P15 E Gr.1 Gr.91	GTAW					ER90S-B9	TGS2CW/ 2CrWVTIG/ YT-SCM2S	ER90S-B9			
	SMAW					E9015-91	E9018-B23	E9015-B91			
T23	GTAW						TGS2CW/ 2CrWVTIG/YT-SCM2S	TGS2CW/ 2CrWVTIG/ YT-SCM2S			
	SMAW						E9018-B23	E9018-B23			

Table- A3.3 (Contd...)

Material	Welding Process	P1 Gr 1 P1 Gr 2	P3 Gr 1	P4 Gr 1	P5A Gr 1	P15 E Gr 1	T23	T92/P92	P8	P8 SA 213 UNS S 30432	DIN14MoV63 or equivalent
P15 E Gr.1 Gr.92	GTAW							9CrWV-TIG/ Themanit-MTS616			
	SMAW							E9015-B92			
P8	GTAW			ERNi Cr3	ERNiCr3	ERNiCr3	ERNiCr3	ERNiCrFe7A	ER347		
	SMAW			ENiC rFe3	ENiCrFe3	ENiCrFe3	ENiCrFe3	ENiCrFe7	E347		
P8 SA 213 UNS S30432	GTAW									YT304H/ THERMANIT 304H Cu	
DIN14MoV63 or equivalent	GTAW				ER 90S-B3						ER90S-B3
	SMAW				E9018-B3						E9018-B3

Note-1: E7018-A1 for P1 Gr2 + P1 Gr2 when PWHT is involved.

Table- A3.4
SELECTION OF ELECTRODES FOR WELDING ATTACHMENTS TO TUBES

Tube Material	Attachment Material			
	P1 Group 1	**P4 Group 1**	**P5A Group 1**	**P8**
P1 Group 1 P1 Group 2	E 7018	E 7018	E 7018	E 309
P3	E 7018-A1	E 7018-A1	E 7018-A1	E 309
P4 Group 1	E 8018-B2	E 8018-B2	E 8018-B2	E 309
P5A Group 1	E 9018-B3	E 9018-B3	E 9018-B3	E 309
P8 including SA 213 UNS S30432		E 309	E 309	E 347
P15E Gr.1 (Gr. 91/92)			E9018-B3	ENiCrFe-3
SA213T23			E9018-B3	ENiCrFe-3

Table- A3.5
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 (Note 2)	Welding Requirements	P1	P3	P4	P5 A	P8 Group 1	P8 Group 2	P 15E / 1
P1	Electrode Preheat PWHT	E7018 Nil Nil	-	E 7018 150°C 650 – 670°C	-	-	-	-
P3	Electrode Preheat PWHT	E7018 150°C (Note 1) For Thickness>16mm: 620-650°C	E7018-A1 150°C For Thickness>16mm: 620-650°C	-	-	-	-	-
P4	Electrode Preheat PWHT	E7018 150°C (Note 1) For Thickness>13mm: 650-670°C	E7018-A1 150°C For Thickness>13mm: 650-670°	E8018-B2 150°C (Note 1) For Thickness>13mm: 650-670°C	-	-	-	-
P5 A	Electrode Preheat PWHT	-	-	E8018-B2 150°C (Note 1) For Thickness>13: 680-710°C	E9018-B3 150°C (Note 1) For Thickness>13:680-710°C	-	-	-
P8	Electrode Preheat PWHT	E309 Nil Nil	-	E309 Nil Nil	E309 Nil Nil	E347 Nil Nil	E309 Nil Nil	-
P 15E/ 1	Electrode Preheat PWHT	-	-	-	E9018-B3 220°C 730-760 °C	ENi Cr Fe3 220°C (only on P15E side) 730-760 °C	ENi Cr Fe3 220°C (only on P15E side) 730-760 °C	E9015-B91 220°C 740-770 °C

Note – 1 : Preheat is not required for P3/P4up to 16 mm& for P5 A up to 13 mm, if PWHT is carried out.
Note - 2: For load carrying members, PWHT is required irrespective of thickness.

Table- A3.6
SELECTION OF ELECTRODES FOR WELDING NOZZLE ATTACHMENTS, HAND HOLE PLATE, RG PLUG ETC. TO HEADERS, PIPES

Header, Pipe Material	Attachment Material					
	P1	**P3**	**P4**	**P5 A**	**P15 E/1**	**P8**
P1	E7018-1	E7018-1	E7018-1	-	-	ENiCrFe3
P4	E7018-1	E7018-A1	E8018-B2	E8018-B2	-	-
P5 A	-	-	E8018-B2	E9018-B3	E9018-B3	ENiCrFe3
P15 E/1	-	-	-	E9018-B3	E9015-B91	ENiCrFe3
DIN 14MoV63 or equivalent	-	-	-	E9018-B3	-	ENiCrFe3

Table – A3.7
SELECTION OF ELECTRODES FOR NON-PRESSURE PARTS (INCLUDING STRUCTURES) (NOTE 1)

Material	SMAW Electrodes	SAW Wires	CO_2 Wires
P1 + P1 (IS2062 E250)	For butt welds ≤ 6 mm: E 6013 (only for Ducts) > 6 mm: E 7018 For fillets ≤8 mm : E 6013 >8 mm: E 7018	EL 8 EM 12 K EL 8 EM 12 K	E 71 T - 1
Corten Steel + P1	E 6013 or E 7018	EM 12 K	
Corten Steel + Corten Steel	E 8018 – B2	EB 2	E 81 T 1 – B2
IS2062 E350+E350/ E250	E7018-1	EM 12 K	NA
IS2062 E450+E450	E8018-G	EG	NA
SA 204 Gr.A	E7018-A1	NA	NA

Note 1: E 6013 Electrodes can be used for all non-load carrying welds of all thickness of IS 2062 plates up to 20 mm thickness and 8 mm fillets

TABLE- A3.8
A NUMBERS
CLASSIFICATION OF FERROUS WELD METAL ANALYSIS FOR PROCEDURE QUALIFICATION

A. No.	Types of Weld Deposit	Analysis, % (Note 1)					
		C	Cr	Mo	Ni	Mn	Si
1	Mild steel	0.20	–	–	–	1.60	1.00
2	Carbon-Molybdenum	0.15	0.50	0.40-0.65	–	1.60	1.00
3	Chrome (0.4% to 2%)-Molybdenum	0.15	0.40-2.00	0.40-0.65	–	1.60	1.00
4	Chrome (2% to 6%)-Molybdenum	0.15	2.00-6.00	0.40-1.50	–	1.60	2.00
5	Chrome (6% to 10.5%)-Molybdenum	0.15	6.00-10.50	0.40-1.50	–	1.20	2.00
6	Chrome-Martensitic	0.15	11.00-15.00	0.70	–	2.00	1.00
7	Chrome-Ferritic	0.15	11.00-30.00	1.00	–	1.00	3.00
8	Chromium-Nickel	0.15	14.50-30.00	4.00	7.50-15.00	2.50	1.00
9	Chromium-Nickel	0.30	19.00-30.00	6.00	15.00-37.00	2.50	1.00
10	Nickel to 4%	0.15	–	0.55	0.80-4.00	1.70	1.00
11	Manganese-Molybdenum	0.17	–	0.25-0.75	0.85	1.25-2.25	1.00
12	Nickel-Chrome-Molybdenum	0.15	1.50	0.25-0.80	1.25-2.80	0.75-2.25	1.00

Note 1: Single values shown above are maximum.

Table A3.9
F NUMBERS GROUPING OF ELECTRODES AND WELDING RODS FOR QUALIFICATION

	ASME Specification No.	AWS Classification No.
1	SFA-5.1	EXX20
1	SFA-5.1	EXX22
1	SFA-5.1	EXX24
1	SFA-5.1	EXX27
1	SFA-5.1	EXX28
1	SFA-5.4	EXXX(X)-26
1	SFA-5.5	EXX20-X
1	SFA-5.5	EXX27-X
2	SFA-5.1	EXX12
2	SFA-5.1	EXX13
2	SFA-5.1	EXX14
2	SFA-5.1	EXX19
2	SFA-5.5	E(X)XX13-X
3	SFA-5.1	EXX10
3	SFA-5.1	EXX11
3	SFA-5.5	E(X)XX10-X
3	SFA-5.5	E(X)XX11-X
4	SFA-5.1	EXX15
4	SFA-5.1	EXX16
4	SFA-5.1	EXX18
4	SFA-5.1	EXX18M
4	SFA-5.1	EXX48
4	SFA-5.4 other than austenitic and duplex	EXXX(X)-15
4	SFA-5.4 other than austenitic and duplex	EXXX(X)-16
4	SFA-5.4 other than austenitic and duplex	EXXX(X)-17
4	SFA-5.5	E(X)XX15-X
4	SFA-5.5	E(X)XX16-X
4	SFA-5.5	E(X)XX18-X
4	SFA-5.5	E(X)XX18M
4	SFA-5.5	E(X)XX18M1

Table- A3.9 (Contd...)
F NUMBERS GROUPING OF ELECTRODES AND WELDING RODS FOR QUALIFICATION

F.No.	ASME Specification No.	AWS Classification No.
5	SFA-5.4 austenitic and duplex	EXXX(X)-15
5	SFA-5.4 austenitic and duplex	EXXX(X)-16
5	SFA-5.4 austenitic and duplex	EXXX(X)-17
6	SFA-5.2	All classifications
6	SFA-5.9	All classifications
6	SFA-5.17	All classifications
6	SFA-5.18	All classifications
6	SFA-5.20	All classifications
6	SFA-5.22	All classifications
6	SFA-5.23	All classifications
6	SFA-5.25	All classifications
6	SFA-5.26	All classifications
6	SFA-5.28	All classifications
6	SFA-5.29	All classifications
6	SFA-5.30	INMs-X
6	SFA-5.30	IN5XX
6	SFA-5.30	IN3XX(X)
Aluminium and Aluminium-Base Alloys		
21	SFA-5.3	E1100
21	SFA-5.3	E3003
21	SFA-5.10	ER1100
21	SFA-5.10	R1100
21	SFA-5.10	ER1188
21	SFA-5.10	R1188
22	SFA-5.10	ER5183
22	SFA-5.10	R5183
22	SFA-5.10	ER5356
22	SFA-5.10	R5356
22	SFA-5.10	ER5554
22	SFA-5.10	R5554
22	SFA-5.10	ER5556

TABLE- A3.9 (Contd...)
F NUMBERS GROUPING OF ELECTRODES AND WELDING RODS FOR QUALIFICATION

F.No.	ASME Specification No.	AWS Classification No.
22	SFA-5.10	R5556
22	SFA-5.10	ER5654
22	SFA-5.10	R5654
23	SFA-5.3	E4043
23	SFA-5.10	ER4009
23	SFA-5.10	R4009
23	SFA-5.10	ER4010
23	SFA-5.10	R4010
23	SFA-5.10	R4011
23	SFA-5.10	ER4043
23	SFA-5.10	R4043
23	SFA-5.10	ER4047
23	SFA-5.10	R4047
23	SFA-5.10	ER4145
23	SFA-5.10	R4145
23	SFA-5.10	ER4643
23	SFA-5.10	R4643
24	SFA-5.10	R206.0
24	SFA-5.10	R-C355.0
24	SFA-5.10	R-A356.0
24	SFA-5.10	R357.0
24	SFA-5.10	R-A357.0
25	SFA-5.10	ER2319
25	SFA-5.10	R2319
Copper And Copper Alloys		
31	SFA-5.6	ECu
31	SFA-5.7	ERCu
32	SFA-5.6	ECuSi
32	SFA-5.7	ERCuSi-A

TABLE- A3.9 (Contd...)
F NUMBERS
GROUPING OF ELECTRODES AND WELDING RODS FOR QUALIFICATION

F.No.	ASME Specification No.	AWS Classification No.
33	SFA-5.6	ECuSn-A
33	SFA-5.6	ECuSn-C
33	SFA-5.7	ERCuSn-A
34	SFA-5.6	ECuNi
34	SFA-5.7	ERCuNi
34	SFA-5.30	IN67
35	SFA-5.8	RBCuZn-A
35	SFA-5.8	RBCuZn-B
35	SFA-5.8	RBCuZn-C
35	SFA-5.8	RBCuZn-D
36	SFA-5.6	ECuAl-A2
36	SFA-5.6	ECuAl-B
36	SFA-5.7	ERCuAl-A1
36	SFA-5.7	ERCuAl-A2
36	SFA-5.7	ERCuAl-A3
37	SFA-5.6	ECuNiAl
37	SFA-5.6	ECuMnNiAl
37	SFA-5.7	ERCuNiAl
37	SFA-5.7	ERCuMnNiAl
Nickel And Nickel Alloys		
41	SFA-5.11	ENi-1
41	SFA -5.11	ENiCrFe-3 & ENiCrFe-7A
41	SFA-5.14	ERNi-1
41	SFA-5.14	ERNiCr-3 & ENiCrFe-7A
41	SFA-5.30	IN61
42	SFA-5.11	ENiCu-7
42	SFA-5.14	ERNiCu-7
42	SFA-5.14	ERNiCu-8
42	SFA-5.30-7	IN60

TABLE- A3.9 (Contd...)
F NUMBERSGROUPING OF ELECTRODES AND WELDING RODS FOR QUALIFICATION

F.No.	ASME Specification No.	AWS Classification No.
45	SFA5.11	ENiCrMo-11
45	SFA5.14	ERNiCrMo-1
45	SFA5.14	ERNiCrMo-8
45	SFA5.14	ERNiCrMo-9
45	SFA5.14	ERNiCrMo-11
45	SFA5.14	ERNiFeCr-1
Hard-Facing Weld Metal Overlay		
71	SFA-5.13	E Co Cr – A & All classifications
72	SFA-5.21	ER Co Cr – A & All classifications

INDEX NO: 2-8

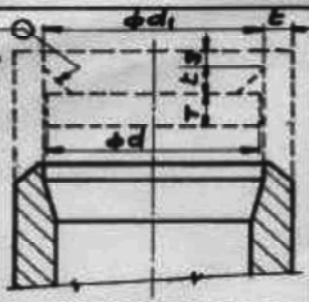
TIRUCHY

SELECTION CHART FOR DUMMY END COVERS FOR HYDRAULIC TEST

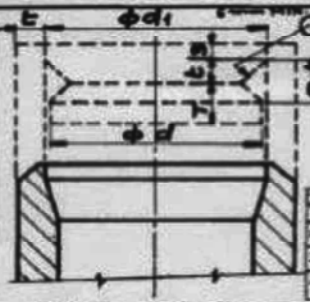
THICKNESS 'T' = $0.5 d_1 \sqrt{\frac{P}{f}}$ (IBR - SEC. II 831/1968) f = 1900 kg/cm²
ROUNDED OFF TO THE NEXT NEAREST RATIONALISED PLATE SIZE.

MIN. 6mm

$\phi d = d_1 - 1$ mm (ROUNDED OFF TO THE NEXT INTEGER)



CASE WHEN T ≤ 20



$\phi d = d_1 - 2$ mm (ROUNDED OFF TO THE NEXT INTEGER)

CASE WHEN T > 20

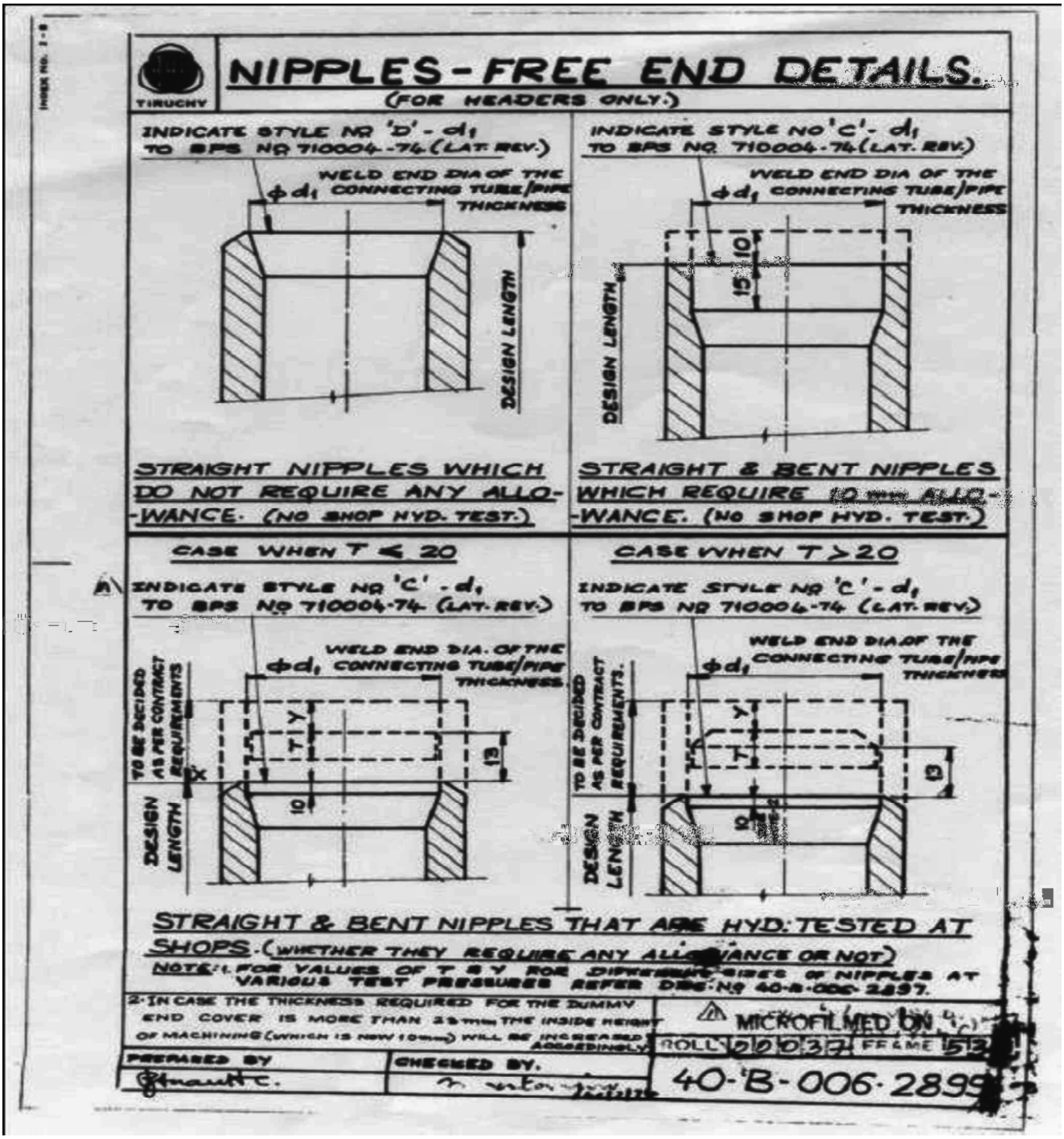
THICKNESS 'T' mm	MATERIAL
6 to 20	BM-C20
21 to 63	BM-C16
ABOVE 63	ASTM-A 36

THICKNESS OF DUMMY END COVERS FOR HYDRAULIC TEST (T)

'd' mm	30	45	60	75	90	105	120	135	150	165	180	210	240	270	300	350
15	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5
25	5	5	5	5	5	5	5	5	5	5	5	5	6	6	6	8
30	5	5	5	5	5	5	5	5	5	6	6	6	8	8	8	8
35	5	5	5	5	5	5	6	6	6	6	8	8	8	8	8	10
40	5	5	5	5	6	6	6	8	8	8	8	8	8	10	10	10
45	5	5	5	6	6	6	8	8	8	8	8	10	10	10	10	12
50	5	5	6	6	8	8	8	8	8	10	10	10	10	12	12	12
55	5	6	6	8	8	8	8	10	10	10	10	10	12	12	12	14
60	5	6	8	8	8	8	10	10	10	10	10	12	12	14	14	14
65	5	6	8	8	8	10	10	10	10	12	12	12	14	14	14	16
70	6	8	8	8	10	10	10	12	12	12	12	14	14	14	16	16
75	6	8	8	10	10	10	12	12	12	12	14	14	16	16	16	20
80	6	8	8	10	10	12	12	12	12	14	14	14	16	16	20	20
85	8	8	10	10	10	12	12	14	14	14	14	16	16	20	20	20
90	8	8	10	10	12	12	14	14	14	14	16	16	20	20	20	20
95	8	10	10	12	12	12	14	14	16	16	16	20	20	20	20	25
100	8	10	10	12	12	14	14	16	16	16	20	20	20	20	25	25
125	10	12	12	14	16	16	20	20	20	20	20	25	25	25	32	32
150	12	14	16	16	20	20	20	25	25	25	25	32	32	32	32	36
175	12	16	20	20	20	25	25	25	32	32	32	32	32	36	36	40
200	14	20	20	25	25	25	32	32	32	32	32	36	40	40	56	56
250	20	20	25	32	32	32	36	36	36	40	40	56	56	56	56	56
300	20	25	32	32	36	36	40	36	56	56	56	56	56	63	63	63
350	25	32	32	36	40	36	36	36	56	56	56	63	63	70	75	80
400	32	32	40	56	56	56	56	56	63	63	63	70	75	80	85	90
450	32	36	56	56	56	56	63	63	63	70	70	80	85	90	95	100
500	36	40	56	56	56	63	63	70	75	75	80	85	90	95	100	110

PREPARED BY

CHECKED BY


TIRUCHY
NIPPLES - FREE END DETAILS.
(FOR HEADERS ONLY.)
INDICATE STYLE NO 'D' - d1 TO BPS NO 710004-74 (LAT. REV.)
φd1 WELD END DIA OF THE CONNECTING TUBE/PIPE THICKNESS
DESIGN LENGTH
STRAIGHT NIPPLES WHICH DO NOT REQUIRE ANY ALLO- -WANCE. (NO SHOP HYD. TEST.)
INDICATE STYLE NO 'C' - d1 TO BPS NO 710004-74 (LAT. REV.)
φd1 WELD END DIA OF THE CONNECTING TUBE/PIPE THICKNESS
15
10
DESIGN LENGTH
STRAIGHT & BENT NIPPLES WHICH REQUIRE 10 mm ALLO- -WANCE. (NO SHOP HYD. TEST.)
CASE WHEN T ≤ 20
INDICATE STYLE NO 'C' - d1 TO BPS NO 710004-74 (LAT. REV.)
φd1 WELD END DIA. OF THE CONNECTING TUBE/PIPE THICKNESS.
TO BE DECIDED AS PER CONTRACT REQUIREMENTS
T
Y
X
13
10
DESIGN LENGTH
CASE WHEN T > 20
INDICATE STYLE NO 'C' - d1 TO BPS NO 710004-74 (LAT. REV.)
φd1 WELD END DIA. OF THE CONNECTING TUBE/PIPE THICKNESS
TO BE DECIDED AS PER CONTRACT REQUIREMENTS.
Y
T
13
10
DESIGN LENGTH
STRAIGHT & BENT NIPPLES THAT ARE HYD: TESTED AT SHOPS. (WHETHER THEY REQUIRE ANY ALLOWANCE OR NOT)
NOTE: 1. FOR VALUES OF T & Y FOR DIFFERENT SIZES OF NIPPLES AT VARIOUS TEST PRESSURES REFER DRG. NO 40-B-006-2897.
2. IN CASE THE THICKNESS REQUIRED FOR THE DUMMY END COVER IS MORE THAN 23 mm THE INSIDE HEIGHT OF MACHINING (WHICH IS NOW 10 mm) WILL BE INCREASED ACCORDINGLY.
MICROFILMED ON
ROLL 00037 FRAME 53
PREPARED BY
CHECKED BY.
40-B-006-2899

CHAPTER A4 - PROCEDURE FOR WELDER QUALIFICATION

SECTION A4.1-PROCEDURE FOR WELDER QUALIFICATION FOR NON-IBR APPLICATIONS

1.0 SCOPE:

1.1 This chapter details the procedure for qualification of welder and performance monitoring.

2.0 CONTENTS:

SECTION A4.2-QUALIFICATION OF WELDER

1.0 BASE METAL:

1.1 For selection refer Tables provided in Chapter II (Base Materials) of this manual.

2.0 TEST COUPON:

2.1 Depending on the range to be qualified, choose the appropriate test coupon from Table-A6.1

2.2 For plate butt welds, details of edge preparation shall be as per Figure-A6.9.

2.3 For pipe butt welds, details of edge preparation shall be as per Figure-A6.10.

2.4 For structural tack welds, refer Figure-A6.1.

3.0 REQUIREMENT OF TESTS:

3.1 For Structural Tack Welders:

3.1.1 Break Test as per Figure-A6.2.

3.2 For Plate and Pipe Butt welders:

3.2.1 100 % Radiographic examination of test welds shall be carried out. Procedure and acceptance criteria shall be as per NDE Manual (BHEL:PS:NDEM – Latest)

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: 'V' bevel to 'U' bevel.

4.1.3 **Base Metal :**A change in thickness or pipe diameter beyond the limits as prescribed in Table- A6.1

4.1.4 **Filler Metal:**A change from one F number to another F-number, except as specified in Table-A6.1.

4.1.5 **Positions:**This procedure envisages qualification of welders to perform in all positions. Deviation to this is not recommended.

4.1.6 **Gas:**This procedure envisages test to pre-prescribed gas as for production welds. Deviation to this is 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:** This procedure envisages only use of uphill progression technique.

Acceptance Criteria:

Structural Tack Welding:

- No cracks.
- No lack of fusion.
- Undercut not exceeding 1 mm.
- Not more than 1 porosity (max. diameter of porosity 2 mm).

Plate/Pipe Welding:

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 2mm).

5.0 VALIDITY:

5.1 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.The validity may be extended by one year each time, based on satisfactory performance, with sufficient back up records.

6.0 REQUALIFICATION :

6.1 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.

7.0 RECORDS:

The welding in charge at site shall maintain the following records:

a) Record of Welder Performance qualification Test (as per Annexure V).

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

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

The above register shall be updated for deletions also.Copies of welder identity card (including details as in 7 b and relevant variables qualified) and pertinent radiography reports.

8.0 ENCLOSURES :

1. Table –A6.1: Welder Qualification Requirements.
2. Record of Welder Performance Qualification Test.
3. Figure-A6.1: Structural Tack Weld Specimen.
4. Figure-A6.2: Break Test.
5. Figure-A6.3:Weld Positions.
6. Figure- A6.4 - 6G position
7. Figure- A6.5 - Flat position
8. Figure- A6.6 - Vertical position
9. Figure- A6.7 - Horizontal position
10. Figure- A6.8 - Overhead position
11. Figure-A6.9: Plate Butt Weld Specimen.
12. Figure-A6.10: Pipe Butt Weld Specimen

ANNEXURE - V: RECORD OF WELDER PERFORMANCE QUALIFICATION TEST

WELDER/TACK WELDER QUALIFICATION TEST RECORD -NON IBR

Site :		Test Record No. :		Affix welder photo
Contractor Name :		DATE :		
NAME Sri.		Joint Details 		
ID NO :				
WPS No. :	Rev :			

Variables	Recorded Actual values used in Qualification	Qualification Range
Process / Type		
Electrode (Single or Multiple)		
Current / Polarity		
Position		
Weld Progression		
Backing		
Material / Specification	to	
Thickness : (Plate)		
Groove		
Fillet		
Thickness : (Pipe / Tube)		
Groove		
Fillet		
Diameter : (Pipe)		
Groove		
Fillet		
Filler Rod / Electrode		
SFA No		
AWS Class		
F.No		
Gas / Flux Type :		

Pre-heat temp : Inter-pass Temp : Post-heat Temp :

VISUAL INSPECTION

ACCEPTABLE : YES or NO DATE :

Guided Bend Test Results

Type	Result	Type	Result

Fillet Test Results

Apperance		Fillet Size	
Fracture Test Root Penetration		Macroetch	
Inspected by		Test Number	
Organization		Date	

RADIOGRAPHIC TEST RESULTS

Report No/Date	Result	Report No/Date	Result

Reviewed by		Reviewer Level :	
NDT Company Name :		Date	

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

This is valid upto

Contractor :		Signature :	Date :
BHEL :		Signature :	Date :
Customer :		Signature :	Date :

TABLE – A6.1
WELDER QUALIFICATION REQUIREMENTS (FOR NON-IBR APPLICATIONS)

Sl. No.	Test For	Base[6] Metal Note 1	Test Coupon Dimension OD, t	Electrode[6] to be used Note 2, 4	Weld Positions	Reference Figure	Range Qualified Dia. & T	Position Qualified	Electrode Qualified Note 2, 4
1	Structural tack	P1 Gr 1	t=10mm or 12mm	(E6013) F2	3F&4F	Fig. A6.1 A6.2 & A6.3	T-Unlimited	All	F2, F1
				(E7018) F4	3F&4F		T-Unlimited	All	F4 & Below
2	Plate Welder (Structural)	- do -	t≥25mm	F4	3G & 4G	Fig.A6.7 & A6.8	T≥3.0 mm*	All	F4 & Below
			t<25mm	F4	3G & 4G		T>3.0 mm*≤2t	All	F4 & Below
3	Plate Welder (Other than structural)	- do -	t≥13mm	F4	2G, 3G & 4G	Fig.A6.6 , A6.7 & A6.8	T-Unlimited OD≥600mm	All	F4 & Below
			t<13mm	F4	2G, 3G & 4G		T≤2t OD≥600mm	All	F4 & Below
4	Pipe/Tube Welder	- do -	OD<25mm	F4	6G	Fig.A6.4	Test piece Dia.& above	All	F4 & Below
			OD≥25mm &≤73mm	F4	6G		25mm & above	All	F4 & Below
			OD>73mm	F4	6G		73mm & above	All	F4 & Below
			t<13mm	F4	6G		T≤2t	All	F4 & Below
			t≥13mm	F4	6G		T-Unlimited	All	F4 & Below

* Also qualifies for welding fillet welds on material of unlimited thickness.

TABLE – A6.1 (contd...)

NOTES:

1. For P grouping refer Chapter II.
2. For F grouping refer Chapter III.
3. Base material limitation:
   a. Where test coupons belong to P1 thro' P15E, welder is qualified for base materials P1 thro' P15E.(ASME Sec IX QW 423, Alternate base material for welder qualification)

      It means, if a welder is qualified with carbon steel material, he is also qualified for alloy steel and vice versa.
   b. Use appropriate F group electrodes.
4. Qualification in one F number, qualifies for that F-number only, except as stated below in A, B, C & D.
   A. Qualification in F4 qualifies for F4 and below.
   B. Qualification in F5 qualifies for F5 only.
   C. Qualification in any of F41 thro' F45 qualifies for F41 thro' F45.
   D. For non-ferrous materials, the base materials shall be typical of production material and appropriate filler materials shall be selected. Qualification is limited to the base material, process and filler F group. Diameter and thickness limitations apply as per Table –A6.1

   OD = outer diameter, t = thickness of test coupon; T = thickness qualified.
5. Where qualification is for GTAW followed by SMAW, the welder is also qualified up-to 6 mm thickness by GTAW process.
6. Base material indicated is carbon steel; for other base materials, corresponding electrodes are to be chosen. Also for GTAW process, the corresponding filler wire should be chosen.

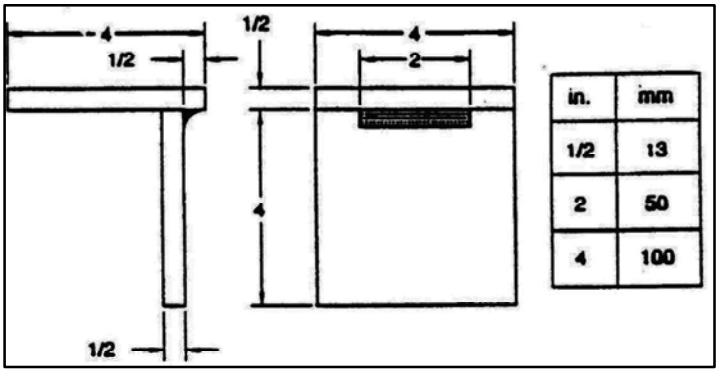


Figure A6.1 – Structural Tack Weld Specimen

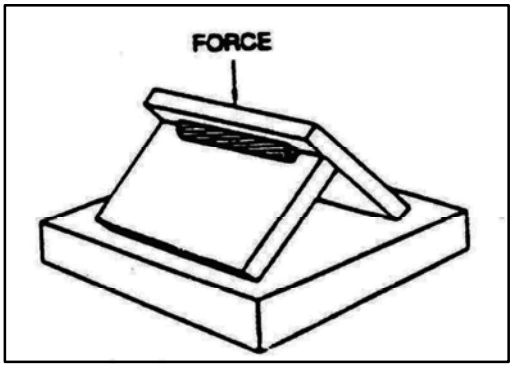


Figure A6.2 – Break Test

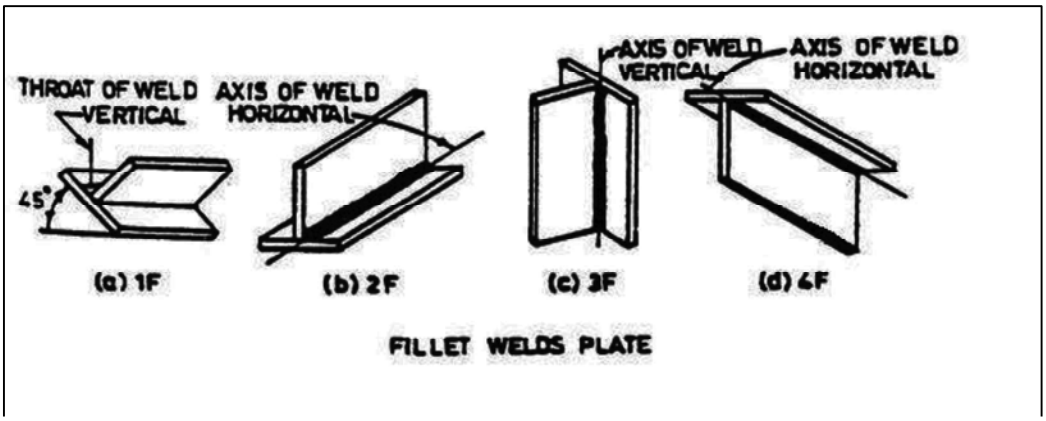


Figure A6.3 - WeldPositions

SECTION A4.3-PROCEDURE FOR WELDER QUALIFICATION FOR IBR APPLICATIONS

1.0 SCOPE

1.1 These requirements shall apply to testing of welders/welding operators engaged in the manufacture and welding connected with sitefabrication, erection and repair of boilers and piping of ferrous material under the purview of IBR.

2.0 DEFINITION

Welder: one who performs manual or semiautomatic welding.

3.0 ENGAGING OF CERTIFIED WELDERS

All welders engaged on welding of boilers or piping under fabrication, erection and repair at site shall possess a valid certificate as required byIBR, as per Form XIII issued by the Competent Authority under IBR.

4.0 QUALIFICATION TEST AND ISSUE OF CERTIFICATE

Every welder shall be duly tested and qualified at site to the satisfaction of BHEL/Customer.Every welded test piece for the examination of welders/welding operator shall be stamped by BHEL with an identification mark on either side of the weld. After satisfactory completion of the tests, BHEL shall issue a Certificate/ID Card to each Qualified Welder as per the Format given in Figure no.A6.9.

4.1 Each welder shall havebasic knowledge on the following:

i. Weld edge preparation
ii. Working of welding equipment.
iii. Properties of material to be welded – cold and hot working, thermal conductivity, fusion point, oxidation (for welders engaged in alloy steel welding).
iv. Electro-technical principles viz. kinds of current, striking arc voltage, welding arc voltage, etc.
v. Weld defects, their causes and prevention.
vi. Electrodes for different types of materials, welds and joints in different positions.

4.2 **MATERIAL FOR TESTS** – The material of plates, tubes, pipes and electrodes used for these tests shall conform to the requirements given below:

4.2.1 TEST WELDS FOR QUALIFICATION

(a) PLATE WELDING –

i. One weld joint of two pieces of boiler quality plates with double 'V' ordouble 'U' grooves over a minimum length of 300 mm shall be made in the following positions (size of plates to be welded being not less than 229 mm x 381 mm x 16 mm each):

(1) Flat position (figure A6.5) - Plate in a horizontal plane with the weld metal deposited from above.

(2) Horizontal Position (figure A6.6) – Plate in a vertical plane with the axis of the weld horizontal.

(3) Vertical Position (figure A6.7)- Plate in a vertical plane with the axis of the weld vertical

(4) Overhead Position (figure A6.8) – Plate in a horizontal plane with the weld metal deposited from underneath.

Qualification in Horizontal position shall automatically qualify Flat position. Qualification in Vertical position shall automatically qualify Flat and Horizontal positions. Also, qualification in Overhead position shall automatically qualify Flat, Horizontal and Vertical positions.

(b) For Pipe Welding –6G-Position:

Tube/Pipe with its axis inclined at 45 Deg. to horizontal. Welding shall be done without rotating the Tube/ pipe. Refer FigureA6.4.

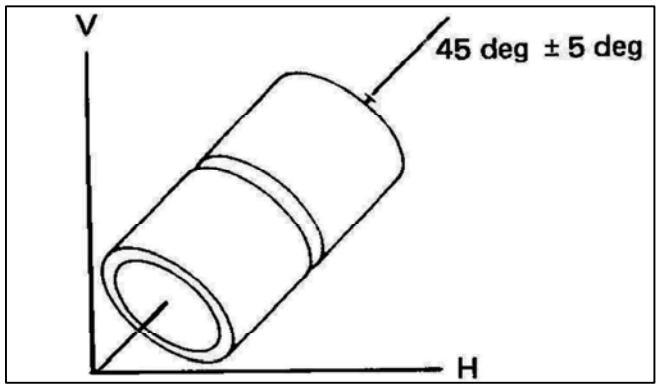


Figure A6.46G-Position

5.0 VALIDITY OF CERTIFICATE

a) Certificate issued to a welder shall remain valid for a period of twenty-four months from the date of issue, provided that the welder has, subsequent to the test, been continuously (gap not more than six months) employed on the class and type of work for which he is qualified.

b) The certificate may be extended, after the validity period, for another twenty-four months after conducting the re-qualification tests in-line with the initial Qualification tests.

c) In case of unsatisfactory performance of the Certified Welder as observed by the site engineer, the welder shall be re-qualified as per the requirements prior to engaging in subsequent welding works.

d) A welder qualified for a type and process of higher grade of steel can be allowed to weld the lower grade of steel.

e) A welder qualified on groove weld shall automatically qualify for fillet and socket welds.

6.0 EXAMINATION OF TEST SPECIMENS FOR QUALIFICATION TESTS

(a) The test specimens shall be visually examined as per Cl 6.0 of Chapter A7 of this Manual.

(b) After visual examination, the test specimen shall be subjected to radiographic examination as per the requirements specified in NDE Manual (BHEL:PS:NDEM-Latest).

7.0 MAINTENANCE OF RECORDS

Records of Qualified welders shall be maintained by the site engineer till the closure of the project. At the time of project closure, these records shall be handed over to the customer, if required by the Contract.

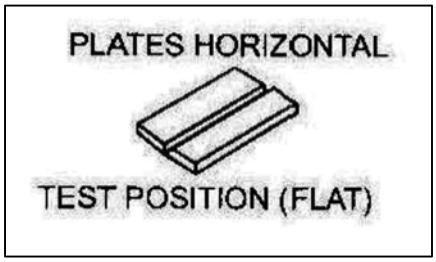


Figure A6.5Flat position

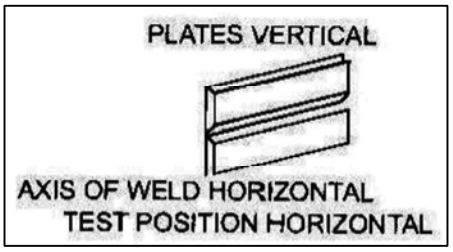


Figure A6.6Horizontal Position

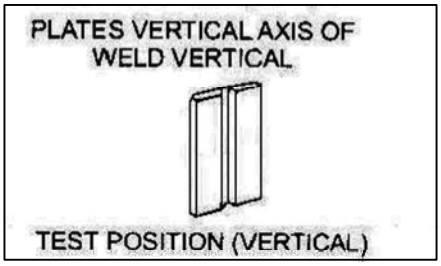


Figure A6.7Vertical Position

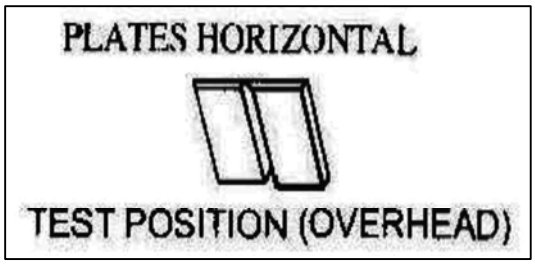


Figure A6.8Overhead Position

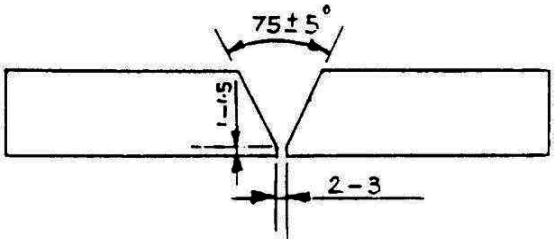
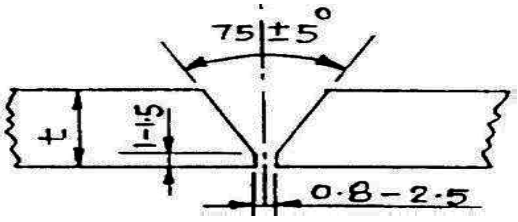
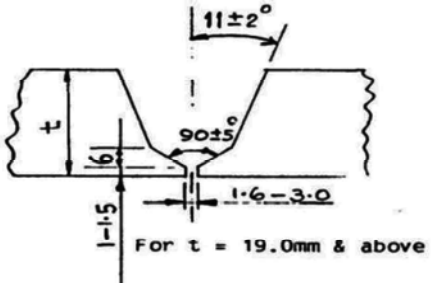


Figure A6.9- Plate butt weld specimen

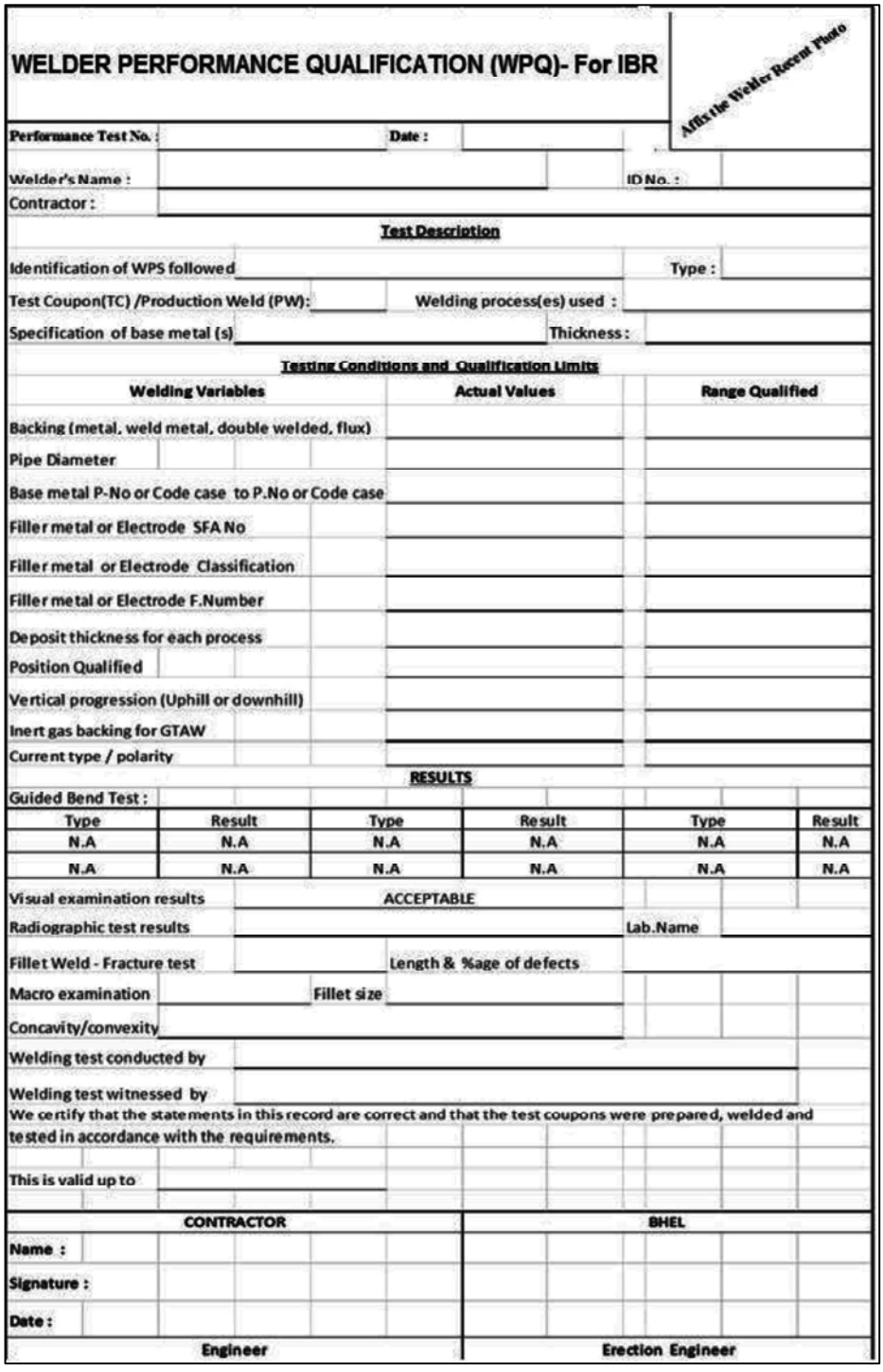


(A) for T upto 19 mm



(B) For T = 19.0mm &Above

Figure – A6.10 – Pipe Butt Weld Specimen



WELDER PERFORMANCE QUALIFICATION (WPQ)- For IBR

Affix the Welder Recent Photo

Performance Test No. : Date :

Welder's Name : ID No. :

Contractor :

Test Description

Identification of WPS followed Type :

Test Coupon(TC) /Production Weld (PW): Welding process(es) used :

Specification of base metal (s) Thickness :

Testing Conditions and Qualification Limits

Welding Variables	Actual Values	Range Qualified
Backing (metal, weld metal, double welded, flux)		
Pipe Diameter		
Base metal P-No or Code case to P.No or Code case		
Filler metal or Electrode SFA No		
Filler metal or Electrode Classification		
Filler metal or Electrode F.Number		
Deposit thickness for each process		
Position Qualified		
Vertical progression (Uphill or downhill)		
Inert gas backing for GTAW		
Current type / polarity		

RESULTS

Guided Bend Test :

Type	Result	Type	Result	Type	Result
N.A	N.A	N.A	N.A	N.A	N.A
N.A	N.A	N.A	N.A	N.A	N.A

Visual examination results ACCEPTABLE

Radiographic test results Lab.Name

Fillet Weld - Fracture test Length & %age of defects

Macro examination Fillet size

Concavity/convexity

Welding test conducted by

Welding test witnessed by

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

This is valid up to

CONTRACTOR	BHEL
Name :	
Signature :	
Date :	
Engineer	Erection Engineer

Figure A6.11: BHEL issued Welder Qualification Certificate

SECTION A4.4-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 having diameter≤ 88.9 mm:**

2.5.1.1 The percentage of defects shall be calculated as a percentage of number of unaccepted welds to those radiographed.

2.5.1.2 Upto and including 5% defects: Performance is satisfactory else unsatisfactory.

2.5.2 **For welds having diameter>88.9 mm and plate welds:**

2.5.2.1 The percentage of defects shall be calculated as a percentage of length of defects to the length radiographed.

2.5.2.2 Upto and including 2.5% defects: performance is satisfactory else unsatisfactory.

2.6 When a welder gives unsatisfactory performance for a continuous period of 3 months, he shall be re-qualified.

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 clause 2.6.

2.7 Welds produced during any month shall be radiographed and evaluated latest by 10th of the succeeding month.

2.7..1 Under circumstances when clause 2.7 is not satisfied for any particular welder, he may be disengaged from the job till such time his performance is evaluated for the month in study.

2.7..2 Site in-charge may waive the restriction imposed in 2.7.1reviewing the situations for non-compliance with 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, welder-wise as per the Annexure VI.

ANNEXURE VI: WELDERS PERFORMANCE MONITORING RECORD

WELDERS PERFORMANCE MONITORING RECORD - MONTH/YEAR :						
	Dia ≤ 88.9 mm (Note -1)			Dia > 88.9mm (Note-2)		
Welder Code	No of joints RT taken	No of defective joints	%age of defects	Length Radiographed	Length of defects	%age of defects

Note : 1. Upto and including 5% defects., performance is satisfactory else unsatisfactory.
2. Upto and including 2.5% defects, peformance is satisfactory else unsatisfactory.

CHAPTER – A5
INSPECTION OF WELDING

1.0 SCOPE:

1.1 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 Field 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 shall 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 Positive Material Identification (PMI) shall be carried out for all alloy steel and stainless steel materials for the parent metal before fit-up and for weld after welding.However, in case of tubes random PMI check shall be done on the parent metal and on 10% of the welds made by each welder per day. The procedure recommended by the PMI equipment manufacturer shall be followed for testing.

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

Maximum permissible misalignment at bore

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

4.4 While fit up, components to be welded shall not show any appreciable off-set or misalignment when viewed from positions apart.

4.5 The root opening of components to be joined shall be adequate to provide acceptable penetration.

4.6 On fillet welds, the parts to be joined shall be brought as close to contact as practical, although in most instances a small opening between the parts is desirable.

4.7 Weld area shall 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 maintained during welding. Preheating shall be done using resistance heating or induction heating or LPG burners. Preheating by cutting/ heating torches is not permitted.

5.2 Ensure correct electrode / filler metal is used for welding.

5.3 Tack welds shall be 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 inter pass temperature mentioned in WPS is not exceeded during welding.

5.6 Ensure proper cleaning of weld between beads.

6.0 CHECKS ON THE COMPLETED WELD:

6.1 There shall be 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 shall not exceed 0.8 mm (0.4 mm for tubes) or 10% of wall thickness whichever is less.

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: up to and including 3.2 mm.

6.5 For plate butt welds, the weld reinforcement shall 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 (ASME Sec I – PW 35)

Thickness of base metal in mm	Reinforcement in mm
Up to 3.0	2.5
Over 3 to 5	3.0
Over 5 to 13	4.0
Over 13 to 25	5.0
Over 25 to 50	6.0
Over 50	Max of 6.0 or 1/8 of weld width

6.7 There shall be no overlaps.The faces of fillet welds are not excessively convex or concave and the weld legs are of proper length.

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

CHAPTER – A6
SAFE PRACTICES IN WELDING

(This is included for information purposes only)

1.0 This 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.

2.0 **Electrical Hazards**

2.1 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.

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

2.3 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.

2.4 Cables and connections 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, non-conducting materials should be used. A physician should be called and CPR continued until breathing has been restored, or until a physician has arrived.

3.0 Fumes and Gases

3.1 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 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.

4.0 Noise

4.1 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 behaviour. 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.

5.0 Burn Protection

5.1 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.

5.2 Workers should wear protective clothing made of fire resistance 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 resistance clothing before working with open arc or flame.

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

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

6.0 Fire Prevention

6.1 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.

6.2 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.

6.3 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.

7.0 Radiation

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

7.2 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.

7.3 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.

1. Welding arcs should not be viewed except through welding filter plates.
2. Transparent welding curtains are not intended as welding filter plates, but rather, are intended to protect passersby from incidental exposure.
3. Exposed skin should be protected with adequate gloves and clothing as specified.
4. The casual passersby 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.

CHAPTER – B1
ERECTION WELDING PRACTICES FOR SA335 P91/P92, SA182 F91/F92 & SA217 C12A MATERIALS

1.0 SCOPE:

1.1. This document details out the practices to be adopted during erection of SA335 P91/P92,SA182 F91/F92 and SA 217 C12A materials.

2.0 MATERIAL:

2.1 Pipe materials shall be identified as follows:-

1) Colour codes given by the MUs.
2) Hard Stamping: Specification, Heat No, Size.
3) Paint / Stencil: WO DU, as per the relevant drawing & document.

2.2 When any defect like crack, lamination, and 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 P91/P92/F91/F92 material shall be done by band saw / hacksaw / machining / grinding only.Edge preparation (EP) shall be done by grinding/machining. During machining /grinding, care shall 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 weldof minimum 25mm length by GTAW at minimum 4 locations and fit-up by a clamping arrangement is recommended. Use of site manufactured clamps for fit up is acceptable.The necessary purging and preheat shall be done as per clause 3.3 and 5.0 respectively. Welding shall be done employing IBR qualified welders only.

3.1.4 The fit-up shall be as per the drawing. Root gap shall be 2 to 2.5mm and root mismatchshall be within 1.6mm. 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. Fixing of thermocouple (TC) and heating elements during preheating and PWHT:

3.2.1 Heat Treatment Manual (AA/CQ/GL/011/ PART II-HTM-Latest),Chapter 1, Clause no. 3.1.1, 3.1.5, 3.2.1, 3.2.2&3.2.6shall be referred for guidelines for fixing of thermocouples and heating elements on the jobs

3.3 Arrangement for purging:

3.3.1 Argon gas conforming to Gr 2 of IS 5760 (latest) 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 shall 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.

3.3.2 The flow rate which shall be maintained during purging is 10 to 26 litres/minute. Purging shall be started from inside of pipe when root temperature reaches 220°C. Continuous and adequate Argon Gas shall be provided 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 pipe size.

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

3.3.4 **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 similar to one as indicated in the Figure B2.1.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 shall be pulled outwards softly.

CAUTION: ENSURE REMOVAL OF PURGE DAM ARRANGEMENT AFTER WELDING

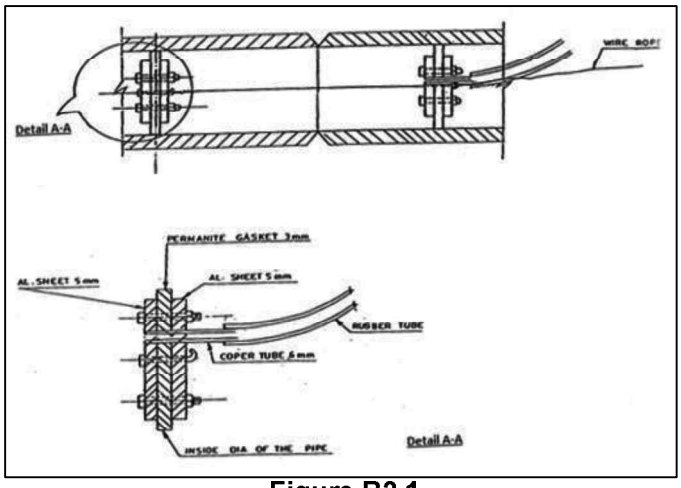


Figure B2.1

3.3.5 **Using water soluble paper:**

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

The Purge damming process illustrated as below:

3.3.5.1. For small diameter pipes, simply stuff water soluble paper/water soluble tissue paper into each section to be joined(Refer Figure B2.2).

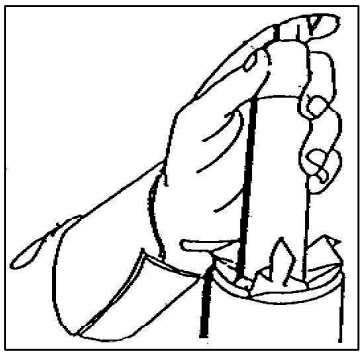


Figure B2.2

3.3.5.2. For larger pipes, cut out a circular aluminium foil disc slight 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)(ReferFigureB2.3).

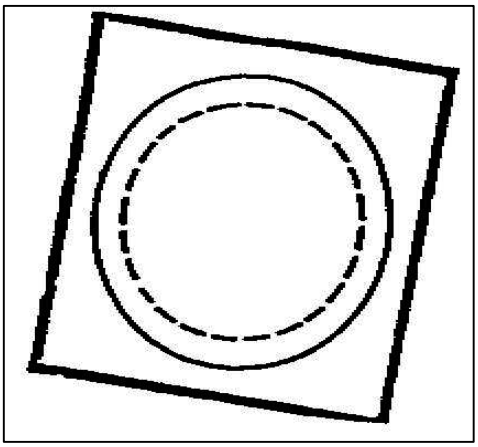


Figure B2.3

3.3.5.3. Position the disc within the pipe and tape in place with water soluble paper. Repeat procedure for other section. Insert the backing gas into the joint with a needle valve and make root pass in the usual manner (Refer Figure B2.4).

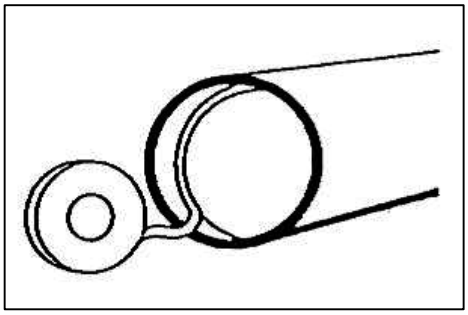


Figure B2.4

3.3.5.4. For pipes larger than 508 mm diameter, simply splice two sheets of water soluble paper together with water soluble tape as per Figure B2.5 and repeat procedure as shown in Figure B2.3 and B2.4 above.

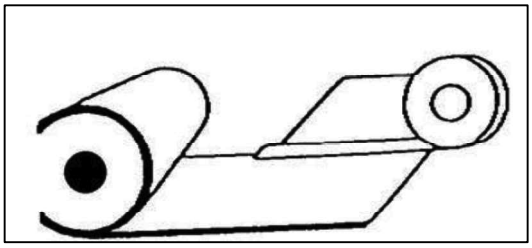


Figure B2.5

4.0 WELDING / WELDERS QUALIFICATION:

Welders Qualified as per IBR and qualified at site with Gr.91/Gr.92 material only shall be engaged. Welders log book shall be maintained and welders performance shall be monitored by site engineer. The applicable WPS as per FWS shall be followed for welder qualification and welding.

5.0 PREHEATING:

Heat Treatment Manual (AA/CQ/GL/011/ PART II-HTM-Latest),Chapter 1, Clause 3.1 shall be referred for guidelines for preheating.

6.0 WELDING:

6.1 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 till minimum two filler passes of SMAW.

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

7.0 STORAGE OF WELDING CONSUMABLES:

Refer Chapter A3, Section A-3.4of this Manual for guidelines which shall be followed for receipt, storage, drying & holding and issue of welding consumables.

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

8.0 POST WELD HEAT TREATMENT:

8.1 Heat Treatment Manual (AA/CQ/GL/011/ PART II-HTM– Latest), Chapter 1, Clause no. 3.2 shall be referred for guidelines on PWHT. In addition, the below requirements and precautions shall also be followed:

8.2 Welding and PWHT shall be monitored every one hour by site authorized personnel.

8.3 Preventive measures during power failure and non-functioning of equipment: 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 equipment, standby welding and heating equipment, reserve thermocouple connections, gas burner arrangement for maintaining temperature etc.). Following preventive measures shall be adopted until normal power supply or backup power supply through diesel generator is restored.

8.3.1 **Interruption 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 bepreheated as per Clause No: 5.0.

8.3.2 **Interruption during GTAW / SMAW:**

Maintain a preheat temperature of 220°C minimum using LPG gas burners till the welding is restarted. In case, preheat temperature is not maintained, an inter-stage stress relieving shall be carried out followed by visual inspection to ensure that no surface cracks are present in the weld, prior to restart of the welding.

8.3.3 **Interruption during cooling cycle**: After SMAW welding completion and cooling to holding temperature at 80 to 100°C, care shall be taken to avoid faster cooling rate by providing adequate insulation. The required temperatureof 80 – 100°C shall be maintained by gas burner arrangements till power resumes / start of PWHT (within 8 hours).

8.3.4 **Interruption during post weld heat treatment**;Heat treatment Manual (AA/CQ/GL/011/ PART II-HTM– Latest), Chapter 1, clause no. 3.2.5 shall be referred for guidelines to be followed for interruption during PWHT.

8.3.5 In all the above cases (8.3.1 to 8.3.4), the temperaturemeasurement on the weld joint shall be recorded using calibrated gauges/instrumentsat regular Intervals of 15 minutes in the log book by SiteEngineer.

8.4 Caution:

The PWHT temperature recorded in the chart shall not deviate from the specified values since any deviations to the specified soaking temperature Range, will adversely affect the mechanical properties of the weldment and may lead to rejection of the weldment. The weld Joints should be kept dry and no water/liquid is allowed to come in contact with the weld or preheated portion of pipe under any circumstances, till PWHT is completed.

9.0 CALIBRATION:

All equipment like recorder, thermocouple, compensating cable, oven thermostat etc. shall have valid calibration carried at BHEL approved laboratories. The calibration reports shall be reviewed and accepted by welding In-charge at site prior to use.

10.0 NONDESTRUCTIVE EXAMINATION (ReferNDE ManualAA/CQ/GL/011/ Part III-NDEM latest):

10.1 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.

UT procedure shall be as per BHE: NDT: PB: UT21 with additional requirementsas in (a) through (e):

a) The calibration blocks used shall be of the same product form and material specification or equivalent P-Number grouping as one of the materials being examined. P-Nos. 1, 3, 4, 5A through 5C, and 15A through 15F materials are considered equivalent for this purpose.

b) The UT equipment shall be calibrated prior to use and should be of 'digital type' capable of storing calibration data as well as ultrasonic test results as per procedure numberBHE:NDT:PB:UT-21.

c) All recordable indications shall 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 pattem' – 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 shall form part of test documentation.

e) The examination as well as evaluation shall be performed by a qualified Level II personnel, and a test report shall be issued. Any defect noticed during NDT shall be marked with marker.

11.0 REPAIR OF WELD JOINTS:

11.1 Weld repair at root:

If any surface defect is revealed at the time of visual inspection during root welding, the following steps shall be followed:

1. Maintain the temperature at 80-100°C for 1 hour.
2. Perform inter-stage PWHT.
3. Remove the defect by grinding.
4. After complete removal of defect, preheat the weld area to 220°C minimum and re weld with GTAW before starting SMAW, if required.

11.2 Weld repair on completion:

11.2.1 Any defect observed on the weld shall be brought to the notice of Site engineer. Any repair on weld shall be carried out with their approval only.

11.2.2 If any defects are noticed on the fully completed weld while performing UT after completion of PWHT, the depth of the defect shall be locatedfrom 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 shall be free from sharp corners and provided with sufficient slope towards the weldface sides.

b) Surface examination (MPI/LPI) on the ground area shall be performed to ensure complete defect removal before re-welding. Repair welding shall be carried as per the applicable WPS as for original welding.

12.0 HARDNESS SURVEY:

Hardness shall be measured using portable hardness tester.The equipment used for the hardness measurement shall be calibrated as recommended by the equipment manufacturer.

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 15mm from the edge of the weld.All the hardness values shall be recorded.

The hardness of the weld metal and the base metal in the soak band (heating band), excluding welding heat-affected zone shall be between 160HB & 300HB for Gr.91 and Gr.92 joints. The hardness measurements shall be recorded in the format as given in Annexure IX.Joints having hardness above 300HB shall be re-heat treated

and hardness shall be checked again. If hardness is still more, the case shall be referred to concerned MUs/ECs.In case Hardness falls below 160HB also, the case shall be referred to the concerned MUs/ECs.

Cautionary note: To achieve meaningful and consistent hardness results, below recommendations should be followed:

- The accuracy of the instrument shall be verified prior to use.
- The surface to be tested shall be reasonably flat and free of scale and oxides, grease, paint, etc.
- Prior to hardness test, the de-carburized surface layer with a thickness up to 0.8mm shall be removed by grinding/buffing, without encroaching the specified minimum wall thickness of the pipe/tube.

ANNEXURE IX – HARDNESS MEASUREMENT

BHARAT HEAVY ELECTRICALS LTD

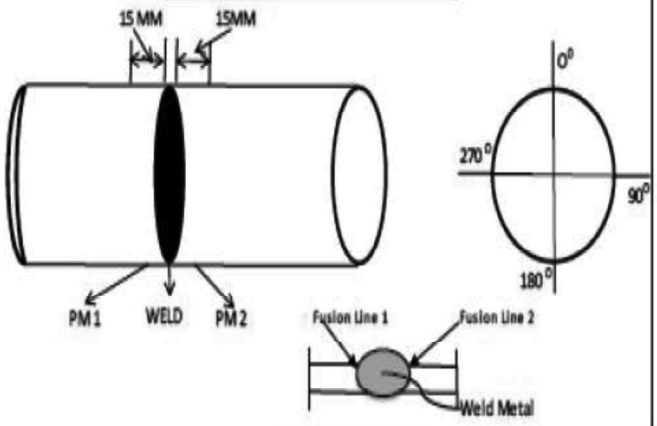
T91/T92/P91/P92/F91/F92/C12A HARDNESS TESTING PROTOCOL

PROJECT NAME :	UNIT No. :	Customer Name :
Report No.:	Date :	Contractor :
Description :	Specn :	Stage of test : After PWHT
Calibration Block No.:	Equipment details:	
PGMA :	Model No :	
JOINT NO. :		

Location	PM 1	WELD	PM 2
Readings	AVERAGE OF 3 READINGS	AVERAGE OF 3 READINGS	AVERAGE OF 3 READINGS
12 O'Clock/ 0^0			
3 O' Clock/ 90^0			
6 O'Clock/ 180^0			
9 O'Clock/ 270^0			

PM: PARENT MATERIAL (15 MM FROM THE WELD FUSION LINE). ALL AVERAGE READINGS SHOULD BE LESS THAN THE PERMISSIBLE HARDNESS VALUE.

HARDNESS TEST LOCATIONS SKETCH



Gap between successive reading shall be 1mm in the same spot

RECOMMENDATION / RESULT : ACCEPTED / NOT ACCEPTED / RE-PWHT

	AGENCY	NAME	SIGNATURE & DATE
INSPECTED BY	CONTRACTOR		
CHECKED BY	BHEL		
WITNESSED BY	CUSTOMER		

13.0 COMBINATION WELDING:

For other combination of materials with Gr.91/Gr.92, the applicableWPS for the same shall beobtained fromconcerned MUs/ECs.

14.0 DEMAGNETIZATION:

Refer NDE Manual BHEL:PS:NDM:latest Chapter 1.10

15.0 TRAINING:

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

a. Method and care to be taken 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 knowledge of the WPS requirements.
g. Handling of P91 welding consumables and re-drying conditions.
h. Special precautions to be taken during the power/equipment failure.
i. Weld joints of dissimilar thickness / material specification.
j. Weld defect control and weld repair systems.

15.2 **Specific training for welders:**

a. The qualified welders who will be engaged in P91 welding shall be given training on 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 Dos and DON'Ts of P91 welding.
d. Welders only who are qualified on P91 welding alone shall be engaged.
e. Whenever new welders have to be engaged they shall undergo all the training as above and shall be qualified with P91 material only.

16.0 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 inter-pass 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.

17.0 PERSONNEL / CONTRACTORS ENGAGED FOR HEATING CYCLES (HT OPERATOR):

17.1 The Personnel / Contractor shall have adequate heat treat experience on P91 or similar material.

17.2 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 equipment.

c. Procedure to be followed in case of power failure or equipment non-functioning so that heating cycle is not disrupted.

d. Calibration of equipment.

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.

18.0 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-IA.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.

19.0 LEVEL OF SUPERVISION

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

20.0 DO'S AND DON'T'S DURING P 9 1 /P 92 /F9 1 /F92 /C1 2 A WELDING.HEAT TREATMENT AND NDE AT CONSTRUCTION SITE:

20.1 **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 capacitor discharge portable spot-welding equipment.

e. Reserve Thermocouples shall be madeavailable,in case 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 °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 onroot weld maintaining weld preheating temp.

j. Continue Argon purging until the GTAW root welding followed by minimum two filler passes of SMAW, is completed.

k. Perform partial root welding to facilitate fit-up if necessary.

l. Ensure proper use of TIG wires as identified by color coding or suitable hard punching.

m. Keep the GTAW wires in absolutely clean condition and free from oil, rust, etc.

n. Dry the SMAW electrodes before use.

o. Ensure the inter-pass temperature is less than 350°C.

p. Hold at 80-100°C fora period ofMinimum 1 hour before the start of PWHT.

q. Record entire heating cycle on Chart through recorders.

r. Exercise control during grinding of weld and adjoining base metal while removing surface/sub-surface defects or during preparation for NDE.

s. Ensure no contact with moisture during preheat, welding, post heat and PWHT of Weld Joints.

t. Ensure removal of argon purging arrangements after welding.

u. Use short Arc only. The maximum weaving shall be limited to 1.5 times the Dia. of the electrode.

20.2 DO N' T' s:

a. Avoid Oxy-Acetylene flame cutting.

b. Avoid Weld-build up to correct the weld end-d1 or to set right the lip of the weld bevel.

c. Avoid Arc strike on materials at the time of weld fit up or during welding.

d. Do not Tack weld the Thermocouple wires with Manual Arc/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 unidentifiedTIG 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 un-calibrated equipment for temperature measurement during heating, welding, post weld, heat treating etc.

21.0 DOCUMENTATION:

The documentation shall be as per the approved Quality Plan.

CHAPTER – B2
ERECTION WELDING PRACTICES FOR SA 213 T91/T92 MATERIALS

1.0 SCOPE:

1.1 This document details out the practices to be adopted during welding of SA213 T91/T92 material.

2.0 MATERIAL:

2.1 Tube materials shall be identified as follows:-

a) Colour codes given by the Manufacturing Units (MU).

b) Paint / Stencil: WO DU, as per the relevant drawing & document.

2.2 When any defect like crack, lamination, and 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 T91/T92 material shall be done by band saw/hacksaw/machining/ grinding only. Edge preparation (EP) shall be done by grinding/machining. During machining/ grinding, care should be taken to avoid excessive pressure to prevent heating of the tube edges.

3.1.2 The weld fit-up shall be carried out to ensure proper alignment and root gap. Neither tack welds nor bridge pieces shall be used to secure alignment. Use site fabricated clamps for fit up. Ensure that coil load does not come on stubs/header. Coil load shall be transferred to the crown plate/ end bar assembly. The necessary purging and preheat shall be done as per clause 3.3 and 5.0 respectively.

3.2 **Fixing of thermocouple (TC) and heating elements during preheating and PWHT**

3.2.1 Heat Treatment Manual (AA/CQ/GL/011/ PART II-HTM-Latest), Chapter 1, Clause no. 3.1.1, 3.1.5, 3.2.1, 3.2.2, 3.2.6 & 3.2.7 shall be referred for guidelines for fixing of thermocouples and heating elements on the jobs.

3.3 **Arrangement for purging:**

3.3.1 Argon gas with requisite quality shall be used for purging the root side of weld. The purging dam (water soluble paper) shall be fixed on header nipple side of the weld bevel prior to fit-up and pre-heating. Purging is to be done from cross over tube downstream end. (Refer Figure B3.2 and B3.3). Ensure that atmospheric air is completely purged out through the root gap before starting welding and welding can be continued with Argon backing. The flow rate which shall be maintained for purging is 6 to 8 litres per minute.

3.3.2 When root temperature reaches 220°C, start purging through cross over tube downstream end for 5 minutes. Then the root gap is to be covered by insulating material. Continuous and adequate argon gas shall be provided to ensure complete

purging in the root area. Only water-soluble paper is to be used. Plastic foils that are not water-soluble are NOT acceptable.

3.3.3 Usage of water soluble paper:

3.3.3.1 The dams can be made of water-soluble paper /water soluble tissue paper for creating the purging chamber. The advantage in such dam arrangement is that the dissolving paper dam gets flushed during hydraulic test. The following is the method to be used:

3.3.3.2 Stuff the water-soluble paper/ water soluble tissue paper into the Header Nipples at a distance of 60mm(approximately) from the weld end as per attached Figure B3.1

4.0 WELDING/WELDERS QUALIFICATION:

4.1 Welders Qualified as per IBR and qualified at site with Gr.91/Gr.92 material only shall be engaged. Welders log book shall be maintained and welders performance shall be monitored by site engineer. The applicable WPS as per FWS shall be followed for welder qualification and welding.

5.0 PREHEATING (Bunching of tubes can be followed):

5.1 Heat Treatment Manual (AA/CQ/GL/011/ PART II-HTM-Latest), Chapter 1, Clause 3.1 shall be referred for guidelines for preheating.

6.0 WELDING:

6.1 Welding shall be done as per the WPS. Filler wire shall be clean and free from rust or oil. Argon Purging shall be continued till completion of welding in case of full GTAW and for minimum two filler passes of SMAW in case of GTAW + SMAW.

7.0 POST WELD HEAT TREATMENT (PWHT) – RESISTANCE HEATING METHOD(Bunching of tubes can be followed):

7.1 Heat Treatment Manual (AA/CQ/GL/011/ PART II-HTM– Latest), Chapter 1, Clause no. 3.2.12 shall be referred for guidelines on PWHT.

8.0 HARDNESS SURVEY:

8.1 100% hardness survey shall be conducted on welds and parent material in first five coils. Based on satisfactory results, the hardness survey can be reduced to 10% covering each heat treatment cycles as per FWS requirement. The equipment recommended to measure the hardness is EQUOTIP or equivalent. Portable equipment used in the hardness measurement shall be calibrated.

8.2 The surface shall be cleaned and prepared as per hardness test instrument manufacture's recommendation prior to hardness survey. Hardness survey of weld and parent metal (both tubes) shall be carried out. The hardness shall be between 160HB & 300HB. The hardness measurements shall be recorded in the format as given in Annexure IX. Joints having hardness above 300HB shall be re-heat treated and hardness shall be checked again. If hardness is still more, the case shall be

referred to concerned MUs. In case Hardness falls below 160HB also, the case shall be referred to the concerned MUs.

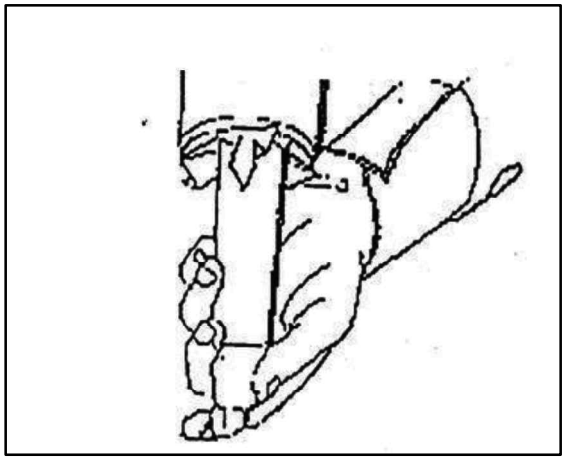


Figure B3.1: Insertion of Water Soluble Tissue paper

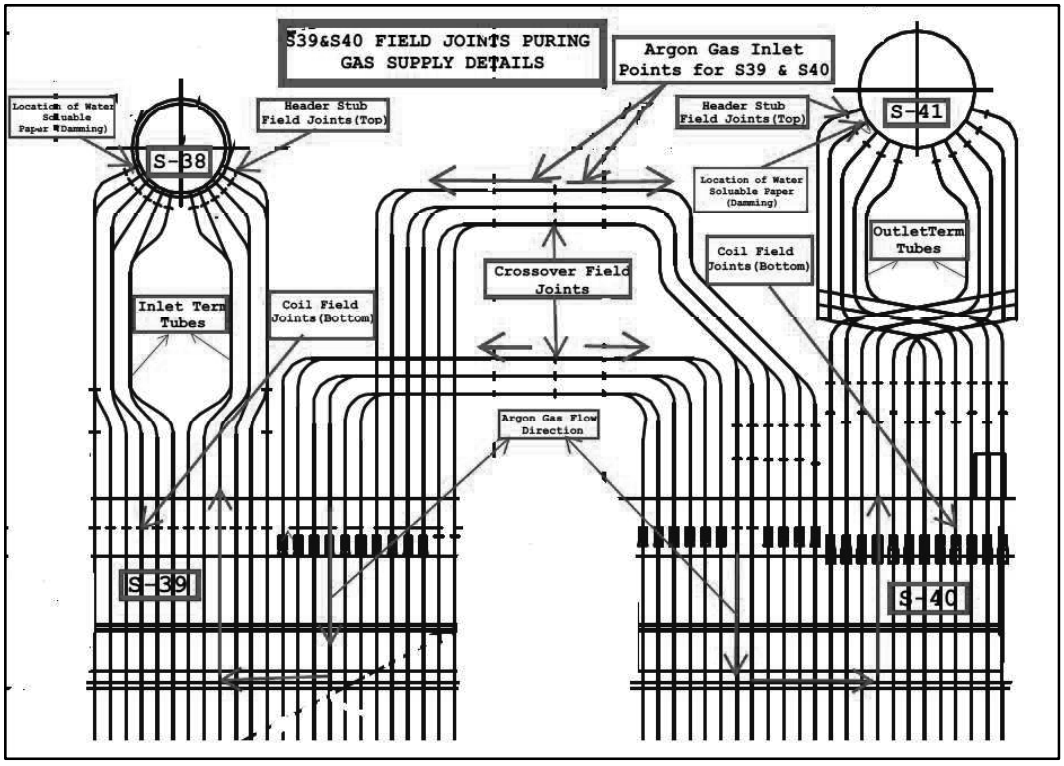


Figure B2.2: Purging Arrangement for SH Header Field Joints

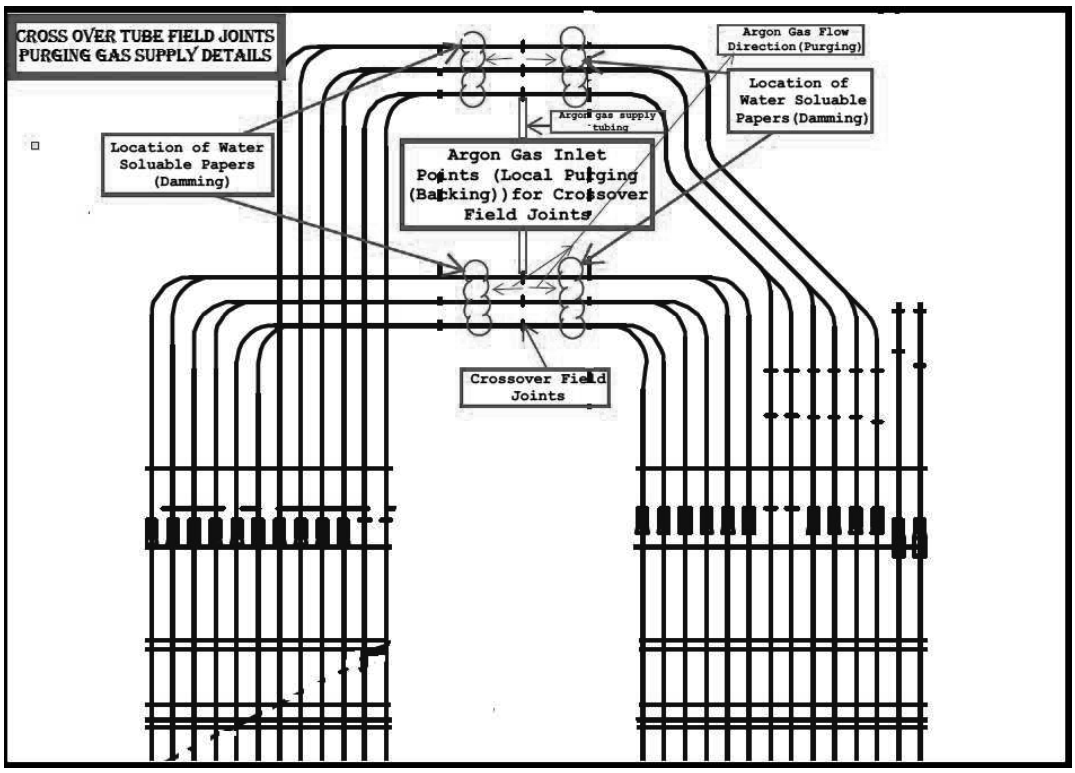


Figure B2.3: Purging Arrangement for Cross Over Tube Field Joints

CHAPTER –B3
ERECTION WELDING PRACTICES FOR SA213 T23 MATERIAL

1.0 SCOPE:

1.1 This procedure is applicable for the welding of T23 tubes at sites.

2.0 Ensure the availability of the following items/characteristics before preparing the joint for welding:

a) LPG gas (for heating in case of interruption in preheating)
b) Grinding machine
c) Mini cutter
d) Conical grinder
e) Proper illumination
f) Thermal chalk or pyrometer
g) Torch light
h) Portable Oven
i) Hacksaw and chisel

3.0 PROCEDURE:

The following procedure shall be followed for T23 Welding at Site:

3.1 Clean the edges of the tube, both OD & ID by buffing upto 30 mm from the edge of the tube.

3.2 Create a purging dam on both tubes at about 200 to 250 mm away from the joint beforefit-up.

3.3 Fit-up the tubes for butt joint with a root gap of 2 to 2.5 mm and ensure a land of 1 to 1.5 mm.

3.4 Set up Argon purging for the tube to tube butt joint.

3.5 Carryout preheating by wrapping heating pads/coils uniformly for a width of 200 mm on both sides of the joint. Each tube should be provided with a thermocouple (K type) at a distance of 75 mm from the joint.(Refer FigureB4.1, B4.2 &B4.3)

3.6 Preheat the joint to a minimum of 200°C and ensure the same with a thermal chalk or a pyrometer before the start of welding.

3.7 Ensure drying of SMAW electrodes at 250 to 300°C for 2 hours and keep them at a temperature of 150°C in a Holding oven after drying.

3.8 The electrodes shall be maintained dry at 65 to 100 °C in a portable oven after issue from the holding oven till use.

3.9 Perform welding as per applicable WPS using IBR qualified welders.

3.10 Ensure the welding of root and second pass by TIG welding process and further layers by SMAW process. Alternatively, the entire joint may be welded by TIG process using the applicable WPS.

3.11 Maintain the Interpass temperature at 350°C max. Ensure the same using thermal chalk or pyrometer after each pass of welding.

3.12 Conduct post heating on the completed weld at 250 to 280°C for a minimum of 1 hour immediately after completion of welding and then allow the joint to cool in air to ambient temperature.(Refer Figure B4. 4)

3.13 Perform RT to ensure that the joints are defect free.

3.14 If RT reveals any unacceptable defect, cut the joint and put a spool piece in place for a minimum length of 200 mm. Repeat the procedure from step 3.1 to 3.13.

3.15 Perform PWHT on the weldment within 7 days after post heating.

3.16 Use only calibrated PWHT accessories (thermocouples, temperature recorder, etc.).

3.17 Use only ceramic resistance pads with low voltage heating arrangement for PWHT.

3.18 Ensure the PWHT arrangement to meet the following conditions;

3.19 When heat treating butt welds, the width of the circumferential heating band on either side of the weld must be at least 3 times the width of the widest part of the weld groove but not less than twice the thickness of the thicker part welded. The width of the insulation band shall be at least twice the total width of the heating band.

3.20 Ensure wrapping of heating pads, location of thermocouples before covering with insulation.(referFigure B4.5& B4.6)

3.21 PWHT shall be carried out with 1 thermocouple per joint.

3.22 PWHT time and temperature shall be as per applicable WPS.

3.23 Measure hardness on the joint and ensure it to be within 160 to 260 HB. If hardness exceeds 260 HB, PWHT shall be repeated and hardness checked. The total no. of PWHT cycles shall not exceed 3 times for a joint.

3.24 In case the hardness measures above 260HB even after 3 PWHT cycles, cut the joint and put a spool piece in place for a minimum length of 200 mm. Repeat the procedure from step 3.1 to 3.23. In case the hardness measures below 160HB, it shall be referred to the MUs.

4.0 DOCUMENTATION:

Record the details of welding carried out in correlation to welders, heat treatment and NDE reports.

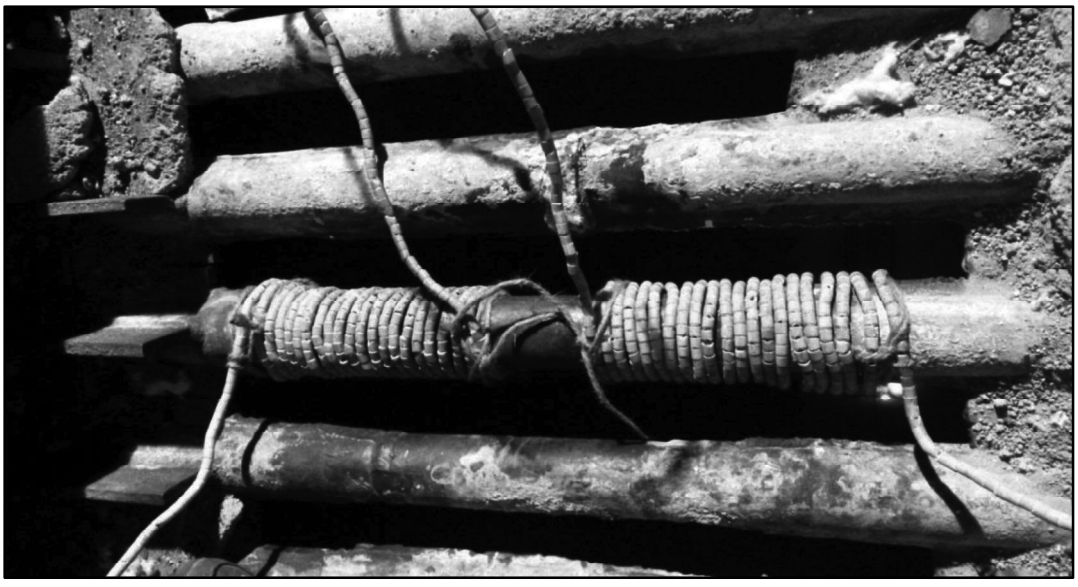


Figure B3.1: Preheating by Resistance coil winding

Figure B3.2: K - Type Thermocouple

Figure B3.3: Preheating arrangement with thermocouples in place

Figure B3.4: Post heating arrangement

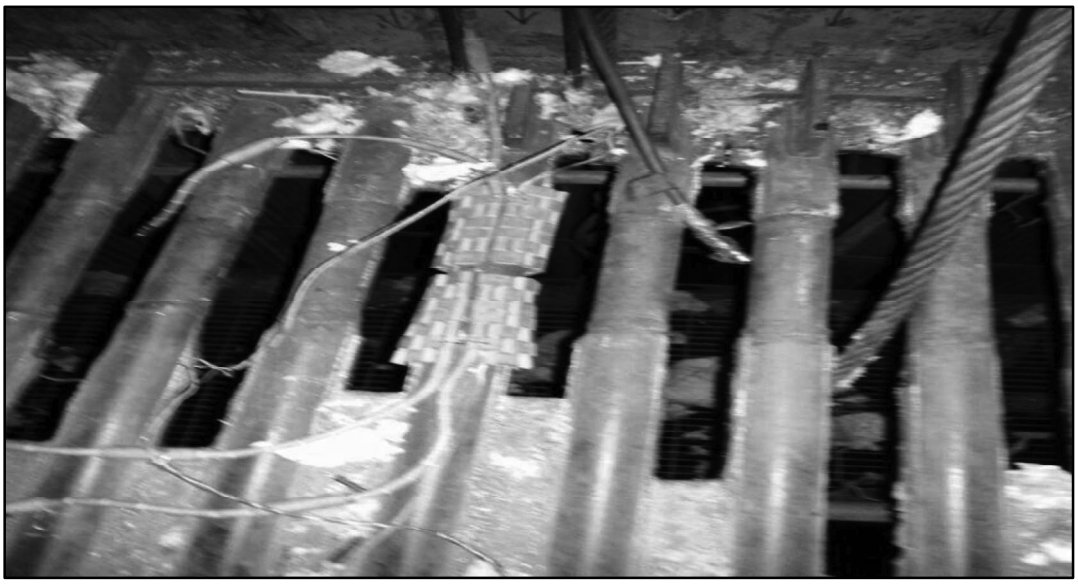


Figure B3.5: Heating pads in place for PWHT

Figure B3.6: PWHT in progress