VOLUME – IA
Part I & II

TECHNICAL CONDITIONS OF CONTRACT (TCC)

BHARAT HEAVY ELECTRICALS LIMITED

CONTENTS

Sl.No.	DESCRIPTION	Chapter	No. of Pages
Vol IA	**Part-I: Contract specific details**		
1	Project Information	Chapter-I	02
2	Scope of works	Chapter-II	08
3	Facilities & Consumables in the scope of Contractor / BHEL (Scope Matrix)	Chapter-III	08
4	T&Ps and MMEs to be deployed by Contractor	Chapter-IV	03
5	T&Ps and MMEs to be deployed by BHEL on sharing basis	Chapter-V	02
6	Time Schedule	Chapter-VI	03
7	Terms of Payment	Chapter-VII	02
8	Taxes and other Duties	Chapter-VIII	02
9	BOQ	Chapter-IX	19
10	General	Chapter-X	11
11	Progress of work	Chapter-XI	02
12	Foundations, Grouting and Civil Works	Chapter-XII	03
13	Handling & storage	Chapter-XIII	03
14	Erection	Chapter-XIV	19
15	Welding, Heat treatment ,Radiography & Non-Destructive Testing	Chapter-XV	06
16	Coating & wrapping	Chapter-XVI	02
17	Hydraulic test for Piping	Chapter-XVII	02
18	Testing & Commissioning	Chapter-XVIII	08
19	Painting	Chapter-XIX	04
Vol IA	**Part-II: Technical specifications**		
1	Corrections / Revisions in General Conditions of Contract and Forms & Procedures.	Chapter-1	04
2	Erection welding Schedule- LP PIPING	Chapter-2	10
3	Painting schedule/Customer painting specification for LP Piping	Chapter-3	18
4	P&ID & other layout for LP Piping Works	Chapter-4	14
5	Guidelines for Heat Treatment	Chapter-5	18
6	Guidelines for Welding	Chapter-6	98
7	Guidelines for NDE and Heat Treatment Agency	Chapter-7	13
8	T&P Hire Charges	Chapter-8	13
9	"HSE Plan for Site Operations by Subcontractor" (Document No. HSEP: 14 Rev01)	Chapter-9	82

10	Format for Form no.: F-14 (Rev 01); Monthly Plan and Review with Contractors	Chapter-10	06
11	Format for Form no.: F-15 (Rev 03); Monthly Performance Evaluation of contractor	Chapter-11	08
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-Procedure for Conduct of Conciliation Proceedings	Chapter-14	11

VOLUME-IA PART-I CHAPTER-I
PROJECT INFORMATION

1.1	Project Title	:	Ennore SEZ project of 2 x 660 MW Coal Based Super Critical Thermal Power Project at Ash Dyke of NCTPS
1.2	Plant capacity	:	1320 MW (2 units of 660 MW each)
1.3	Type of project	:	Green field
1.4	Owner	:	Tamil Nadu Generation and Distribution Corporation Limited (TANGEDCO)
1.5	Consultant	:	DESEIN, New Delhi
1.6	Plant site location	:	Ash dyke of North Chennai Thermal Power Station (NCTPS)
1.7	Location co-ordinates	:	80° 18' E to 80 ° 19' E Longitude 13° 17' N to 13 ° 18' N Latitude
1.7	Nearest Village	:	Vayalur
1.8	Nearest Town & City	:	Chennai (35 Km)
1.9	State Capital	:	Chennai (35 Km)
1.10	Nearest Railway Station	:	Athipattu Pudunagar (~ 5 Km) on Chennai – Vijayawada Line
1.11	Nearest Airport	:	Chennai (~ 60 Km)
1.12	Nearest Seaport	:	Ennore (~ 3 Km)
1.13	Nearest Road access	:	All weather road from Pattamandri on the Thiruvottiyur – Ponneri highway
2.0	**Meteorological Condition**		
2.1	Climate	:	Tropical, very dry and hot summer, dry and cold winter and good rain-fall in monsoon accompanied with strong wind
2.2	Site Elevation	:	(+) 10.0 Meter above Mean Sea Level
2.3	Ambient Temperature		
a.	Annual Maximum Mean Temperature	:	32 ºC
b.	Annual Minimum Mean Temperature	:	24 ºC
c.	Design ambient temperature	:	35 ºC
2.4	Relative Humidity		
a.	Maximum	:	100 %

b.	Minimum	:	36 %
c.	Design	:	75 %
2.5	Annual Rainfall		
	Maximum	:	2540 mm
	Average	:	1600 mm
	Minimum	:	1175 mm
2.6	Basic Design Wind Pressure	:	As per IS: 875 (Latest Edition)
2.7	Wind Speed	:	11.8 kmph (Avg), 50 m/s (max)
2.7	Seismic zone	:	Zone: III as defined in IS:1893-2002
2.8	Design ambient temperature for Electrical equipment	:	50 °C

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

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

1.2.1 The scope of work includes 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 & hangers and supports, pre-commissioning, commissioning, trial operation & handing over to customer of LP piping including Sea-water Piping System, Plant water system, DM cooling water system, Instrument & Service Air system, Plant service water and potable water system, PT-RO-DM Plant System, Fire Protection system, Pumps & Misc Equipments, Cranes and hoists and its associated items / systems, hangers and supports, valves, miscellaneous Equipment's .etc. for both Unit -1 & Unit -2 at 2 x 660 MW Ennore SEZ Supercritical Thermal Power Project at Ash Dyke of NCTPS, Tamil Nadu.

1.2.2 Brief list of system / sub system to be erected by the contractor & approximate weight individual PGMA are given elsewhere in this booklet are meant for giving general idea to the tenderer. The piping components are sent in parts for convenient transportation / layout requirements. They are to be cleaned, pre-assembled in stage, welded, erected and aligned as per the drawing dimensions / tolerance and instructions of BHEL engineers.

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

1.2.4 Preassembly, Erection, Testing, Commissioning, Trial operation and reliable operation of equipment.

1.2.5 Final painting and labelling including supply of paints.

1.2.6 Preparation of As Built drawings.

1.2.7 The terminal points are given as per drawing /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.

1.2.8 General scope of system covered under scope of work includes LP piping including Sea-water Piping System, Plant water system, DM cooling water system, Instrument & Service Air system, Plant service water and potable water system, PT-RO-DM Plant System, Fire Protection system, Pumps & Misc Equipments, Cranes and hoists and its associated items / systems, hangers and supports, valves, miscellaneous Equipment's etc. The general scope covers the installation and commissioning of all systems.

The scope of the works for the above mentioned systems will comprise of but not limited to the following activities:-

- Receipt of materials, storage at site, erection and commissioning of the system.
- Piping and associated all types of fittings, Hanger & supports, expansion bellows, etc.,
- Flow measuring devices / sensors like nozzles, orifice plates etc.,
- Air and moisture traps, Air release valves
- Safety relief valves, Butterfly valves, Expansion joints, dummies erection for Hydro testing of pipe lines.
- The material range from MS, GI, CS, SS, PVC etc., the connection are welded, flanged or threaded as per system and drawings.
- Completion of Hydro test as per P & ID and site requirement as per IBR, to be completed for all the systems for LP piping, Sea Water Intake Piping, PT-RO-DM System piping and piping for Fire protection system.
- Valves – with Manual, Electrical and Pneumatic operated actuators.

- All misc. pumps- Horizontal, Vertical and submersible with motors.
- Strainers, Filters, Coolers, pre-fabricated Tanks
- Hoists & Cranes- either manual or motor operated
- Chemical dosing system Skid and associated Equipments.
- All underground piping should be wrapped and coated as per specifications.
- Chemical handling / loading to be carried.
- The valves are operated -manual, electrical or Pneumatic or hydraulic. The valves may be supplied either mounted with or without actuator. If supplied separately, the actuator is to be assembled to the valve at site during erection.
- The pumps are supplied along with motors. The motors are to be erected and aligned with the pumps and with gear box wherever supplied as loose.
- The welding of stubs for Pressure & temperature transmitters and other instruments, thermo wells etc. welding as per P& ID and wherever necessary is within the scope of contract .
- Grouting to be carried out for all pumps (both primary and secondary grouting) after initial & final alignment of pumps, grouting details to be referred from pump supplier.
- Similarly, all tanks, equipment foundations to be grouted.
- All the wrapping & coating for underground piping to be carried as per painting specification only.
- Painting to be carried as per painting specification only for both over ground and underground including supports. For detailed information on Painting and Wrapping and coating refer relevant chapters.

The area of work covers erection of valves, pumps with motors, underground and over ground piping, supports and instrumentation etc. including pre-commission and commissioning but not limited to the following.

Broad description of area wise with scope is as follows, relevant P & ID are also enclosed for tendering purpose.

1.2.9 **LP PIPING SYSTEM:**

1. Sea Water Piping System

A. Piping inside Sea Water Intake PH

B. Piping from Sea Water Intake Pump House to plant boundary (Approximate distance of 1.4 Kms Upon concrete pedestal at ground level from Sea Water Intake PH to nearby of TH-1 and approximate distance of 2.6 Kms Upon Pipe Conveyor 1A/1B pier deck from nearby of TH-1 to plant boundary at approximate height of 15-20 Mtrs). For further details bidders to refer enclosed drawings. (tentative and liable to change)

C. CW Blow down line from Hot water Channel to plant boundary boundary (Approximate distance of 1.4 Kms Upon concrete pedestal at ground level from Hot water Channel to nearby of TH-1 and approximate distance of 2.6 Kms Upon Pipe Conveyor 1A/1B pier deck from nearby of TH-1 to plant boundary at approximate height of 15-20 Mtrs). For further details bidders to refer enclosed drawings (tentative and liable to change)

D. Intermittent Over ground piping (CS Piping) arising from GRP Piping at various locations between plant boundary and CW Pump House.

2. Plant Water System

A. Clarified Water Storage tank inlet to RO Plant

B. Filtered Water Storage tank inlet to common header and further distribution to Ash water P/H, Potable water tanks, Service Water tank, APH wash system of both Units, Crusher House, Ash Utility Building etc.

C. Filtered Water Storage tank inlet to common header and further distribution to HVAC make up system to different buildings including PH roof, Service

Building roof, Admin Building roof, Air Washer room -1 ,2,3 & 4 , ESP 1 roof, ESP 2 roof etc.

D. Filtered Water Storage tank inlet to common header and further distribution to Fire Protection System.

3. **DM cooling water system:**

A. From DMCW pumps to all TG auxiliaries /equipments

B. DM tank to SG & Boiler Auxiliaries.

C. DMCW pumps to Auxiliary boiler, SWAS, Deareator, chiller system.

D. All chemical dosing lines

4. **Instrument Air System:** from compressor house to FOPH, Unloading/DYKE area, DM, all BOP & water packages, Deareator, Aux boiler, TG & BOILER and its auxiliaries etc.

5. **Service Air System**; from Compressor house to TG & BOILER, all BOP and water packages, DG SET, Service building, CPU, gas room, elevator, Auxiliary boiler ,HFO,FOPH,AC plant etc.

6. **Service water system:** from service water overhead tank to all BOP & water packages, all service buildings [TG, ESP, CCR, make pump house, simulator, fire station, indoor storage area ,gate complex etc.] ,air washer room, boiler ,SWAS, flash tank drain tank cooling, CHP , ECHS area, SWIPH, AHP area, FOPH, FO unloading & dyke area, flash tank area ,chemical house, Fire water protection system area, make up water tank, canteen , auxiliary boiler etc.

7. **Potable water system:** From potable water tank to all BOP & water packages, switch yard control room, ETP ,CMB, chemical house, Fire water protection system area, make up water tank, canteen, auxiliary boiler ,ash water pump house, boiler area, CCR, AHP& CHP area , SWIPH, FO unloading & dyke area. Etc.

8. PT-RO-DM system:

A. Pre Treatment System including Horizontal Dual Media Filters, DMF air blowers with all accessories , DMF backwash pumps with all accessories, dosing system, self cleaning strainers, ultra filtration skids, UF air blowers with all accessories, inter connecting piping & valves, UF backwash pumps, UF CIP pumps, UF CIP Tank (FRP MOC), UF Backwash tank (FRP MOC) etc.

B. RO System including Cartridge filter feed pump & accessories, dosing system, cartridge filters – RO Stage I & Stage II, RO Stage I & Stage II - HP Pumps & motors, Energy recovery device, RO Stage I (SWRO), SWRO flash pump & accessories, RO Stage I permeate supply pumps & accessories, RO Stage II (BWRO), Degasser Tower, Degasser blower with motor & accessories, inter connecting pipes & valves ,etc.

C. Common Chemical cleaning system including CC Preparation tank (FRP), SWRO CC Tank (FRP MOC), SWRO CIP pump & accessories, SWRO CC Cartridge filters, BWRO CIP tank (FRP MOC), BWRO CIP pump & accessories, BWRO CC cartridge filters, etc.

D. Remineralization system including Remineralization filter feed pumps & accessories, Remineralization filter backwash pumps & accessories, Remineralization Filters, Dosing system, etc.

E. Other Systems & equipment's including external piping, instrument air piping, utility piping, hangers & supports, platforms, assembly of pipe rack, Lab items, Monorail with hoists, etc.

9. **Fire Protection system** –

A. Water based Fire protection system:

A.1 Fire water pump house:[FWPH] Erection of piping for all the Equipments like centrifugal hydrant pumps [electrical & diesel], booster pumps and its accessories including Integral piping both under & over ground with supports

from fire water storage tank to all jockey, hydrant pumps, spray also lines from Hydro pneumatic tank in the Fire water pump house etc.

A.2 Hydrant & Spray System: Erection of over ground & underground piping with supports, including erection of hose boxes, valves which covers, areas of CHP, AHP, ESP, BOILER & all BOP packages, and other Equipment's etc.

A.3 Medium Velocity water Spray System: Erection of ERW GI pipe from main spray header line to Rectifier transformer at ESP roof top, Fuel Oil storage tank, Fuel Oil Unloading PH & Pressurising PH, Coal Conveyors, Bunker bay, Crusher House, Transfer Towers (TT-1 to TT-12), Transfer House TH1, Junction Tower (JTB 3, JTB4), Pipe Conveyor (PC 1A/1B), Emergency Reclaim Hopper (including tunnel conveyor), TG, ESP, transfer points in CHP area, SWIPH , Cable Galleries in TG Building, CHP Control room, Ash water PH, CWPH, ESP Control room, etc.

A.4 High Velocity water Spray System: Erection of ERW GI & MS pipe from main spray header to GT, ST, UAT, SAT & UT transformers, Boiler Burner, Aux Boiler Burner, Lube Oil console, BFP lube oil & turbine lube oil, Turbine Oil Canal, Generator Seal oil system tanks & cooler assembly, Diesel tank of DG set, ICHP auxiliary transformers, SWI & ECHS transformers, AHP auxiliary transformers, RODM Aux transformers, ECHP Aux transformers, etc.

B. Foam Protection system: From foam tanks to foam chamber near LDO, HFO tanks including foam pumps, foam bypass valves, deluge valves, bypass lines with instrumentation like foam monitors and foam proportions, etc.

C. INERT GAS EXTINGUISHING System: Receipt and Placement of cylinders inert gas cylinders in respective locations room, erection of all hose connections, instruments in cylinder room, completion of CI piping in the areas of Main Control rooms, Control equipment room Unit 1 & 2, Computer room & UPS Charger room, etc.

10. Miscellaneous Pumps , Hoists & Other Equipments:

A. Miscellaneous Pumps including Sea Water Makeup pumps, Filter Feed Pumps, APH/ESP Wash Pumps, SG Fill Pumps, AHP Seal water Pumps, HVAC Makeup Pumps, Service Water Pumps, Service Water Booster Pumps, CHP DFDS MUP Pumps, Potable Water Pumps, Potable Water Booster Pumps, AHP Conditioner MUP Pumps, Hotwell MUP Pumps, DM MUP Pumps, Sump Pumps, Travelling Water Screen, Conical Strainers, etc.

B. Single Girder Crane & Electric Hoist in buildings including Air Compressor Building , DG Building , Filter Water PH, Workshop Building, Sea Water Intake PH TWS Screen & gates handling, Clarified Water PH, Permanent Store, CST Pumps Shed, Sea Water Intake PH, Boiler MCC Switchgear room, ESP Control room, Compressor Building MCC, Service Building (Elevator M/c Room), Admin Building (Elevator M/C Room), ESP Control Room (Elevator M/c Room), FOPH, DM Pump House, Chain pulley blocks in Booster PH, Fire Station Building & other bldgs., etc.

Note: for further detailed scope of works, refer relevant chapters in this book

VOLUME-IA PART-I CHAPTER-III

FACILITIES IN THE SCOPE OF CONTRACTOR / BHEL

(SCOPE MATRIX)

Sl.No	Description	Scope to be taken care by		Remarks
		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 equipments, office / store / canteen consumables		Yes	
1.3.1.1.1.5	Canteen facilities for the bidder's staff, supervisors and engineers etc		Yes	
1.3.1.1.1.6	Fire fighting equipments like buckets, extinguishers Etc		Yes	
1.3.1.1.1.7	Fencing of storage area, office, canteen etc of the bidder		Yes	
1.3.1.1.2	**FOR LIVING PURPOSES OF THE BIDDER**			
1.3.1.1.2.1	Open space		Yes	
1.3.1.1.2.2	Living accommodation		Yes	
1.3.1.2	**ELECTRICITY**			
1.3.1.2.1	Electricity For construction purposes (to be specified whether chargeable or free)			**Chargeable Basis.**
1.3.1.2.1.1	Single point source	Yes		Refer clause 1.3.4
1.3.1.2.1.2	Further distribution for the work to be done which include supply of materials and execution		Yes	
1.3.1.2.2	Electricity for the office, stores, canteen etc of the bidder which include:		Yes	
1.3.1.2.2.1	Distribution from single point including supply of materials and service		Yes	
1.3.1.2.2.2	Supply, installation and connection of material of energy meter including operation and maintenance		Yes	Calibration certificate to be provided

Sl.No	Description	Scope to be taken care by		Remarks
		BHEL	Bidder	
1.3.1.2.2.3	Duties and deposits including statutory clearances for the above		Yes	
1.3.1.2.2.4	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	
1.3.1.3	**WATER SUPPLY**			
1.3.1.3.1	For construction purposes:			**Chargeable Basis**
1.3.1.3.1.1	Making the water available at single point	Yes		Refer clause 1.3.5
1.3.1.3.1.2	Further distribution as per the requirement of work including supply of materials and execution		Yes	
1.3.1.3.2	Water supply for bidder's office, stores, canteen etc			
1.3.1.3.2.1	Making the water available at single point		Yes	
1.3.1.3.2.2	Further distribution as per the requirement of work including supply of materials and execution		Yes	
1.3.1.4	**LIGHTING**			
1.3.1.4.1	For construction work (supply of all the necessary materials) At office storage area At the preassembly area At the construction site /area		Yes	
1.3.1.4.2	For construction work (Execution of the lighting work / arrangements) At office storage area At the preassembly area At the construction site /area		Yes	
1.3.1.5	**COMMUNICATION FACILITIES for site operations of the bidder**	-		
1.3.1.5.1	Telephone, Fax, internet, internet, email etc (min 2 Nos of PC & Printer) – 2 Data entry operator with computer knowledge		Yes	
1.3.1.6	**COMPRESSED AIR SUPPLY**			
1.3.1.6.1	Supply of Compressor and all other equipments required for compressor & compressed air system including pipes, valves, storage systems etc	-	YES	

1.3.1.6.2	Installation of above system and operation & maintenance of the same	-	YES	
1.3.1.6.3	Supply of the all the consumables for the above system during the contract period		YES	

Sl.No	**Description**	**Scope to be taken**		**Remarks**
1.3.2	**PART II**	**BHEL**	**Bidde**	
1.3.2.1	**ERECTION FACILITIES**			
1.3.2.1.0	Engineering works for construction			
1.3.2.1.1	Providing the erection drawings for all the equipments covered under this scope	Yes		
1.3.2.1.2	Drawings for construction methods		Yes	In 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	Yes	In consultation with BHEL
1.3.2.1.5	Preparation of site erection schedules and other input requirements		Yes	
1.3.2.1.6	Review of performance and revision of site erection schedules in order to achieve the end dates and other commitments		Yes	In consultation with BHEL
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 are completed as per schedule. It is suggested this review by the senior official of the bidder should be done once in every two months.		Yes	
1.3.2.1.10	Preparation of preassembly bay		Yes	
1.3.2.1.11	Laying of racks for gantry crane if provided by BHEL or brought by the contractor/bidder himself			Not applicable

1.3.3 **LAND FOR SITE OFFICE AND LABOUR COLONY**

1.3.3.1 Minimum Open space as made available by customer will be provided at free of charges to the contractor, for construction of temporary office shed, fabrication yard and storage area at the job site, contractor's stores shed(s).

1.3.3.2 BHEL shall not provide to the contractor any residential accommodation to any of his staff and the contractor has to make his own arrangements. Contractor has to make his own arrangements for labour colony.

1.3.3.3 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 In general, Construction power will be provided to the contractor on prevailing rates of TANGEDCO on chargeable basis at one single point by BHEL. The contractor to Provide necessary energy meter for measuring the power consumption. The contractor shall make his own arrangement for further distribution with necessary isolator/LCB etc. However, based on request of Contractor and requirement of project, BHEL Site in charge, at his discretion, may provide construction power at multiple point (as close to work area as possible), for smooth execution of the work at site. If, BHEL provides electricity at more than one point (as close to work area as possible), it will be responsibility of the contractor to provide all the support necessary for enabling BHEL for extending such provision to contractor. However, the Construction power provided to the contractor shall be on chargeable basis at prevailing rates of TANGEDCO. The contractor has to Provide necessary meter for measuring the power consumption. The contractor shall make his own arrangement for further distribution with necessary isolator/ LCB etc. Any dispute, BHEL engineer's decision shall be final and binding on contractor.

Construction power prevailing charges are as below,
The present LT tariff VI rate of TANGEDCO is:
a) Consumption charges at Rs.12.00 per unit
b) Maximum demand (MD) charges as applicable per month
c) Low Power Factor (LPF) charges
d) Electricity Tax on total amount
e) Any other miscellaneous charges charged by M/s TANGEDCO pertaining to construction power supply.

Note - The TANGEDCO tariff and tax may vary from time to time and the same is applicable for the bidder.

1.3.4.2 Any other charges, 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.

1.3.4.3 Provision of distribution of electrical power from the given points to the required places with proper distribution boards, approved cables and cable laying including supply of all materials like cables, switch boards, pipes etc.,

observing the safety rules laid down by electrical authority of the State/ BHEL / their customer with appropriate statutory requirements shall be the responsibility of the tenderer / contractor.

1.3.4.4 The required energy meter for measuring power consumption shall be arranged by the contractor and taken care by the contractor.

1.3.4.5 Necessary "Capacitor Banks" to improve the Power factor to a minimum of 0.9 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.

1.3.4.6 Contractor has to make their own arrangements for electricity requirement for labour colony at their cost. Any duty, deposit involved in getting the Electricity for contractors use i.e. Office shed, labour colony etc shall be borne by the bidder

1.3.4.7 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.

1.3.4.8 As there are bound to be interruptions in regular power supply, power cut/ load shedding in any construction sites / non availability of power source near work area, contractor should make his own arrangement for alternative source of power supply through deployment of adequate number of DG sets at their cost during the power breakdown / failure to get urgent and important work to go on without interruptions. No separate payment shall be made for this contingency.

1.3.5 CONSTRUCTION WATE

1.3.5.1 Water required for construction purposes will be provided at one single point within the plant area on chargeable basis from the nearest storage tank located inside the plant area at the prevailing rates of TANGEDCO / Metro water. The required water meter for measuring the consumption shall be provided and installed by the contractor. The required pumps & accessories, pipes for drawing water from the storage tank and further distribution will be arranged by the contractor at their cost.

1.3.5.2 The water charges may vary from time to time as per TANGEDCO / Metro water conditions, however the prevailing water charge is Rs.191.00 per 1000 litres. Any dispute regarding consumption, the BHEL engineer decision will be final. In case of non-availability of water, the contractor shall make his own arrangements of water suitable for construction to have 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.

1.3.5.3 Incase non-availability of water, the contractor shall make his own arrangements of water suitable for construction purpose to have uninterrupted work. No separate payment shall be made for any contingency arrangement made by contractor, due to delay / failure for providing water supply.

1.3.5.4 Contractor has to make his own arrangements for his water requirement for his labour colony at his cost.

1.3.6 DRINKING WATER:

1.3.6.1 Bidder shall provide drinking water at the work spot at their cost.

1.3.7 ONLINE SITE CONSTRUCTION MANAGEMENT SYSTEM [SCMS]:

Two Nos of computers and printers(MFP) of latest configuration (preferably i5 processor, 8 GB Ram, 1 TB Hard disk, with internet provision on all the computers), along with one data entry operator per computer to be arranged by contractor for reporting of daily progress, billing, updating details in online SCMS package of BHEL, etc., within the quoted rate.

1.3.8 CONSUMABLES:

1.3.8.1 Any special welding electrodes / consumables as provided by manufacturing units for LP Piping works, 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/equipments 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 of equipments will be supplied free of cost by BHEL.

1.3.12 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.

1.3.13 OTHER FACILITIES

Adequate water less urinals [at least 2 nos per level] shall be arranged by the contractor within quoted rates, with proper disposal arrangement.

1.3.14 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 each unit for execution of the scope of works covered under this contract.

Sl. No.	Description	Qty
01	For loading and transportation, all necessary T&P such as trailers, Cranes, Winches, welding generators, slings, jacks, sleepers, rails etc., are to be arranged by the contractor.	As required
02	Crane with appropriate capacity	As required
03	Fill pump	As required
04	HT pump for hydro test (up to 50 Kg/Sq.cm) of LP piping	As required
05	DG Set with appropriate capacity	As required

1.4.2 All the T&Ps required for this scope of work, except the Tools & Plants provided by BHEL are to be arranged 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, quantity / numbers and capacity as mutually agreed at site for major T&Ps, have to be adhered to. Numbers/quantity, Capacity & time of requirement of T&Ps will be reviewed time to time by BHEL site and contractor will provide required T&Ps / equipments 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 The contractor to furnish a list of Tools and plants including cranes, tractors / trailers / trucks etc. which contractor proposed to deploy for this work.

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

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

1.4.7 For handling at store and transportation, contractor shall make his own arrangement.

1.4.8 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.

1.4.9 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.

1.4.10 Required HYDRA / 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.

1.4.11 In the event of contractor failing to arrange the required tools, plants, machinery, equipments, material or non-availability of the same owing to the breakdown, BHEL will make alternative arrangement at the risk and cost of the contractor:

Case 1: BHEL provides its own Capital T&P: In case the BHEL provides any T&P which is owned by BHEL, hire charges (as per BHEL norms) will be recovered from the contractor as per the prevailing BHEL Corporate hire charges. In case, the T&P is specifically listed in “T&Ps to be deployed by Contractor”, “hire charges applicable to outside agencies other than contractors working for BHEL” will apply. If not listed, “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: 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 5 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.

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

1.4.13 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.

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

1.4.15 Also Refer clause no 1.5.6 to 1.5.8 in connection with BHEL T&Ps in chapter V of this booklet.

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

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

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

1.5.1 EOT crane without operating personnel shall be made available in the T.G. Hall free of charge for erection purposes. The contractor has to arrange operator for EOT Crane. As the above crane is deployed for T.G. & Aux. erection and also for various contractors the decision of BHEL engineers will be final with regard to allotment of crane.

1.5.2 Experienced Crane operator for EOT crane to be arranged by the bidder at their cost.

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

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

1.5.5 In the event of the crane not available for longer duration due to major breakdown or any other reasons, BHEL will reschedule the work in consultation with bidder and direct the bidder to concentrate on other areas till such time the cranes are made available.

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

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

1.5.8 All the distribution boards, connecting cables, hoses etc., and temporary connection work including electrical connections for the BHEL issued T & Ps shall have to be arranged by the contractor at his cost.

1.5.9 Cranes provided by BHEL are only for erection purpose and shall not be available for material handling or transportation purpose. Contractor shall make their own arrangements for material transportation to erection site.

1.5.10 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.

1.5.11 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.,

1.5.12 Any additional crane and other T & P which may be required for successful and timely execution of the work covered within the scope of this tender shall be arranged and provided at site by the contractor at his cost. In case if the contractor fails to provide such equipments, BHEL will arrange for the same and the cost will be recovered from the contractor's bill with BHEL overheads, as applicable from time to time which may vary even during contract period.

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 LP piping including Sea-water Piping System, Plant water system, DM cooling water system, Instrument & Service Air system, Plant service water and potable water system, PT-RO-DM Plant System, Fire Protection system, Pumps & Misc Equipments, Cranes and hoists and its associated items / systems, hangers and supports, valves, miscellaneous Equipment's .etc. for both units (Unit-1 & Unit-2) as detailed elsewhere in the Tender Specification shall be completed within Twenty-Four (24) months from the date of commencement of work at site. The phase shift between both units shall be approximately 02 months.

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 both units are in operation. The decision of BHEL in this regard shall be final and binding of the contractor. The scope of work under this contract is deemed to be completed only when so certified by the site Engineer.

1.6.1.4. The contractor is required to refer Form 15 in Volume-I Book-II for all the instructions to be taken immediately after receipt of LOI.

1.6.3. COMMENCEMENT OF CONTRACT PERIOD

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

1.6.4. MOBILISATION FOR ERECTION, TESTING, ASSISTANCE FOR COMMISSIONING 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**	
	Unit-1	Unit-2
Start of Erection	01st Month	03rd Month
Readiness for Boiler Light Up	07th Month	09th Month
Readiness for Synchronization	13th Month	15th Month
Readiness for Full Load & Trial Operation	14th Month	16th Month
Completion of Hoists and other non critical Misc. works in all respect	20th Month	22nd Month
Completion of contractual obligation	24th 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 CONTRACT PERIOD

The contract period shall be **Twenty-Four (24) months** from the "COMMENCEMENT OF CONTRACT PERIOD" as specified earlier for completion of the entire work.

1.6.5 GUARANTEE PERIOD

The guarantee period of **Twenty-Four (24) months** for workmanship shall commence from

a) the date of handing over of the latter unit to customer

(or)

b) Six months after the date of first synchronization of the latter unit (provided all erection, testing, and commissioning works are completed in all respects at site).

whichever is earlier.

1.6.6 MAJOR INTERMEDIATE MILESTONES :

Sl. No.	Description	Month (from date of commencement)	Intermediate Milestone
1	Readiness for Boiler Light Up of first unit to get commissioned	07th Month	M1
2	Readiness for Synchronisation of the latter unit to get commissioned	15th Month	M2

Note : Please refer Please refer *Sl No. 6 Part II Chapter-1* of Technical Conditions of Contract (Volume IA of Volume I Book I) for Penalty for Intermediate Milestones

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

1.7.1 **Terms of payment :**

Progressive Payment against monthly running bills will be made up to 85 % of the value of the erected tonnage Pro rata as per Cl no 1.7.1.1 to 1.7.1.7 of the following table.

1.7.1	**Activity /Erection**	% of payment
1.7.1.1	ON PRE-ASSEMBLY WHEREVER APPLICABLE. (if not applicable then this portion to be paid along with placement in position) FOR UG- wrapping & coating included	10%
1.7.1.2	PLACEMENT IN POSITION OF PRE ASSEMBLED [equipment/pipe/instruments]	20%
1.7.1.3	ALIGNMENT IN ALL ASPECTS	15%
1.7.1.4	WELDING/BOLTING/GROUTING[including initial & final]	15%
1.7.1.5	Completion of Supports in all aspects	15%
1.7.1.6	COMPLETION OF NON DESTRUCTIVE EXAMINATION & STRESS RELIEVING / HEAT TREATMENT (if not applicable, then this portion to be clubbed with next activity)	5%
1.7.1.7	HYDRAULIC TEST / PNEUMATIC TEST WHEREVER APPLICABLE (if not applicable, then this portion to be clubbed with previous activity)	5%
	Total for Pro rata (85%)	**85%**

1.7.2 Further 15 % payment on pro-rata basis common to all PG shall be released on achievement of the following stage / milestones events (as per Cl no 1.7. 2.1 to1.7.2.8of the following table) for the tonnage erected.

1.7.2	**STAGE / MILESTONE PAYMENTS (15%)**	
1.7.2.1	Boiler Light Up	1%
1.7.2.2	Rolling and Synchronization	2%
1.7.2.3	Full Load	1%
1.7.2.4	Trail Operation	2%
1.7.2.5	Painting (including arrow marking, nomenclature, etc)	3%
1.7.2.6	Area cleaning, temporary structures cutting/removal and return of scrap.	2%
1.7.2.7	Punch List points/pending points liquidation	2%
1.7.2.8	Material Reconciliation	1%
1.7.2.9	Completion of Contractual Obligations	1%
	Total for Milestone / Stage payments (15%)	**15%**
	Total of 1.7.1 & 1.7.2	**100%**

Notes to Terms of payment:

Refer Part II Chapter 1 of this Technical Conditions of Contract for Corrections/ Revisions in Special Conditions of Contract, General Conditions of Contract and Forms & Procedures.

VOLUME-IA PART – I CHAPTER-VIII

TAXES AND 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 : 33AAACB4146P2ZL

NAME : BHARAT HEAVY ELECTRICALS LIMITED

ADDRESS : BHEL PSSR SITE OFFICE
2X 660 MW ENNORE SEZ STPP,
VAYALUR BR PO, MINJUR PO
TAMILNADU – 601203, India

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) 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 BILL OF QUANTITY

S.NO.	DESCRIPTION	APPROX WT (In MT)	Rate Schedule
1	SS PIPING	95.377	1A
2	CS PIPING	1943.363	1B
3	GI PIPING	63.794	1C
4	CS PIPING (UG + WRAPPING)	280.693	1D
5	SEA WATER PIPING SYSTEM	5708.212	1E
6	H&S / EQPTS / INSTR / MISC ITEMS	817.430	2
	TOTAL WEIGHT (in MT)	8908.870	

1.9.1 APPR`OXIMATE WEIGHT DETAILS

Workorder	PGMA Description	Qty	WEIGHT (MT)	CATEGORY	Rate Schedule
P1/7273-LU-066-1-80-470	SEA WATER PIPING SYSTEM		5708.212	SW Piping	1E
P1/7273-LU-185-1-80-473	DEMINERALISED WATER SYSTEM		36.728	SS Piping	1A
P1/7273-LU-057-1-80-477	SERVICE WATER PIPING		309.801	CS Piping	1B
P1/7273-LU-286-1-80-478	DRINKING WATER PIPING		86.462	CS Piping	1B
P1/7273-LU-190-1-80-610	SERVICE AIR PIPING		37.865	GI Piping	1C
P1/7273-LU-190-1-80-610	SERVICE AIR PIPING		7.327	SS Piping	1A
P1/7273-LU-195-1-80-614	INSTRUMENT AIR PIPING		14.862	GI Piping	1C
P1/7273-LU-195-1-80-614	INSTRUMENT AIR PIPING		7.327	SS Piping	1A
P1/7273-LU-030-1-80-933	H AND S FOR LPP		51.746	CS Piping	1B
	AIR TRAPS	50	0.350	CS Piping	1B
	AIR RELEASE VALVES	80	15.000	CS Piping	1B
	BALL VALVES	350	1.300	CS Piping	1B
	GUN METAL GATE/ GLOBE/ NRV/ HV	196	0.350	CS Piping	1B
	BUTTERFLY VALVES (STEAM SERVICE)	4	28.500	CS Piping	1B
	STEEL(GATE/GLOBE/NRV)	226	50.000	CS Piping	1B
	BFV (WATER SYSTEM)	11	2.000	CS Piping	1B
	PUMPS & EQUIPMENTS		175.300	Refer 1.9.1.2	
	CRANES & HOISTS		54.025	Refer 1.9.1.3	
	FIRE PROTECTION SYSTEM		1714.715	Refer 1.9.1.4	
	PT-RO-DM SYSTEM		607.000	Refer 1.9.1.5	

1.9.1.1 SEA WATER PIPING SYSTEM DETAILS (P1/7273-LU-066-1-80-470)

PG	MA	DU	MARK NO./DESCRIPTION	UNIT	QTY	WEIGHT (KG).	Rate Schedule
80	470	004	PIPE OD1320X12 WITH SADDLE SUPP(OG)	NO	650.000	32,05,605.000	1E
80	470	005	PIPE OD1524X14 WITH SADDLE SUPP(OG)	NO	300.000	19,81,290.000	1E
80	470	006	PIPE OD1320X12 WITH SADDLE SUPP(OG) - GF	NO	14.000	69,043.800	1E
80	470	007	PIPE OD1524X14 WITH SADDLE SUPP(OG) - GF	NO	37.000	2,44,359.100	1E
80	470	008	P.F.PIPE OD 1320X12(OG) L=5M NO G.F COAT	NO	15.000	29,015.955	1E
80	470	009	P.F.PIPE OD 1524X14(OG) L=5M NO G.F COAT	NO	10.000	29,742.080	1E
80	470	010	P.F.PIPE OD1320X12 WITH MANHOLE(OG) - GF	NO	20.000	23,598.980	1E
80	470	011	P.F.PIPE OD1524X14 WITH MANHOLE(OG) - GF	NO	10.000	16,061.850	1E
80	470	012	90DEG MITREBEND OD1320X12(OG) -GF	NO	34.000	20,994.354	1E
80	470	013	30DEG MITREBEND OD1320X12(OG) -GF	NO	4.000	1,132.660	1E
80	470	014	45DEG MITREBEND OD1320X12(OG) -GF	NO	10.000	3,853.720	1E
80	470	015	90DEG MITREBEND OD1524X16 (OG) -GF	NO	16.000	17,503.616	1E
80	470	016	30DEG MITREBEND OD1524X16 (OG) -GF	NO	2.000	967.120	1E
80	470	017	45DEG MITREBEND OD1524X16 (OG) -GF	NO	3.000	1,987.998	1E
80	470	019	P.F.PIPE NB600 WITH FLANGES-OG GF COAT	NO	16.000	8,159.232	1E
80	470	020	90DEG MITRE BEND WITH FLANGES (OG) GF	NO	4.000	1,325.976	1E
80	470	022	90DEG MITREBEND OD1016X10(OG) -GF	NO	4.000	1,423.992	1E
80	470	023	UN EQUAL TEE NB1800X1000 (UG) -GF COAT	NO	4.000	7,470.648	1E
80	470	024	UN EQUAL TEE NB1800X1300&NB600 (UG) GF	NO	1.000	6,767.019	1E
80	470	025	DISHED END NB1800 (UG) GF COAT	NO	2.000	1,328.848	1E
80	470	026	HEX BOLT M33X140-SS316L	NO	320.000	400.000	1E
80	470	027	HEX NUT M33 -SS316L	NO	320.000	96.000	1E
80	470	028	RUBBER GASKET NB600 CL150	NO	16.000	12.960	1E
80	470	029	HEX BOLT M20X90-SS316L	NO	270.000	82.890	1E
80	470	030	HEX NUT M20 -SS316L	NO	270.000	17.550	1E
80	470	031	RUBBER GASKET NB200 CL150	NO	31.000	6.200	1E
80	470	032	P.F. PIPE OD1829X16-(UG) GF COAT	NO	1.000	6,898.454	1E
80	470	033	P.F. PIPE OD1016X10-(OG) GF COAT	NO	4.000	1,617.416	1E
80	470	034	P.F. PIPE OD1016X10-(OG) NO GF COAT	NO	4.000	4,958.060	1E
80	470	035	P.F.REDUCER OD1016/OD964 (OG) GF COAT	NO	4.000	372.784	1E
80	470	036	45DEG MITREBEND NB600 WITH FL(OG) GF COA	NO	2.000	430.686	1E
80	470	037	PUDDLE FLANGE NB1000(OG)-GF COAT	NO	4.000	2,941.256	1E
80	470	038	PIPE OD1016 WITH SADDLE&STUB(OG)G.F COAT	NO	3.000	2,332.377	1E

80	470	039	PIPE OD1016 WITH SADDLE&STUB(OG)G.F COAT	NO	1.000	785.319	1E
80	470	040	PIPE OD219.1X3.76EPATSHOP STY-D,D1=211.6	M	100.000	1,997.000	1E
80	470	041	PIPE OD168.3X3.4 EPATSHOP STY-D,D1=161.5	M	310.000	4,287.300	1E
80	470	042	PIPE OD60.3X3.91 EPAT SITE STY-D,D1=53.2	M	30.000	163.200	1E
80	470	043	PIPE OD33.4X3.38 EPAT SITE STY-D,D1=26.6	M	20.000	50.000	1E
80	470	044	BW LR 90DEG ELL OD219.1X3.76SA815-S32205	NO	10.000	100.000	1E
80	470	045	BW LR 90DEG ELL OD168.3X3.4 SA815-S32205	NO	32.000	192.000	1E
80	470	046	ASMEB16.9 BWLR 90DEG ELBOW OD60.3X3.91	NO	12.000	7.800	1E
80	470	047	BW 90DEG ELL OD33.4 X3.38 SA815-S32205	NO	12.000	2.400	1E
80	470	048	BW EQT OD219.1X3.76 SA815-S32205	NO	2.000	28.000	1E
80	470	049	BW EQT OD60.3X3.91 SA815 S32205	NO	2.000	2.600	1E
80	470	050	FLANGE NB100 CL150-FOR PRESSURE STUB	NO	15.000	15.000	1E
80	470	051	PIPE DIA 114.3 X 6.02 L=5M NO EP	M	5.000	80.350	1E
80	470	052	F.F. FLANGE NB100 CL150	NO	15.000	81.750	1E
80	470	053	PIPEOD 21.3 X 2.77 L=5M NO EP	M	5.000	6.350	1E
80	470	054	P.F PIPE OD1829X16 (UG) -GF COAT	NO	4.000	4,279.444	1E
80	470	055	RUBBER GASKET NB600 CL150	NO	30.000	24.300	1E
80	470	056	HEX BOLT M33X140-SS316L	NO	600.000	750.000	1E
80	470	057	HEX NUT M33 -SS316L	NO	600.000	180.000	1E
80	470	058	PIPE OD1320X12 WITH STUB NB100 & FLANGE	NO	2.000	1,589.860	1E
80	470	059	FLANGE NB100 CL150-FOR PRESSURE STUB	NO	4.000	4.000	1E
80	470	060	HEX BOLT M16X80-SS316L	NO	60.000	9.300	1E
80	470	061	HEX NUT M16 -SS316L	NO	60.000	1.800	1E
80	470	062	RUBBER GASKET NB100	NO	6.000	0.660	1E
80	470	063	BRANCH PIPE OD21.3X2.77 L=1000	NO	1.000	1.270	1E
80	470	064	FLANGE NB100 CL150 FOR TEMPERATURE STUB	NO	2.000	2.000	1E
80	470	065	TEMPERATURE STUB RC 1INCH-DUPLEX SS	NO	2.000	1.000	1E
80	470	066	PLUG RC 1INCH -DUPLEX SS	NO	2.000	0.400	1E
80	470	067	ASMEB16.9 RED OD219.1X3.76/168.3X3.40	NO	2.000	12.000	1E
80	470	068	ASMEB16.9 UEQT OD219.1X3.76/168.3X3.40	NO	2.000	26.000	1E
80	470	069	SORF FLANGE NB150 CL150 SA815-S32205	NO	4.000	28.000	1E
80	470	070	HEX BOLT M20X90-SS316L	NO	40.000	12.280	1E
80	470	071	HEX NUT M20 -SS316L	NO	40.000	2.600	1E
80	470	072	RUBBER GASKET NB150 CL150	NO	4.000	0.560	1E
80	470	073	FLAT FACED FLANGE NB200 CL150-DUPLEX SS	NO	2.000	21.280	1E
80	470	074	BLANK FLANGE NB200 CL150 DSS	NO	2.000	38.824	1E
80	470	075	RUBBER GASKET NB200 CL150	NO	3.000	0.600	1E

80	470	077	PF PIPE OD1524X14 WITH STUBS NB100 &FLNG	NO	1.000	1,217.911	1E
80	470	078	FLANGE NB100 CL150-FOR PRESSURE STUB	NO	4.000	4.000	1E
80	470	079	HEX BOLT M16X80-SS316L	NO	36.000	5.580	1E
80	470	080	HEX NUT M16 -SS316L	NO	36.000	1.080	1E
80	470	081	RUBBER GASKET NB100	NO	5.000	0.550	1E
80	470	082	BRANCH PIPE OD21.3X2.77 L=2000	NO	1.000	2.540	1E
80	470	083	PUDDLE FLANGE NB200 GLASS FLAKE COATING	NO	2.000	176.646	1E
80	470	084	PIPE NB200 WITH FLANGES GLASS FLAKE COAT	NO	2.000	112.948	1E
80	470	085	PUDDLE FLANGE ASSEMBLY NB200 DSS	NO	2.000	106.912	1E

1.9.1.2 PUMPS & EQUIPMENTS

Sl. No.	Description	Dimensions	Qty	Weight (MT)	Category	Rate Schedule
1	Sea Water Makeup Pumps(V)	1200mmX1200mm	4	69.200	H&S / Eqpts / Instr / Misc Items	2
2	Filter Feed Pumps(H)	600mmX600mm	3	17.700	H&S / Eqpts / Instr / Misc Items	2
3	APH/ESP WASH PUMPS (H)	1800mmX800mm	2	8.800	H&S / Eqpts / Instr / Misc Items	2
4	SG FILL PUMPS (H)	2500mmX900mm	2	10.000	H&S / Eqpts / Instr / Misc Items	2
5	AHP SEAL WATER PUMPS (H)	1800mmX750mm	2	2.600	H&S / Eqpts / Instr / Misc Items	2
6	HVAC Makeup Pumps (H)	1600mmX600mm	2	1.600	H&S / Eqpts / Instr / Misc Items	2
7	Service Water Pumps (H)	1600mmX600mm	2	1.600	H&S / Eqpts / Instr / Misc Items	2
8	Service Water Booster Pumps (H)	1600mmX600mm	2	1.600	H&S / Eqpts / Instr / Misc Items	2
9	CHP DFDS MUP PUMPS(H)	1200mmX500mm	2	1.000	H&S / Eqpts / Instr / Misc Items	2
10	Potable Water Pumps (H)	1800mmX800mm	2	3.000	H&S / Eqpts / Instr / Misc Items	2
11	Potable Water Booster Pumps (H)	1200mmX500mm	6	3.000	H&S / Eqpts / Instr / Misc Items	2
12	AHP Conditioner MUP PUMPS (H)	1600mmX600mm	2	1.600	H&S / Eqpts / Instr / Misc Items	2
13	HOTWELL MUP PUMPS (H)	1800mmX800mm	4	6.000	H&S / Eqpts / Instr / Misc Items	2
14	DM MUP PUMPS (H)	1600mmX600mm	2	1.600	H&S / Eqpts / Instr / Misc Items	2
15	Sump Pumps (Type III)	200mmX200mm	8	4.000	H&S / Eqpts / Instr / Misc Items	2
16	Sump Pumps (Type III)	200mmX200mm	24	6.000	H&S / Eqpts / Instr / Misc Items	2

Sl. No.	Description	Dimensions	Qty	Weight (MT)	Category	Rate Schedule
17	Travelling Water Screen	3000mmX2000mm	2	20.000	H&S / Eqpts / Instr / Misc Items	2
18	Conical Strainers	2500mmX1000mm	8	16.000	H&S / Eqpts / Instr / Misc Items	2

1.9.1.3 Single Girder Crane, Electric Hoist & Chain Pulley Blocks

Sl. No.	Description	Capacity	Qty	Weight (MT)	Category	Rate Schedule
1	**Single Girder Crane**					
1.1	Air Compressor Building (Overhead electric operated)	8T	1	5.300	H&S / Eqpts / Instr / Misc Items	2
1.2	DG Building (Underslung electric operated)	8T	1	5.300	H&S / Eqpts / Instr / Misc Items	2
1.3	Filter water pump house (Underslung electric operated)	5T	1	4.900	H&S / Eqpts / Instr / Misc Items	2
1.4	Workshop building (Overhead electric operated)	10T	1	5.600	H&S / Eqpts / Instr / Misc Items	2
1.5	Sea water intake pump house TWS screen & gates handling (Gantry Crane (Electrically Operated))	10T	1	8.300	H&S / Eqpts / Instr / Misc Items	2
1.6	Clarified water pump house (Underslung electric operated)	5T	1	4.600	H&S / Eqpts / Instr / Misc Items	2
1.7	Permanent store (heavy material store) (Underslung electric operated)	10T	1	5.000	H&S / Eqpts / Instr / Misc Items	2
1.8	Permanent store (Light material store) (Underslung electric operated)	3T	1	5.000	H&S / Eqpts / Instr / Misc Items	2
2	**Electric Hoist**					
2.1	CST PUMPS SHED (non-hazardous) (Lift 6m &Travel 15m)	3T	1	0.400	H&S / Eqpts / Instr / Misc Items	2
2.2	SEA WATER INTAKE PUMP HOUSE (non-hazardous) (with CANOPY) (Lift 15m&Travel 23.55m)	5T	2	1.000	H&S / Eqpts / Instr / Misc Items	2
2.3	BOILER MCC SWITCHGEAR ROOM (non-hazardous) (with CANOPY) (Lift 32.5m &Travel 11m)	10T	1	1.500	H&S / Eqpts / Instr / Misc Items	2
2.4	ESP CONTROL ROOM (nonhazardous) (with CANOPY) (Lift 9m &Travel 5m)	8T	1	0.650	H&S / Eqpts / Instr / Misc Items	2

Sl. No.	Description	Capacity	Qty	Weight (MT)	Category	Rate Schedule
2.5	ESP CONTROL ROOM (nonhazardous) (with CANOPY) (Lift 12m &Travel 3.5m)	8T	1	0.650	H&S / Eqpts / Instr / Misc Items	2
2.6	COMPRESSOR BUILDING MCC (nonhazardous)(Lift9m&Travel3.5m)	5T	1	0.500	H&S / Eqpts / Instr / Misc Items	2
2.7	SERVICE BUILDING (ELEVATOR M/C ROOM) (non-hazardous) (Lift 9m &Travel 7m)	3T	2	0.800	H&S / Eqpts / Instr / Misc Items	2
2.8	ADMINISTRATIVE BUILDING (ELEVATOR M/C ROOM) (nonhazardous)(Lift 9m &Travel 7m)	3T	1	0.400	H&S / Eqpts / Instr / Misc Items	2
2.9	ESP CONTROL ROOM (ELEVATOR M/C ROOM) (non-hazardous) (Lift 9m &Travel 7m)	3T	2	0.800	H&S / Eqpts / Instr / Misc Items	2
2.10	FUEL OIL PUMP HOUSE (hazardous) (Lift 9m &Travel 4.5m)	2T	1	0.400	H&S / Eqpts / Instr / Misc Items	2
2.11	DM PUMPS HOUSE (Lift 6m &Travel 15m)	2T	1	0.400	H&S / Eqpts / Instr / Misc Items	2
3	**Chain Pulley Blocks**					
3.1	Specific Requirement	1T	10	0.300	H&S / Eqpts / Instr / Misc Items	2
3.2	Specific Requirement	3T	10	0.700	H&S / Eqpts / Instr / Misc Items	2
3.3	Specific Requirement	5T	8	0.880	H&S / Eqpts / Instr / Misc Items	2
3.4	Specific Requirement	10T	3	0.540	H&S / Eqpts / Instr / Misc Items	2
3.5	Booster Pump House	1T	1	0.050	H&S / Eqpts / Instr / Misc Items	2
3.6	Fire Station Building	1T	1	0.055	H&S / Eqpts / Instr / Misc Items	2
	TOTAL			**54.025**		

1.9.1.4 FIRE PROTECTION SYSTEM (PIPING & RELATED EQUIPMENTS)

Sl. No.	System Description	Unit	Qty	Total Weight (MT)	Category	Rate Schedule
1.	**ERECTION BOQ FOR WATER BASED FIRE PROTECTION SYSTEM**					
1.1	**FIRE WATER PUMP HOUSE EQUIPMENT**					
1	Electric Motor Driven Hydrant Pumps & Accessories	Sets	2	8.20	H&S / Eqpts / Instr / Misc Items	2

Sl. No.	System Description	Unit	Qty	Total Weight (MT)	Category	Rate Schedule
2	Diesel Engine Driven Hydrant Pumps & Accessories	Sets	2	6.24	H&S / Eqpts / Instr / Misc Items	2
3	Electric Motor Driven Spray Pumps & Accessories	Sets	1	4.10	H&S / Eqpts / Instr / Misc Items	2
4	Diesel Engine Driven Spray Pump & Accessories	Sets	1	3.12	H&S / Eqpts / Instr / Misc Items	2
5	Electric Motor Driven Jockey Pumps & Accessories	Sets	2	1.94	H&S / Eqpts / Instr / Misc Items	2
6	Electric Motor Driven Hydrant Booster Pumps & Accessories	Sets	1	0.64	H&S / Eqpts / Instr / Misc Items	2
7	Diesel Engine Driven Hydrant Booster Pump & Accessories	Sets	1	0.80	H&S / Eqpts / Instr / Misc Items	2
10	Diesel Engine Equipment in Fire Water Pump House	Sets	3	0.60	H&S / Eqpts / Instr / Misc Items	2
11	Diesel Engine Equipment in Booster Pump House	Sets	1	0.20	H&S / Eqpts / Instr / Misc Items	2
12	Hydro-pneumatic Tank of Cap. 22.5Cu. Mtrs. In Fire Water PH	Nos.	1	7.50	H&S / Eqpts / Instr / Misc Items	2
13	Air Compressors Cap. 25M3 at 25 Kg/cm2 (Main and Stand-by)	Nos.	2	0.84	H&S / Eqpts / Instr / Misc Items	2
15	200 NB Basket Stainer in M.S. Contruction	NOS	2	0.17	CS Piping	1B
16	Exhaust Pipe with insulation for deisel engine	M	2	0.03	CS Piping	1B
1.2	**Hydrant System and Spray system (upto DV) :: Main Header and branch lines - Piping & equipment**					
1	**UG Pipes (with Wrapping & Coating)::**					
i	300 NB	Mtrs	1200	66.60	CS Piping (Buried & Wrapping)	1D
ii	250 NB	Mtrs	2300	94.30	CS Piping (Buried & Wrapping)	1D
iii	200 NB	Mtrs	1700	56.27	CS Piping (Buried & Wrapping)	1D
iv	150 NB	Mtrs	2600	55.38	CS Piping (Buried & Wrapping)	1D
v	100 NB	Mtrs	200	2.90	CS Piping (Buried & Wrapping)	1D
vi	80 NB	Mtrs	500	4.95	CS Piping (Buried & Wrapping)	1D
vii	50 NB	Mtrs	100	0.29	CS Piping (Buried & Wrapping)	1D
2	**AG Pipes::(With Paintings)**					
i	600 NB	Mtrs	62	7.36	CS Piping	1B

Sl. No.	System Description	Unit	Qty	Total Weight (MT)	Category	Rate Schedule
ii	400 NB	Mtrs	34	2.67	CS Piping	1B
iii	300 NB	Mtrs	2,800	155.40	CS Piping	1B
iv	250 NB	Mtrs	5400	221.94	CS Piping	1B
v	200 NB	Mtrs	3900	129.09	CS Piping	1B
vi	150 NB	Mtrs	6000	127.80	CS Piping	1B
vii	100 NB	Mtrs	450	6.53	CS Piping	1B
viii	80 NB	Mtrs	1150	11.39	CS Piping	1B
ix	50 NB	Mtrs	100	0.29	CS Piping	1B
3	**Water monitor 38 mm Nozzle Bore**	Nos	47	1.88	H&S / Eqpts / Instr / Misc Items	2
4	**Single headed 63 mm dia hydrant landing valve (conforming to IS : 5290 : 1983) with MS matching flanges**					
i	External	Nos	250	2.50	CS Piping	1B
ii	Internal	Nos	150	1.50	CS Piping	1B
5	**63 mm Branch pipe Nozzle as per IS : 903 (Internal)**					
i	Branch Pipe & Nozzles, (Solid Jet type) in SS Construction to IS:903	Nos	200	0.80	CS Piping	1B
6	**Fire Hoses**					
i	Fire Hoses - with instantaneous SS End Couplings to IS:636 (Type-A) Size - 63 mm Dia	Nos	394	5.91	CS Piping	1B
7	**750 x 600 x 250 mm Hose Box For Internal Hydrant**	Nos	150	0.75	H&S / Eqpts / Instr / Misc Items	2
8	**Rubber Hose Reel as per IS: 884 Type A, with Drum**	Nos	45	0.54	H&S / Eqpts / Instr / Misc Items	2
9	**Air Release Valves - Size 25 mm NB.**	Nos	45	0.05	CS Piping	1B
10	**25 mm NB CS Ball valve**	Nos	45	0.05	CS Piping	1B
11	**Miscelleneous items for erection of piping**					
i	Insert plates	Lot	1	2.00	H&S / Eqpts / Instr / Misc Items	2
ii	U –Clamp	Lot	1	3.00	H&S / Eqpts / Instr / Misc Items	2
iii	Anchor fasteners	Lot	1	3.00	H&S / Eqpts / Instr / Misc Items	2
12	**Wrapping & Coating for Underground Pipe**	Sq.M	8,000	24.00	CS Piping	1B
13	**Structural Steel**	Lot	1	20.00	CS Piping	1B
14	**Cast Iron Gate Valves in FWPH, Hydrant Header and FEH**	Unit				
i	15 NB GATE VALVE	Nos	25	0.08	CS Piping	1B

Sl. No.	System Description	Unit	Qty	Total Weight (MT)	Category	Rate Schedule
ii	25 NB GATE VALVE	Nos	7	0.04	CS Piping	1B
iii	50 NB GATE VALVE	Nos	0	0.00	CS Piping	1B
iv	80 NB GATE VALVE	Nos	4	0.11	CS Piping	1B
v	100 NB GATE VALVE	Nos	62	2.72	CS Piping	1B
vi	150 NB GATE VALVE	Nos	55	4.21	CS Piping	1B
vii	200 NB GATE VALVE	Nos	10	1.26	CS Piping	1B
viii	250 NB GATE VALVE	Nos	30	6.01	CS Piping	1B
ix	300 NB GATE VALVE	Nos	7	2.13	CS Piping	1B
x	600 NB GATE VALVE	Nos	2	2.80	CS Piping	1B
15	**Pipe Fittings, Flanges, Studnuts & gaskets**	Lot	1	47.00	CS Piping	1B
16	**Paints & primer for Above Ground Pipes**	Lit	1625	1.95		
1.3	**MEDIUM VELOCITY WATER SPRAY SYSTEM (For Conveyors, Cable Galleries, Transfer Points, Fuel Tanks, Crusher House, Wagon Tippler etc.)**					
1	**MS ERW Galvanized to IS:1239,Part-1 or IS3589 Galvanized as per IS: 4736**					
i	200 NB	Mtrs.	100	3.00	CS Piping	1B
ii	150 NB	Mtrs.	3100	66.03	CS Piping	1B
iii	100 NB	Mtrs.	6000	87.00	CS Piping	1B
iv	80 NB	Mtrs.	3000	29.70	CS Piping	1B
v	65 NB	Mtrs.	200	1.59	CS Piping	1B
vi	50 NB	Mtrs.	6000	37.14	CS Piping	1B
vii	40 NB	Mtrs.	7000	30.59	CS Piping	1B
viii	32 NB	Mtrs.	2200	7.70	CS Piping	1B
ix	25 NB	Mtrs.	14326	41.98	CS Piping	1B
2	**ERW, MS black pipe as Per IS:1239 Heavy Class**					
i	15 NB	Mtrs.	300	0.45	CS Piping	1B
ii	25 NB	Mtrs.	2200	6.45	CS Piping	1B
iii	100 NB	Mtrs.	750	10.88	CS Piping	1B
iv	150 NB	Mtrs.	150	3.20	CS Piping	1B
3	**Cast iron Gate Valve**					
i	150 NB	Nos.	38	2.91	CS Piping	1B
ii	100 NB	Nos.	226	9.92	CS Piping	1B
4	**Cast iron Butterfly Valve**					

Sl. No.	System Description	Unit	Qty	Total Weight (MT)	Category	Rate Schedule
i	150 NB	Nos.	19	0.25	CS Piping	1B
ii	100 NB	Nos.	113	0.98	CS Piping	1B
5	**Cast iron Deluge Valve (wet pilot) complete with necessary trim, water gong**					
i	150 NB	Nos.	19	2.87	CS Piping	1B
ii	100 NB	Nos.	113	10.96	CS Piping	1B
6	**M.S Y- Type Strainer**					
i	150 NB	Nos.	19	0.76	H&S / Eqpts / Instr / Misc Items	2
ii	100 NB	Nos.	113	2.83	H&S / Eqpts / Instr / Misc Items	2
7	**Spray Nozzle - Stainless Steel**	Nos.	12500	1.56	SS Piping	1A
8	**QBD**	Nos.	500	0.07	SS Piping	1A
9	**SS orifice plate**					
i	150 NB	No	3	0.01	SS Piping	1A
ii	100 NB	No	20	0.03	SS Piping	1A
10	**Structural Steel**	Lot	1	30.00	CS Piping	1B
11	**Pipe Fittings, Flanges, Studnuts & gaskets**	Lot	1	25.00	CS Piping	1B
13	**Paints and Primer**	Lit	3125	3.75		
1.4	**HIGH VELOCITY WATER SPRAY SYSTEM (ST, SAT, UAT & UT TRANSFORMERS, BOILER BURNER, LUBE OIL CONSOLE, BFP LUBE OIL, TURBINE LUBE OIL)**					
1	**ERW G.I. Pipe as Per IS:1239 Heavy Class**					
i	150 NB	Mtrs.	250	5.33	CS Piping	1B
ii	100 NB	Mtrs.	800	11.60	CS Piping	1B
iii	80 NB	Mtrs.	800	7.92	CS Piping	1B
iv	65 NB	Mtrs.	700	5.55	CS Piping	1B
v	50 NB	Mtrs.	2200	13.62	CS Piping	1B
vi	40 NB	Mtrs.	600	2.62	CS Piping	1B
vii	32 NB	Mtrs.	220	0.77	CS Piping	1B
viii	25 NB	Mtrs.	1100	3.30	CS Piping	1B

Sl. No.	System Description	Unit	Qty	Total Weight (MT)	Category	Rate Schedule
2	**ERW, MS black pipe as Per IS:1239 Heavy Class**					
	150 NB	Mtrs.	32	0.68	CS Piping	1B
	100 NB	Mtrs.	250	3.63	CS Piping	1B
i	80 NB	Mtrs.	200	1.98	CS Piping	1B
ii	65 NB (FOR PYLON)	Mtrs.	1000	7.93	CS Piping	1B
iii	50 NB (FOR PYLON)	Mtrs.	1200	7.43	CS Piping	1B
iv	40 NB	Mtrs.	196	0.86	CS Piping	1B
v	25 NB	Mtrs.	4500	13.50	CS Piping	1B
3	**Cast iron Gate Valve**					
i	150 NB	Nos.	8	0.61	CS Piping	1B
ii	100 NB	Nos.	48	2.11	CS Piping	1B
iii	80 NB	Nos.	36	0.98	CS Piping	1B
4	**Cast iron Butterfly Valve**					
i	150 NB	Nos.	4	0.05	CS Piping	1B
ii	100 NB	Nos.	24	0.21	CS Piping	1B
iii	80 NB	Nos.	18	0.01	CS Piping	1B
5	**Cast iron Deluge Valve (wet pilot) complete with necessary trim, water gong**					
i	150 NB	Nos.	4	0.10	CS Piping	1B
ii	100 NB	Nos.	24	2.33	CS Piping	1B
iii	80 NB	Nos.	18	1.26	CS Piping	1B
6	**M.S Y- Type Strainer**					
i	150 NB	No	4	0.23	H&S / Eqpts / Instr / Misc Items	2
ii	100 NB	No	24	1.13	H&S / Eqpts / Instr / Misc Items	2
iii	80 NB	No	18	0.70	H&S / Eqpts / Instr / Misc Items	2
7	**Spray Nozzle - Stainless Steel**	No	2000	0.50	SS Piping	1A
8	**QBD**	No	1500	0.30	SS Piping	1A
9	**SS orifice plate**					
i	150 NB	Nos.	4	0.01	SS Piping	1A
ii	100 NB	Nos.	31	0.05	SS Piping	1A
iii	80 NB	Nos.	2	0.01	SS Piping	1A
10	**Structural Steel**	Lot	1	18.00	CS Piping	1B
11	**Pipe Fittings, Flanges, Studnuts & gaskets**	Lot	1	25.00	CS Piping	1B
13	**Paints and Primer**	Lit	250	0.30		

Sl. No.	System Description	Unit	Qty	Total Weight (MT)	Category	Rate Schedule
2	**ERECTION BOQ FOR FOAM SYSTEM**					
1	Foam tanks and all its accessories of suitable Capacity (1 Working + 1 standby)	Nos.	2	2.00	H&S / Eqpts / Instr / Misc Items	2
2	Foam Pumps with motor : Motor driven (Working)	Nos.	1	0.12	H&S / Eqpts / Instr / Misc Items	2
3	Foam Pumps with engine and battery and battery charger - Engine driven (standby)	Nos.	1	0.29	H&S / Eqpts / Instr / Misc Items	2
4	Foam Chamber with Deflector					
	100 mm NB	Nos.	3	0.06	CS Piping	1B
5	Inline Balance Foam proportioners					
ii	80 NB	Nos.	4	0.05	CS Piping	1B
6	Deluge valve with accessories					
i	100 NB	Nos.	2	0.09	CS Piping	1B
ii	80 NB	Nos.	2	0.07	CS Piping	1B
7	Gate valves (CI)					
i	100 NB	Nos.	4	0.18	CS Piping	1B
ii	80 NB	Nos.	4	0.11	CS Piping	1B
8	Gate valves For foam lines of SS material					
I	65 NB	Nos.	2	0.03	SS Piping	1A
II	50 NB	Nos.	2	0.02	SS Piping	1A
III	40 NB	Nos.	2	0.02	SS Piping	1A
IV	25 NB	Nos.	5	0.04	SS Piping	1A
9	Solenoid operated valves	Nos.	4	0.01	CS Piping	1B
10	Butterfly valves					
i	100 NB	Nos.	2	0.02	CS Piping	1B
ii	80 NB	Nos.	5	0.03	CS Piping	1B
11	Globe Valve For foam lines of SS material					
ii	32 NB	Nos.	2	0.01	SS Piping	1A
iii	25 NB	Nos.	2	0.01	SS Piping	1A
12	Y-Strainers (CI)					
i	100 NB	Nos.	2	0.08	CS Piping	1B
ii	80 NB	Nos.	2	0.05	CS Piping	1B
13	Strainers For Foam lines of SS material					
i	50 NB	Nos.	2	0.08	SS Piping	1A
14	NRV (CI)					
i	100 NB	Mtrs.	4	0.22	CS Piping	1B

Sl. No.	System Description	Unit	Qty	Total Weight (MT)	Category	Rate Schedule
ii	80 NB	Mtrs.	2	0.06	CS Piping	1B
15	NRV For Foam lines of SS material					
i	40 NB	Mtrs.	2	0.02	SS Piping	1A
16	Foam concentrate SS pipe					
i	65 NB	Mtrs.	10	0.06	SS Piping	1A
ii	50 NB	Mtrs.	5	0.03	SS Piping	1A
i	40 NB	Mtrs.	20	0.08	SS Piping	1A
ii	25 NB	Mtrs.	15	0.05	SS Piping	1A
17	Above Ground Piping - GI pipes					
i	150 NB	Mtrs.	8	0.23	GI Piping	1C
i	100 NB	Mtrs.	350	5.60	GI Piping	1C
ii	80 NB	Mtrs.	50	0.60	GI Piping	1C
iii	65 NB	Mtrs.	10	0.10	GI Piping	1C
iv	25 NB	Mtrs.	10	0.04	GI Piping	1C
18	Piping -MS ERW Pipe					
i	150 NB	Mtrs.	12	0.34	CS Piping	1B
ii	100 NB	Mtrs.	30	0.48	CS Piping	1B
iii	80 NB	Mtrs.	12	0.14	CS Piping	1B
22	SS ball valve for Pressure Gauge & Pressure Switch					
i	15 NB	Nos.	10	0.03	SS Piping	1A
23	GM ball valve for Pr. Guage & pr. Switch					
i	25 NB	Nos.	3	0.02	CS Piping	1B
ii	15 NB	Nos.	7	0.02	CS Piping	1B
24	Pressure Releif Valve	Nos.	1	0.01	CS Piping	1B
25	Foam Hydrant Accessories					
	Foam Hydrant Valve	Nos.	6	0.06	H&S / Eqpts / Instr / Misc Items	2
	External Hose Box	Nos.	6	0.03	H&S / Eqpts / Instr / Misc Items	2
	Hose Pipe (63mm Dia)	Nos.	12	0.18	H&S / Eqpts / Instr / Misc Items	2
	Foam Handline Branchpipe	Nos.	6	0.03	H&S / Eqpts / Instr / Misc Items	2
26	Wrapping & coating					
i	Wrapping & coating	Sqm.	18	0.05	CS Piping	1B
3	**ERECTION BOQ FOR INERT GAS EXTINGUISHING SYSTEM**					
1	Inert Gas Cylinder (140Lit. 300Bar)	Nos.	96	27.0048	H&S / Eqpts / Instr / Misc Items	2
2	Cylinder Valve	Nos.	96	0.0672	H&S / Eqpts / Instr / Misc Items	2

Sl. No.	System Description	Unit	Qty	Total Weight (MT)	Category	Rate Schedule
3	6-Cylinder Manifold	Nos.	16	1.6	H&S / Eqpts / Instr / Misc Items	2
4	Cylinder Rack	Nos.	4	0.4	H&S / Eqpts / Instr / Misc Items	2
5	Discharge Hose	Nos.	96	0.0864	H&S / Eqpts / Instr / Misc Items	2
6	Check Valve	Nos.	96	0.048	H&S / Eqpts / Instr / Misc Items	2
7	Contact Pressure Gauge Unit	Nos.	96	0.0192	H&S / Eqpts / Instr / Misc Items	2
12	Pilot Pipes Cylinder rack	Nos.	84	0.0084	H&S / Eqpts / Instr / Misc Items	2
13	Safety Device Malfunction Pressure	Nos.	8	0.0016	H&S / Eqpts / Instr / Misc Items	2
14	Hose MX PH300 DN4x1500	Nos.	4	0.0026	H&S / Eqpts / Instr / Misc Items	2
15	Pneumatic Release Devive PAE-CO2 Electrical	Nos.	1	0.06	H&S / Eqpts / Instr / Misc Items	2
16	Monitoring Loss Pneumatic Activation Device	Nos.	2	0.0004	H&S / Eqpts / Instr / Misc Items	2
17	Disable Device MX	Nos.	1	0.001	H&S / Eqpts / Instr / Misc Items	2
18	Limit Switch Disable Device	Nos.	2	0.0003	H&S / Eqpts / Instr / Misc Items	2
19	Push Button Selector Valve	Nos.	10	0.002	H&S / Eqpts / Instr / Misc Items	2
20	Pilot Control Manifold CO2-DN15-7	Nos.	1	0.05	H&S / Eqpts / Instr / Misc Items	2
21	Adapter Connection CO2-Ermeto-DN4 (6mm)	Nos.	11	0.00165	H&S / Eqpts / Instr / Misc Items	2
22	Reset Tool Release Device EM	Nos.	1	0.00035	H&S / Eqpts / Instr / Misc Items	2
23	Reset Tool Screw	Nos.	1	0.00035	H&S / Eqpts / Instr / Misc Items	2
24	Bracket for Reset Tool Release Device EM	Nos.	1	0.00035	H&S / Eqpts / Instr / Misc Items	2
25	Shuttle non return valves MX-WRV DN4	Nos.	1	0.00025	H&S / Eqpts / Instr / Misc Items	2
26	Pipe 6mm	Mtrs.	30	0.03	H&S / Eqpts / Instr / Misc Items	2
27	selector valve DN50	Nos.	10	0.5	H&S / Eqpts / Instr / Misc Items	2
28	safety valves G1/2 - 365 bar	Nos.	2	0.003	H&S / Eqpts / Instr / Misc Items	2
29	Manual release lever - DN25-50 - 497mm	Nos.	1	0.001	H&S / Eqpts / Instr / Misc Items	2

Sl. No.	System Description	Unit	Qty	Total Weight (MT)	Category	Rate Schedule
30	Limit Switch Pneumatic Operated (Pressure Switch)	Nos.	10	0.015	H&S / Eqpts / Instr / Misc Items	2
31	RD-Nozzle - 1/2"	Nos.	330	0.033	CS Piping	1B
32	High Pressure Pipe DN50 - 365 bar	Mtrs.	18	0.18	CS Piping	1B
33	Elbow 50 NB	Nos.	8	0.052	CS Piping	1B
34	Tee-piece 50 NB	Nos.	16	0.136	CS Piping	1B
35	Coupling HD 50 NB	Nos.	8	0.028	CS Piping	1B
36	Hex Nipple 50 NB	Nos.	8	0.008	CS Piping	1B
37	Pressure Reducer DK RC1 x RC2 x d2 =	Nos.	10	0.01	CS Piping	1B
44	Pipes	Lot	1	3.0	CS Piping	1B
45	Fittings	Lot	1	1.0	CS Piping	1B
46	Structural Steel	Lot	1	4.0	CS Piping	1B

1.9.1.5 PT-RO-DM SYSTEM

Sl No	Description	Qty	Unit	Approx. Unit size (l x b x h) in m	Total wt (in MT)	Category	Rate Schedule
A	**Pre-treatment system**						
1	Horizontal Dual Media Filters: (filter Output: 180 m3/hr) (MSRL MOC)	11	Nos.	Dia. 3.5 m with internals & fasteners , length : 5 m, internals, ladder, platform	132.00	H&S / Eqpts / Instr / Misc Items	2
2	DMF Air blowers with all accessories and foundation bolts	2	Sets	2.1 x 0.60 x 0.80	3.00	H&S / Eqpts / Instr / Misc Items	2
3	DMF backwash pumps (Horizontal pump), Motor, Base Frame & Accessories and Foundation Bolts	2	Nos.	2 x 1 x 0.8	3.00	H&S / Eqpts / Instr / Misc Items	2
4	Dosing system consist of following Chemical Dosing system : a) NaOCl Dosing system b) Coag. Aid dosing system c) Acid dosing system d) NaOCl dosing system	4	Sets	2.5 x 1.5 x 2	3.20	H&S / Eqpts / Instr / Misc Items	2
5	Self-cleaning strainers (975 m3/hr each) - 2 W +1 S	3	Sets	Dia.1m x 2m ht	1.50	H&S / Eqpts / Instr / Misc Items	2

Sl No	Description	Qty	Unit	Approx. Unit size (l x b x h) in m	Total wt (in MT)	Category	Rate Schedule
6	UF skids (6 W +1 S) - Membrane modules - Manifolds - Skid - Piping & valves within skid	7	Sets	9 x 2.2 x 4	105.00	H&S / Eqpts / Instr / Misc Items	2
7	UF Air blowers with all accessories and foundation bolts	2	Sets	2 x 1 x 0.8	1.20	H&S / Eqpts / Instr / Misc Items	2
8	Inter connecting piping & valves (other than piping & valves within skid) for UF system	1	Sets		8.00	CS Piping	1B
9	UF backwash pumps, Motor, Base Frame & Accessories and Foundation Bolts	2	Sets	2 x 1 x 0.8	1.60	H&S / Eqpts / Instr / Misc Items	2
10	UF CIP pumps, Motor, Base Frame & Accessories and Foundation Bolts	2	Sets	2 x 1 x 0.8	1.40	H&S / Eqpts / Instr / Misc Items	2
11	UF CIP tank (FRP MOC)	1	No.	Dia.2.5 x 3m ht	0.50	H&S / Eqpts / Instr / Misc Items	2
12	UF Backwash tank (FRP MOC)	1	No.	Dia.2.4 x 3m ht	0.50	H&S / Eqpts / Instr / Misc Items	2
B	**RO system**						
13	Cartridge filter feed Pumps, Motor, Base Frame & Accessories and Foundation Bolts	3	Sets	2 x 1 x 0.8	6.60	H&S / Eqpts / Instr / Misc Items	2
14	Dosing system consist of following Chemical Dosing system : a) Acid dosing b) Antiscalent c) De-Chlorination	3	Sets	2.5 x 1.5 x 2	2.40	H&S / Eqpts / Instr / Misc Items	2
15	Cartridge filters - RO Stage1	3	Sets	Dia.2 x 2 ht	10.50	H&S / Eqpts / Instr / Misc Items	2
16	RO stage I HP pumps, motor & acc. (Motor by BHEL-Bhopal)	3	Sets	4.8 x 1.5 x 1.5	6.00	H&S / Eqpts / Instr / Misc Items	2
17	Energy Recovery Device (Turbo charger)	3	Sets	1 x 1 x 1	3.90	H&S / Eqpts / Instr / Misc Items	2

Sl No	Description	Qty	Unit	Approx. Unit size (l x b x h) in m	Total wt (in MT)	Category	Rate Schedule
18	RO Stage-1 (SWRO)	3	Sets	8.3 x 5 x 4	37.50	H&S / Eqpts / Instr / Misc Items	2
19	SWRO Flush pump, motor, Base Frame & Accessories and Foundation Bolts	3	Sets	2 x 1 x 0.8	2.10	H&S / Eqpts / Instr / Misc Items	2
20	RO Stage-I permeate supply Pumps, Motor, Base Frame & Accessories and Foundation Bolts	3	Sets	1.6 x 0.6 x 0.65	0.90	H&S / Eqpts / Instr / Misc Items	2
21	Cartridge filters - RO Stage2	3	Sets	Dia.1 x 2 ht	1.20	H&S / Eqpts / Instr / Misc Items	2
22	RO Stage-2 HP pump, Motor, Base Frame & Accessories and Foundation Bolts	3	No	0.5 x 0.5 x 1	3.00	H&S / Eqpts / Instr / Misc Items	2
23	RO Stage-2 (BWRO)	2	Sets	7.6 x 1.8 x 4	11.00	H&S / Eqpts / Instr / Misc Items	2
24	Degasser Towers	2	Sets	Dia.1.2 x 3.3 ht	1.00	H&S / Eqpts / Instr / Misc Items	2
25	Degassser blower with motor and all accessories and foundation bolts	4	Sets	1 x 0.60 x 0.80	1.60	H&S / Eqpts / Instr / Misc Items	2
26	Inter connecting HP Duplex Stainless steel piping & HP Valves with Support (for SWRO system)	3	Lot		12.00	SS Piping	1A
27	Inter connecting HP SS316L piping & HP Valves with Support (for BWRO system)	2	Lot		4.00	SS Piping	1A
28	Inter conneting piping (UPVC, CPVC, GI, HDPE, etc.), Valves (includes manual operated, pneumatic actuated & electrically operated), bellows, fasteners, etc.) for all the equipments (including dosing system & Bulk chemical transfer line) except MB System. [DMF, UF, SWRO,BWRO, Remineralization etc.]	1	Lot	DN15 to DN100	49.00	CS Piping	1B

Sl No	Description	Qty	Unit	Approx. Unit size (l x b x h) in m	Total wt (in MT)	Category	Rate Schedule
	Common Chemical Cleaning system						
29	CC Preparation Tank.	1	No	Dia 1.0x 1.5	0.50	H&S / Eqpts / Instr / Misc Items	2
30	SWRO CC tank (FRP MOC)	1	Set	Dia.3.5 x 4.85ht	1.50	H&S / Eqpts / Instr / Misc Items	2
31	SWRO CIP pump, motor, Base Frame & Accessories and Foundation Bolts	2	Sets	2 x 1 x 0.8	3.60	H&S / Eqpts / Instr / Misc Items	2
32	SWRO CC Cartridge filters	1	Set	Dia. 2. x 2 ht	2.20	H&S / Eqpts / Instr / Misc Items	2
33	CIP tank (FRP MOC), BWRO	1	Set	Dia.2 x 2.5ht	0.50	H&S / Eqpts / Instr / Misc Items	2
34	BWRO CIP pump, motor, Base Frame & Accessories and Foundation Bolts	2	Sets	2 x 1 x 0.8	1.00	H&S / Eqpts / Instr / Misc Items	2
35	BWRO CC Cartridge filters	1	Set	Dia. 1.5. x 2 ht	0.50	H&S / Eqpts / Instr / Misc Items	2
C	**Remineralization system**						
36	Remineralization filter feed pumps, motor, Base Frame & Accessories and Foundation Bolts	3	Sets	2 x 1 x 0.8	1.20	H&S / Eqpts / Instr / Misc Items	2
37	Remineralization filter backwash pumps, motor, Base Frame & Accessories and Foundation Bolts	2	Sets	2 x 1 x 0.8	0.80	H&S / Eqpts / Instr / Misc Items	2
38	Remineralization Filters: (filter Output: 180 m3/hr) (MSRL moc)	3	Nos.	Dia. 2 m with internals & fasteners , height : 5 m, internals, ladder, platform	21.00	H&S / Eqpts / Instr / Misc Items	2
39	Dosing system consist of following Chemical Dosing system :a) CO2 dosing for Remineralizationb) NaOH dosing for Remineralization	2	Sets	2.5 x 1.5 x 2	1.60	H&S / Eqpts / Instr / Misc Items	2

Sl No	Description	Qty	Unit	Approx. Unit size (l x b x h) in m	Total wt (in MT)	Category	Rate Schedule
D	**OTHER EQUIPMENTS**						
40	Fasteners & accessories GI 'U' Bolts, Grip type Foundation Bolts, Fasteners, etc., Rubber gaskets & accessories	1	Lot		10.50	H&S / Eqpts / Instr / Misc Items	2
41	External piping	1	Lot	DN40 to DN350	25.00	SS Piping	1A
42	Instrument air piping	1	Lot		4.00	GI Piping	1C
43	Utility piping	1	Lot		0.50	GI Piping	1C
45	MS fabricated Supports , Platforms & pipe rack	1	Lot		110.00	H&S / Eqpts / Instr / Misc Items	2
47	Handling arrangement - Monorail with hoist Electrical operated/ Manual hoist with chain pulley block	3	Lot		9.00	H&S / Eqpts / Instr / Misc Items	2

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.

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) Provident Fund Registration 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 colour.

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.

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, GROUTING AND CIVIL WORKS

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

1.12.12 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 flowable 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 GP I / 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 650 kg/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 endeavour to store / stack / identify materials properly in their open / closed storage yard / shed it shall be contractor's responsibility to assist BHEL in identifying materials well in time for erection, taking delivery of the same in time following the procedure indicated by BHEL and transport the material safely to pre-assembly yard / erection site in time according to 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 despatched as a single Despatchable Unit (DU) shall be checked before drawing materials from BHEL Stores. If any such attachments / fittings is 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.

1.13.24 Chemicals required pre-commissioning, commissioning & operation of the PT-RO-DM system has to be drawn from BHEL Stores/Bulk storage facility and handling, transport, filling & refilling has to be carried out by contractor within the quoted rates only. Approximate quantity of Operation & Commissioning Chemicals supplied by BHEL will be 560 MT.

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 LP Piping (Common to all system including LP Piping, Sea Water Piping system including CW Blowdown Piping, Fire Protection System, PT-RO-DM System & Other Misc Pumps & equipments)

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 us blue matching, welding of stainless steel parts etc., the work shall be carried out in accordance with instructions and requirements of the BHEL engineer at the quoted rates only.

1.14.1.4 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.

1.14.1.16 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 LP piping including Sea-water Piping System, Plant water system, DM cooling water system, Instrument & Service Air system, Plant service water and potable water system, PT-RO-DM Plant System, Fire Protection system, Pumps & Misc Equipments, Cranes and hoists and its associated items / systems, hangers and supports, valves, miscellaneous Equipment's .etc.

1.14.1.17 Brief list of system / sub system, approximate weight of pipes and accessories to be erected by the contractor mentioned in the Bill of Quantity 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.

1.14.1.18 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.

1.14.1.19 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.

1.14.1.20 Erection of all the piping systems supplied along with PEM / Bhopal / BAP /PESD supplied auxiliaries covered in this contract, is to be erected by the contractor as per the accepted tonnage rate

1.14.1.21 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".

1.14.1.22 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.

1.14.1.23 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.

1.14.1.24 The work on piping system will include wrapping & Coating, 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.

1.14.1.25 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.

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

1.14.1.27 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.,

1.14.1.28 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.

1.14.1.29 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.

1.14.1.30 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.

1.14.1.31 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.

1.14.1.32 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.

1.14.1.33 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.

1.14.1.34 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.

1.14.1.35 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.

1.14.1.36 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.

1.14.1.37 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.

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

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

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

1.14.1.41 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.

1.14.1.42 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.

1.14.1.43 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.

1.14.1.44 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.

1.14.1.45 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.

1.14.1.46 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.

1.14.1.47 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.

1.14.1.48 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.

1.14.1.49 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.

1.14.1.50 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.

1.14.1.51 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.

1.14.1.52 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.

1.14.1.53 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.

1.14.1.54 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.

1.14.1.55 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.

1.14.1.56 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.

1.14.1.57 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.

1.14.1.58 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.

1.14.1.59 For Sea Water Intake Piping & CW Blow down piping, overground CS piping which is arising from GRP Piping between the plant boundary and CW Pump house, is in the scope of the work.

1.14.1.60 For Sea Water Intake Piping & CW Blow down piping, wherever flange joints are envisaged with GRP Piping as per the drawings, the matching of flanges, fixing gaskets, bolting and tightening as per BHEL Engineers instructions is in the scope of work.

1.14.1.61 Sea Water intake piping & CW Blowdown piping outside plant boundary shall be erected upon concrete pedestals from Sea Water Intake Pump House & Hot water Channel respectively to nearby of TH -1 (approximate distance is 1.4 Kms).For further details bidders to refer enclosed drawings (tentative and liable to change).

1.14.1.62 Sea Water intake piping & CW Blowdown piping outside plant boundary shall be erected upon pipe conveyor pier deck (Approximate Height ~ 15-20 Mtrs) from nearby of TH -1 to plant boundary (approximate distance is 2.6 Kms). For further details bidders to refer enclosed drawings (tentative and liable to change).

1.14.1.63 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.

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

1.14.1.65 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.,

1.14.1.66 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.

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

1.14.1.68 Erection of Flow nozzles, flow orifices, flow switches, filters, flow meters, flow indicators, other metering elements, spray nozzles, steam traps, flow orifices, flow indicators, control valves, aux. control valves, filters, suction strainers, NRVs, 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.

1.14.1.69 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.

1.14.1.70 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.

1.14.1.71 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.

1.14.1.72 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.

1.14.1.73 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.

1.14.1.74 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.

1.14.1.75 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.

1.14.1.76 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.

1.14.1.77 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.

1.14.1.78 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.

1.14.1.79 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.

1.14.1.80 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.

1.14.1.81 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.

1.14.1.82 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.

1.14.1.83 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.

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

1.14.1.85 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..

1.14.1.86 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.

1.14.1.87 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 lub oil system, carry out the hydraulic test of oil coolers. etc.,

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

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

1.14.1.90 Single Girder Crane, DSL or equivalent system for hoisting equipments are also to be erected and commissioned including load testing by the contractor within the quoted rates. Required manpower including electricians are to be arranged by the contractor for carrying out commissioning of electrical hoist and load testing of the above electrical hoist. Required loads will be provided by BHEL free of cost

1.14.1.91 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.

1.14.1.92 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.

1.14.1.93 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.

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

1.14.1.95 All pumps & motors will 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.

1.14.1.96 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.

1.14.1.97 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.

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

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

1.14.1.100 Such of those consumables as indicated as "Consumables provided by BHEL" shall alone be provided to the contractor by BHEL free of charge. Weight of above BHEL supplied welding consumables/paint will not be considered for any payment

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

1.14.1.102 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.

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

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

1.14.1.105 Platforms, ladders crossovers and canopies shall be fabricated and erected by contractor at site as per site engineer's advice. Platforms shall also be provided at places where it has not been shown in drawings but if felt necessary by site engineer. Canopies shall be provided for all out door pumps and motors.

1.14.1.106 All operating and approach platforms, cross over, canopies, ladder etc, shall have to be fabricated from raw materials supplied by BHEL and erected by contractor as per instruction of BHEL and shall be paid as per accepted tonnage rate for "Hangers & Supports and Misc Items" .

1.14.1.107 Galvanized pipe shall be joined by screwing in to socket and screwed ends of GI pipes shall be thoroughly cleaned and painted with a mixture of red and white lead before joining. The exposed threaded portion on either side of the socket joint shall be applied with Zinc Silicate Paste. All these consumables are in the scope of contractor and shall carry out within the quoted rate.

1.14.1.108 GI pipe with flanged joints shall have screwed flanges. Flanged joints faces shall be painted with red lead and bolting up evenly on all sides with compressed asbestos gaskets in between two flanges.

1.14.1.109 Teflon tapes shall be used to seal out screwed joints and shall be applied to the male threads only. Threaded parts shall be wiped clean of oil or grease with appropriate solvent if necessary and allowing proper time for drying before applying the sealant. Pipe ends shall be attached by screwing the pipe through the flange and pipe and flange shall be refaced accurately. Required Teflon tapes are to be arranged by the contractor at his cost.

1.14.1.110 Required threading should be done by the contractor at site as specified in the drawing. The pipes shall be cut only by Hacksaw / Machining. Required Teflon tapes are to be arranged by the contractor within the quoted rate.

1.14.1.111 All the screwed joints are to be seal welded if required by Customer, suitable electrodes for full seal welding are to be arranged by the contractor at his own cost.

1.14.1.112 The Buried pipe in general shall be laid with the top of the pipe minimum 2.0 / 1.5 metre below finished general ground level or as specified in the drawing. Anti-corrosive treatment for all buried pipes as specified in the drawings including supply & application of anti-corrosive treatment, required consumables are in the scope of contractor and shall carry out as per drawing within the quoted rate.

1.14.1.113 Buried GI pipes shall not have flanged joints. All the joints shall be screwed with socket. Screwed ends of GI pipes shall be thoroughly cleaned and

painted with a mixture of red and white lead before joining. Threaded portion on either side of the socket joint shall be applied with Zinc Silicate Paste. All these consumables are in the scope of contractor and shall carry out within the quoted rate.

1.14.1.114 Free access is to be provided for the welding of the circumferential joints by increasing the width and depth of the trench at these points. There should be no obstruction to the welder from any side so that good welded joint is obtained. This type of incidental works are to be carried out by the contractor within quoted rates.

1.14.1.115 Prior to lowering and laying pipe in any trench, the contractor shall ensure for the backfill and compact the bottom of the trench or excavation in accordance with IS 5822 / as per drawing to provide an acceptable bed for placing the pipe.

1.14.1.116 Dewatering of excavated area for pipe laying, welding, wrapping coating etc is in the scope of the contractor.

1.14.1.117 Preparation of pipe surface as per customer consultant's specification by sand / shot / grit blasting for wrapping and coating is included in the scope of this tender. All fittings like elbows, tees, reducers, flanges, inserts etc., valves flow nozzles, etc shall be matched with pipes for welding which may require re-edge preparation, grinding etc., if found necessary.

1.14.1.118 Erection of platform and supporting structures around the equipments / valves / filters / in the Fire protection system/LP piping area/ Sea Water Intake Piping/PT-RO-DM System, etc. Is covered in the scope of contract and shall be erected by the contractor as per accepted tonnage rate for other structural work

1.14.1.119 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.

1.14.1.120 Contractor should fabricate bends of </=2" diameter size from running meters of pipe.

1.14.1.121 Contractor shall arrange all the equipments, alignment bolts, tools, consumables like welding electrodes (all type), TIG wires (Other than the supplied TIG wires from BHEL if any) and argon gas cylinders etc., for welding of pipes at his cost. Consumables like jute, cotton waste, hacksaw blades, petrol, Kerosene oil etc. are in contractor's scope.

1.14.1.122 All the rubber – lined pipes are flange joined and the flanges are also rubber lined. No welding is allowed on these pipes. If any damages occurred / notices in the above pipe lines during erection / transportation /

commissioning of rubber lined pipes, the same has to be rectified by the contractor at his cost.

1.14.1.123 Also refer clause 1.16.0 of Technical conditions of Contract –coating and wrapping (Chapter- XVI of this booklet)

1.14.1.124 TARIFF ADIVSORY COMMITTEE APPROVAL

1.14.1.125 BHEL Will make arrangement of TAC approved agency for accreditation of work. The contractor has to facilitate TAC for getting approval. As per TAC any modification or any rerouting of the lines, re erection of equipment should be done and same should be carried by contractor with in quoted rates. There is no extra payment will be paid.

1.14.2 **PT-RO-DM System**

1.14.2.1 All the erection equipment such as welding machine, grinding machine, cutting machine, tools and tackles, required man-power etc., for the complete erection of the plant & equipment shall be made available by the contractor before the start of erection.

1.14.2.2 Read the erection manual and erection drawings thoroughly and familiarize with the erection procedure, sequence and special instructions. The scheme drawings listed in "C&I Erection Drawings List" shall also be referred for general guidelines of all the equipment and instrumentation in addition to the individual equipment layout and erection drawings. Consult BHEL Erection engineer for further clarifications.

1.14.2.3 A complete schedule of sequential erection of all the equipment, method of erection, safety aspects etc., is to be prepared by the contractor, well ahead of the start of the erection and it should be submitted for approval by BHEL. Erection of all the equipment shall be subject to inspection and clearance by BHEL / Customer at every stage. A log book shall be maintained for recording all the erection activities, procedures, checks and inspection details. This will bear the countersignature of BHEL /Customer's inspector at every stage. It is the responsibility of the contractor to maintain necessary records for the stage inspection, critical checks, etc. to meet the protocol for review.

1.14.2.4 Inspect the foundation platform of all the equipment with the Foundation drawing. Any deviation noticed shall be informed to the Erection In-charge and such deviations should be corrected / rectified before the start of erection. All the foundation measurements shall be recorded in a separate check list (to be prepared by the contractor) and approved by BHEL. Check the level of Finish Floor Level (FFL) of the PT- RO-DM building with respect to surrounding graded level from the GA drawing.

1.14.2.5 All foundation pockets shall be thoroughly cleaned before the start of the erection. All the internal and external pipe trenches shall be thoroughly

cleaned before the start of the erection. Loose & precision components shall be kept on the floor over a tarpaulin or LDPE sheet to avoid any possible damage during erection & assembly.

1.14.2.6 Contractor shall be responsible for the safe custody of all the equipments and materials supplied by BHEL during the course of handling and erection. Any damage caused to the equipment till the completion of erection shall be set right by the contractor at their cost.

1.14.2.7 All equipments and accessories, Valves, Pipes and fittings, supports etc., are to be thoroughly cleaned by the Contractor and inspected before the start of the erection.

1.14.2.8 Whenever the erection of any particular equipment is to be carried out under the supervision of the OEM, Contractor shall give advance intimation to BHEL for arranging the visit of the OEM personal.

1.14.2.9 Final grouting shall be carried out after checking and ensuring all the dimensions given in the equipment and pipelines erection and layout drawings after obtaining approval of relevant checklists as per erection manual and stage inspection clearance from BHEL.

1.14.2.10 UPVC pipes and fittings shall be joined strictly as per the procedure given in the drawing / Pipe supplier, under the supervision of BHEL. The dimensions given in the drawing for various UPVC, CPVC and HDPE pipes and pipe fittings are for reference only. End to end dimension for all pipe segments shall be checked. Based on the end-to-end dimension available and considering the 'z' value of the relevant fittings, the length of the pipe is to be decided carefully. Special attention is required on this point to avoid wastages and rework of various pipe joints. Wherever UPVC unequal fittings are supplied with loose reducing bush, the same shall be joined using solvent cement as per the procedure under the supervision of BHEL before assembly. Contractor should use only TANGIT make solvent cement solution or any other reputed international make, acceptable to the piping supplier for all the joining of UPVC fittings and pipes and a separate solution of the same make shall be used for CPVC piping and fittings. For the UPVC piping carrying acid, separate solvent cement of TANGIT make, suitable for Hydrochloric acid should be used. No other make of solvent cement solution shall be used.

1.14.2.11 Required Thrust blocks should be provided at all UPVC joints wherever there is a change in direction of flow. Necessary materials for the fabrication of thrust blocks have been supplied in running meters. Location and type of thrust blocks will be decided as per the site condition and requirement; the same shall be decided jointly by the BHEL Engineer at site and the erection contractor. Contractor should arrange to fabricate the thrust block / supports at site and install them suitably.

1.14.2.12 PVC welding: For Flow meters (which are to be fitted onto the pipes) which are supplied with weld-on fittings, the fittings are to be welded to the pipe carefully with the special UPVC welding equipment within the quoted rate

only. Location of welding of such fittings shall be carefully chosen in consultation with BHEL.

1.14.2.13 Entire piping is to be subjected to hydraulic test to 1.5 times the working pressure after the completion of all the installation and support works. Testing can be done for the complete piping or in segments to suit the site conditions. All necessary hydrotest pumps, connecting piping, dummy flanges, plugs, fasteners, etc., are to be arranged by the contractor to conduct the hydraulic test.

1.14.2.14 Tightening torque values for UPVC / HDPE pipeline bolts are given below.

Outside dia of UPVC pipe MM	16	20	25	32	40	50	63	75	90	110
Torque in Newton metre	6	7	9	10	20	25	30	35	40	45

Outside dia of UPVC Pipe MM	125	140	160	200	225	280	315
Torque in Newton metre	50	50	60	75	75	75	75

1.14.2.15 The socket depth and “Z” values od UPVC pipe lines are given below:

Outside dia of UPVC Pipe MM	20	25	32	40	50	63	75
Socket depth in mm	16	19	22	26	31	38	43.5
“Z “ value in mm	11	14	17	23	26	33.5	39.5

Outside dia of UPVC Pipe MM	90	110	160	225	280	315
Socket depth in mm	51	61	86	119	151	165
“Z “ value in mm	46	55	80	114	147	167

1.14.2.16 Ensure that all insert plates are free from rust and the distance between the plates and alignment at each location are as per the drawing. All pipe supports inside the trench shall be tack welded to the side insert plates initially, maintaining the top elevation of the channels as per the drawing. Any adjustment required in the location or elevation of the supports shall be noted down. After the trial assembly of the UPVC pipes and fittings and inspection of all equipments, these pipes and fittings can be dismantled; any correction works, as noted down earlier, on the support channels shall be carried out and then these support channels can be fully welded.

1.14.2.17 The pipe supports are to be thoroughly cleaned using wire brushes and emery papers and epoxy painting shall be carried out as per the painting schedule / procedure.

1.14.2.18 No welding of support materials shall be done near the UPVC pipes and fittings to avoid any possible damage due to the heat of welding and weld spatter.

1.14.2.19 Trial assembly for all the pipe lines shall be carried out and the position of the service saddle / Weld-on nipple shall be clearly marked as per drawing. Then, drilling on the UPVC pipe for the service saddle shall be carried out as per the marking separately after dismantling the pipe from the assembly. Care shall be taken to de-burr the drilled holes and to remove all the drilling chips. Location of such drilling shall have the approval of BHEL in each case.

1.14.2.20 After completion of the erection the area shall be cleaned for all cut-bits, grouting mixtures, left out materials, consumables etc.,

1.14.2.21 Necessary rubber sheets must be inserted between the supporting arrangement and the equipment / pipeline / valves/ U Clamps etc., Rubber sheets of standard width and length will be supplied by BHEL.

1.14.2.22 Wherever torque values are specified for tightening the bolts, nuts and screws, the same has to be strictly followed and calibrated torque wrenches are to be used.

1.14.2.23 Correct spanners are to be used to avoid damage to nut, bolt/screw heads etc. Adjustable spanners shall not be used.

1.14.2.24 Suitable operating platform made of steel shall be fabricated using necessary step- tread, floor grill, hand rails, support etc at site and installed for equipment wherever necessary such as Process Cartridge Filters, CC Cartridge filter, CC tank, dosing system, etc. Typical fabrication details will be provided during execution. All the steel materials will be supplied in running meters as loose item by BHEL-BAP. All these materials for structural fabrication (including piping & valves support) will be dispatched as loose with red-oxide painting. Necessary epoxy painting (intermittent & finish coat) shall be carried for these materials after structural fabrication by the contractor within the quoted rates.

1.14.2.25 Necessary cross over platforms shall be fabricated wherever required within the quoted rates only.

1.14.2.26 Contractor shall arrange to provide all the tools & tackles and consumables required for the smooth erection and commissioning of the plant. Consumables include first fill of lubricants for all pumps, blowers, motors, etc.,cleaning cloth, Teflon tape, Glycerine for RO membrane loading, etc. shall be arranged by the contractor within the quoted rates .

1.14.2.27 Preparation of dosing chemicals shall be done strictly under the supervision of BHEL Engineers as per the given guidelines.

1.14.2.28 Rubber expansion bellows are to be provided at all pump suction and discharge as per the drawing to avoid transfer of pipe loading and surge loading to the pumps.

1.14.2.29 Necessary drains to be provided at the lowest point on the pipe line to facilitate easy drain of the pipe line whenever required.

1.14.2.30 Necessary air vent to be provided at the highest point of the pipe line to release the air entrapped in the piping system.

1.14.2.31 It is the responsibility of the contractor to carry out all the required works for the erection and commissioning of the plant till PG test is over.

1.14.2.32 Chemicals required for pre-commissioning, commissioning & operation of the PT-RO-DM system has to be drawn from BHEL Stores/Bulk storage facility and handling, transport, filling & refilling has to be carried out by contractor within the quoted rates only. Approximate quantity of Operation & Commissioning Chemicals supplied by BHEL will be 560 MT.

1.14.2.33 The contractor has to carry out the pre-commissioning activities like trial run of pump individually with and without load, leak test of pipe lines and other activities as per manual like commissioning of the plant, trial operation & PG test of the plant etc.

1.14.2.34 PT-RO-DM Plant is to be operated continuously. The contractor has to provide necessary man power for round the clock operation and consumables for continuous O&M of the plant till handing over of the plant (including during the trail operation period and performance test period), within the quoted rates only.

1.14.2.35 All equipment are supplied with painting. However, final coat of painting shall be carried out by the contractor as per the Painting specification.

1.14.2.36 Unutilized material and cut bits material shall be returned to BHEL stores as per procedure.

1.14.2.37 The spares shall be tagged with OEM part number and applicable material code and shall be handed over to BHEL stores for retrieval of spares.

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

1.15.1 The equipments and piping shall be erected in conformity with the 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. All the prepared / patched edges will have to be suitably protected to prevent rusting or foreign material ingression.

1.15.2 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.

1.15.3 All welders shall be tested and approved by BHEL Engineer before they are quality ensured on work though they may possess the requisite certificates. BHEL reserves the right to reject any welder without assigning any reason. The welder’s 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 statutory requirements.

1.15.4 BHEL Engineer may stop any welder from the work if his performance is unsatisfactory for any technical reason or if there is a high percentage of rejection in the joints welded by him. The welders having passed qualification tests does not absolve the contractor of contractual obligation to continuously check the welder's performance.

1.15.5 BHEL Engineer is entitled to stop any contractor’s welders from his work if his work is unsatisfactory for any technical reason or there is a high percentage of rejection of joints welded by him which in the opinion of BHEL Engineer, will adversely affect the quality of welding. Even though the welder has earlier passed the tests it does not relieve the contractor from his contractual obligations, to check the performance of the welders.

1.15.6 Faulty welds caused by the poor workmanship shall be cut and re-welded at the contractor’s expense. The Engineer prior to any repair being made shall approve the procedure for the repair of defective welds. After the repair has been carried out, the compliance shall be submitted to the quality engineer.

1.15.7 Pre -heating, radiography and other NDT tests, post heating and stress relieving after welding of tubes, pipes, including attachment welding wherever necessary are part 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.

1.15.8 The contractor shall conduct nondestructive tests like radiography dye penetrant tests, magnetic particle test etc., on weld joints, castings, valve bodies and other equipments etc., as per drawing / welding schedule.

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

1.15.10 Contractor shall arrange all necessary stress relieving equipment with automatic recording devices. The contractor shall arrange for labour, heating elements, thermocouples, compensating cables , thermo-chalks, temperature recorders, thermocouple attachment units, graph 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.

1.15.11 The contractor shall also be equipped for carrying out other NDT like liquid penetrant inspection (LPI), magnetic particle inspection (MPI), Hardness test etc. as required as per welding schedules / drawings within the finally accepted price / rates. Ultrasonic testing, wherever required also has to be arranged by the contractor.

1.15.12 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 will be submitted and got approved by BHEL Engineer before the actual deployment of agency for radiography work.

1.15.13 Contractor shall note that 100% radiography will be done at the initial stages on the piping welding joints. Subsequently radiographic inspection will be done on the basis of quality of welding. However minimum percentage of joints to be radiographed shall not be less than the requirement of BHEL welding schedule / Customer's requirements. The percentage may be increased depending upon the quality of joints and at the discretion of BHEL. For LP Piping, as per site engineer's instructions, NDT method and other tests to be carried out.

1.15.14 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 safety, labour, supervisors/ Engineer required for the work as per directions of BHEL.

1.15.15 All expenses for testing of contractor's welders (pre-production test) 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. Necessary pipe material and the welding TIG wire, if any, will be arranged by BHEL and all testing/facilities will have to be arranged by contractor with in the quoted rate.

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

1.15.17 The technical particulars, specifications and other general details of work shall be in accordance with ASME / BHEL welding, Heat treatment and NDE manuals or equivalent as decided by BHEL Engineer.

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

1.15.19 Low speed high contrast fine grain films (D7 or equivalent) in 10 cm width only should be used for weld joint radiography. Film density shall be between 1.5. to 2.00

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

1.15.21 Penetrometer as per ASME / ISO shall be used for all exposures.

1.15.22 Lead numbers and letters (generally of 6mm size) are to be used for identification of radiographic contract No., joints identification, sources used, welders identification, SFD used are to be noted down in the paper cover of radiography.

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

1.15.23 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.

1.15.24 The contractor shall be fully equipped with radiography equipments,, films, chemicals and other dark room facilities. There must be a number of radiographic personnel with sufficient experience and certified by BARC for field radiographic inspection. Further, the contractor must follow strictly the safety rules laid down by BARC, from time to time, contractor's radiographers shall also be registered with BARC for film badge service.

1.15.25 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.

1.15.26 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.

1.15.27 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.

1.15.28 Radiography of joints shall be so planned after welding that the same is done either on the same day or next day of the welding to assess the performance of high pressure welders. If the performance of the welder is unsatisfactory, he shall be replaced immediately.

1.15.29 The defects as pointed out by the Engineer shall be rectified immediately to the satisfaction of Engineer and Re-radiographed. The decision of Engineer regarding acceptance or otherwise of the joint shall be final and binding on the contractor.

1.15.30 Wherever radiographs are not accepted on account of poor exposure, joints shall be re-radiographed and new film submitted for evaluation. Radiographs shall be taken again on joints after carrying out repairs. However, if the defect persists after first repair as per radiograph, carrying out radiography shall be repeated till the joint is made acceptable. In case the joint is not repairable, the same shall be cut, re-welded and re-radiographed at contractor's cost.

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

1.15.32 The welded surface irrespective of place of welding shall be cleaned of slag and painted at the center with primer paint to prevent corrosion at no extra cost towards this including supply of Paint for this purpose. All welds shall be painted with primer as specified in the painting schedule, once radiography and stress reliving works are over.

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

1.15.34 The contractor shall carry out the root run welding of all LP piping, valves by TIG welding method as specified in the Drg./ EWS. The contractor shall have to carry out full TIG welding of butt weld joints of tubes / pipes of lesser thickness if required. For oil system piping root run of all the butt joints shall be carried out by TIG welding only.

1.15.35 For Stainless Steel pipe, welding procedure will be as per BHEL site Engineers 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.

1.15.36 Such of those consumables as indicated as “Consumables provided by BHEL” shall alone be provided to the contractor by BHEL free of charge. Any excess requirement shall be arranged by the contractor/BHEL at contractor’s cost. Other indigenous alloy steel, stainless steel and carbon steel filler wires and all electrodes are to be arranged by the contractor at his cost. Other consumables, filler wires, electrodes, gas etc. are to be arranged by the contractor at his cost. Weight of above BHEL supplied welding consumables will not be considered for any payment.

1.15.37 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.

1.15.38 Pre-heating / post heating and stress relieving after welding are part of erection work and shall be performed by the contractor in accordance with the instructions of BHEL Engineer. Contractor shall arrange to supply heating equipment with automatic recording devices. Also the contractor shall have to arrange for the labour, all heating elements, thermocouples, compensating cables, insulation materials like mineral wool, asbestos cloth, ceramic beeds, asbestos rope, etc. required for the heat treatment and stress relieving works. During the heat/stress relieving operations, the temperature required, by attaching thermocouples and recorded on a continuous printing type recorder. All the recorded graphs for the heat treatment works carried out shall be got signed by BHEL Engineer prior to the commencement of each cycle and handed over to BHEL on completion. The graphs will be the property of BHEL. The

contractor has to provide (Thermo chalks) temperature recorders, thermocouple attachment units, graph sheets, etc., required for the job and maintain them in good condition. The field joints are to be radio graphed and preheating and post weld heat treatment to be done as per BHEL procedure and manuals.

1.15.39 Any discrepancy in process, procedures provided BHEL engineer decision is final.

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

1.15.41 Also refer “GUIDELINES FOR HEAT TREATMENT” and “GUIDELINES FOR WELDING” published under Chapter 5 and Chapter 6 respectively of Volume IA Part II of this booklet.

VOLUME-IA PART – I CHAPTER – XVI
COATING & WRAPPING

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

1.16.0 COATING & WRAPPING for buried piping wherever applicable shall be done as follows.

1.16.1 The external surfaces of the buried pipes shall be thoroughly cleaned by sand blasting method for free of rust, weld scales, burns etc., before start application of anti-corrosive coats. Kerosene, solvent or other cleaning material should not be used for external cleaning of the pipes. The above work shall be carried out to the satisfactory of BHEL engineers or as instructed by BHEL engineers.

1.16.2 The entire length of pipe shall be cleaned and coated leaving the end about 230 mm for joints, which shall be coated manually after laying in the trench, welding and testing the pipe.

1.16.3 Coating & Wrapping of site joints shall be done after completion of weld and / or flanged connections and after completion & approval of Hydro testing. Materials required for coating, wrapping and consumables required for cleaning operations are to be arranged by the contractor within the quoted rate. Also refer 1.16.10 for scope matrix for supply.

1.16.4 The materials used for coating and wrapping are

a. Coating Primer (Coal Tar Primer)
b. Coating Enamel (Coal Tar Enamel)
c. Wrapping Material

1.16.5 All primer / Coating / Wrapping materials and method of application shall conform to IS 10221 & AWWA –C–203**.**

1.16.6 Number of coats and wraps, minimum thickness for each layer of application shall be as per IS-10221 and shall be decided based on soil corrosive / resistivity. However the total thickness of completed coating shall not be less than 4 mm, that includes anti corrosive tape of 4 mm thick.

1.16.7 Alternatively the anti-corrosive protection can consist of anticorrosive protection tapes. Material and application of tapes shall conform to IS 15337:2003 & AWWA – C – 203. These tapes shall be applied hot over the coal tar primer. The total thickness of the finished protective coating shall be 4 mm minimum. The required above mentioned tapes are to be provided by the contractor at his cost.

1.16.8 Tests to be carried out after application – (a) Bond / Adhesion test (b) Holiday test. The preservative paint, anti-corrosive tape, all the required consumables, T&Ps and the instruments required for the above application and testing are to be arranged by the contractor at his cost.

1.16.9 All the provisions for bed preparation / laying the pipe / application of primer / coating / wrapping with tapes etc., as indicated above are applicable for buried galvanized steel (GI) pipes also.

1.16.10 **Wrapping Materials Supply & Erection Matrix :**

SL.NO	System	Qty	Scope of supply	Application
1	Sea Water Intake PIPING	For Buried Piping (Approx. 30 Mtr length of buried pipe is in scope of Contractor)	Contractor	Contractor
2	Piping for Fire Protection system	8000 Sq. Mtr supply from BHEL /PESD/HYD.	BHEL (Refer note-B)	Contractor

NOTE:

A) For coating of underground pipe, supply and application of the primer & enamel are within the scope of the contractor.
B) Additional requirement of wrapping materials, if any for satisfactory completion of the works /system to be arranged by contractor within the quoted price.
C) Holiday test - Underground piping -100%.

VOLUME-IA PART – I CHAPTER – XVII

Hydraulic test for LP Piping including LP Piping, Sea Water Piping System including CW Blow down Piping, Piping for Fire Protection system & Piping in PT-RO-DM System

1.17.1 All lines contractor has to arrange Hydraulic Test pump / Hand Pump for Hydro test at his cost.

1.17.2 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.

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

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

1.17.5 In general HT 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.

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

1.17.7 Openings on piping for pressure / temperature impulse connections shall be fully closed during the test to prevent dust or foreign matter entering into the instrument piping inadvertently.

1.17.8 Hydraulic test is to be carried out for buried piping also. Where the length of laid and welded pipe is more, pressure test is to be conducted in sections, blanked at both ends. All arrangements for Hydro test like pumps, piping, valves, blanks, pipe connections, etc., are to be arranged by contractor within the quoted rate. The section of the pipe can be closed and back filled for the portion of the pipe hydraulically tested and cleared.

1.17.9 For FPS pkg Hydro Test of all the lines (Charged with water) - 1.5 times of the design pressure

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

- Date of test
- Identification of piping tested
- Test fluid
- Test pressure
- Approval of the Engineer.

Note: Refer P&ID drawings for conduction of hydro test, if details are not available the decision of BHEL is final.

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

1.18 TESTING, PRE – COMMISSIONING & COMMISSIONING AND POST COMMISSIONING

1.18.1 The Contactor shall carry out all the required tests and pre-commissioning and commissioning activities required for their successful and reliable operation.

1.18.2 The scope of pre-commissioning activities cover installation of all necessary equipment including temporary piping, supports, valves, blanking, pumps, tanks, with access platforms valves, along with accessories required for hydro test, chemical cleaning (Acid cleaning of piping / alkali flushing), steam blowing or for any other tests. The scope also covers the offsite disposal of effluents. The area for effluent disposal shall be provided by BHEL within the plant premises

1.18.3 All items / materials required for conducting pre-commissioning and commissioning tests 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 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.

1.18.4 It shall be the responsibility of the contractor to provide various categories of workers in sufficient numbers along with Supervisors during pre commissioning, commissioning and post commissioning of equipment and attending any problem in the equipment erected by the contractor till handing over. The contractor will provide necessary consumables, T&Ps, IMTEs etc., and any other assistance required during this period. Association of BHEL's / Client's staff during above period will not absolve contractor from above responsibilities.

1.18.5 In case, any rework is required because of contractor's faulty erection, which is noticed during pre-commissioning and commissioning, the same has to be rectified by the contractor at his cost. If any equipment / part is required to be

inspected during pre-commissioning and commissioning, the contractor will dismantle / open up the equipment / part and reassemble / redo the work without any extra claim.

1.18.6 During commissioning, opening / closing of valves, changing of gaskets, Re-alignment of rotating and other equipment, attending to leakage and adjustments of erected equipment may arise. The contractor has to carry out these works at his cost by providing required manpower in all the three shifts. The finally accepted price / rates shall also include all such work.

1.18.7 The valves will have to be checked, cleaned or overhauled in full or in part before erection, after acid cleaning, steam blowing and during commissioning as may be necessary. Experienced technicians shall be arranged by the contractor at his own cost.

1.18.8 The contractor shall carry out cleaning and servicing of valves and valve actuators prior to pre-commissioning tests and / or trial operations of the plant. A system for recording of such servicing operations shall be developed and maintained in a manner acceptable to BHEL Engineer to ensure that no valves and valve actuators are left un-serviced. Wherever necessary as required by BHEL Engineer, the contractor shall arrange to lap / grind valve seats.

1.18.9 Transportation of oil drums from customer's BHEL's stores, filling of lubricants and filling of oil for flushing and first filling and subsequent topping up during commissioning and post commissioning is included in the scope of this contract. The contractor shall have to return all the empty drums to the customer / BHEL stores. Similarly transport of chemicals for various pre-commissioning activities / processes mentioned in the above clauses and returning of remaining and / or the empty containers of the chemicals to customer / BHEL stores is the responsibility of the contractor.

1.18.10 During the initial stages of work, trenches for draining water may not be available for alkali flushing or mass flushing for discharging and draining the system and piping. Necessary low point drains and temporary piping for this will have to be erected by contractor from materials provided by BHEL.

1.18.11 Overhauling, cleaning, Servicing of tanks, pumps, equipments, valves, during erection and commissioning stages are in the scope of work.

1.18.12 Contractor may have to replace old / damaged gaskets / packing etc. for equipments and the same shall be carried out by contractor as per requirement. Gaskets packing required for replacement will be provided free of cost by BHEL.

1.18.13 In case any erection defect is detected during tests, trial runs and commissioning such as loose components undue noises or vibration strain on connected equipment steam or oil or water leakage etc. the contractor shall immediately attend these defects and take necessary corrective measures. The parts to be replaced shall be provided by BHEL free of cost. If the insulation is

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

1.18.14 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.

1.18.15 The contractor shall carryout the required tests on the equipments and the pipelines such as gas tightness test / air tightness test, kerosene test, hydrostatic testing of the equipment/piping etc., and rectify all the defects caused due to contractor's fault at his own cost. Compressed air for pneumatic testing is to be arranged by contractor.

1.18.16 The contractor shall carryout any other test as desired by BHEL Engineer on erected equipment covered under the scope of this contract during testing, pre-commissioning, commissioning, and operation, to demonstrate the completion of any part or whole work performed by the contractor.

1.18.17 All the tests shall be repeated till all the equipment satisfy the requirement of BHEL / Customer. As far as the hydraulic pressure test is concerned and same shall be conducted to the satisfaction of Boiler Inspector wherever applicable. Any rectifications required shall have to be done / redone by the contractor at his cost.

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

1.18.19 All the tests may have to be repeated till all the equipment satisfy the requirement / obligation of BHEL at various stages. The contractor shall do all the repairs for site-welded joints arising out of the failure during testing.

1.18.20 Contractor shall cut / open works if needed, as per BHEL engineer's instructions during commissioning for inspection, checking and make good the works after inspection is over. This contingency shall be included within the quoted value.

1.18.21 Contractor to provide necessary commissioning assistance from pre-commissioning state onwards and up to continuous operation of the unit & handing over to customer. The category of personnel to be as per site requirement and to meet the various pre-commissioning and commissioning programme made to achieve the schedule agreed with customer.

1.18.22 It is the responsibility of the contractor to provide necessary manpower, tools, tackles and consumable till the completion of work under these specifications

including for trial operation, even if commissioning of Unit and the other equipments is delayed due to reasons not attributable to the contractor.

1.18.23 After synchronization, the commissioning activities and trial operations will continue upto 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, tools, etc. during this period. 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.

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

1.18.25 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.

1.18.26 Contractor at his cost shall lay all necessary temporary piping, install the pumps, blanks ,valves pressure gauges etc required for the test,. Contractor shall also lay the temporary pipelines with fittings, accessories and erection / commission pumps, tanks and other installations as instructed by BHEL

Engineer for the purpose of chemical cleaning / alkali flushing / steam blowing / steam washing / steam flushing / water flushing / water washing / oil flushing etc., of piping and other equipments. Necessary, materials for this will be provided by BHEL. Temporary piping, fittings, accessories, pumps, valves, flanges, blanks etc shall be removed by him and returned to BHEL.

1.18.27 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.

1.18.28 Overhauling / cleaning / servicing of valves, pumps, fittings in temporary system and acid cleaning tanks etc prior to the above operations / activities will also be carried by the contractor at his cost.

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

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

1.18.31 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.

1.18.32 Hanger adjustment / re adjustment during erection, before and after Hydraulic Test, before and after steam blowing, during and after full load operation, are to be carried out by the contractor within Quoted Rate.

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

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

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

1.18.36 The contractor shall carry out the trial run of motors including checking the direction of rotation in the uncoupled condition checking aligning and coupling

the motor to the respective driven equipment. Before starting the motor, IR values of insulation shall be recorded and if found necessary the contractor shall dry out to improve the IR value at no extra cost.

1.18.37 In case any erection defect is detected during various tests / operations trial runs as detailed above such as loose components undue noises or vibration strain on connected equipment steam or oil or water leakage etc. the contractor shall immediately attend these defects and take necessary corrective measures. If any readjustment and realignments 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.

1.18.38 All the lubricant oils for flushing and during trail run of the equipment including first fill up, chemicals for detergent flushing, acid pickling / cleaning / trial run, Chemicals required for PT-RO-DM. System, etc., will be arranged by BHEL free of cost. Required manpower shall be provided by the contractor for handling, filling, emptying and re-filling etc., as part of the work without any extra cost, till the unit is handed over. Transportation of all the above shall be arranged by the contractor from BHEL store / yard to work site and returning of the empty barrels / drums to stores at his cost. Care should be taken to avoid any spillage / wastage.

1.18.39 Necessary scaffolding and approaches for carrying out / conducting all the above shall also be within the scope of the contract.

1.18.40 PT-RO-DM: Chemical required for pre-commissioning, commissioning & operation of the PT-RO-DM system has to be drawn from BHEL Stores/Bulk storage facility and handling, transport, filling & refilling has to be carried out by contractor within the quoted rates only. Approximate quantity of Operation & Commissioning Chemicals supplied by BHEL will be 560 MT.

1.18.41 PT-RO-DM Plant is to be operated continuously. The contractor has to provide necessary man power for round the clock operation and consumables for continuous O&M of the plant till handing over of the plant (including during the trail operation period and performance test period), within the quoted rates only.

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

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

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

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

1.18.46 Chemical cleaning will involve the installation of temporary piping, valves, cutting of some of the existing valves, placing the rubber, wedges in the valves, gagging of valves, and installation of temporary tanks for chemical and for mixing. Necessary temporary access platforms to mixing tank are to be made by the contractor. The dissolving tank, neutralizing tank etc. required for acid pickling will have to be fabricated by the contractor with in the quoted rate. Required materials will be provided by BHEL free of cost. Chemicals for chemical cleaning will be provided by BHEL and handling of chemicals & other consumables and other connected activities has to be carried out by the contractor at their cost. All other consumable would have to be provided by the contractor.

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

1.18.48 Raw materials for all temporary piping necessary for conducting hydraulic test, chemical cleaning, steam blowing, flushing, effluent disposal etc., will be provided by BHEL free of cost. However, fabrication servicing, erection and dismantling the same and return of the temporary piping, flanges, valves etc., to BHEL stores is the responsibility of the contractor without any extra charges. Charges for dismantling of temporary lines etc should be included with in the Quoted Rates.

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

1.18.50 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.

1.18.51 The contractor has to provide required man power assistance during pre-commissioning and commissioning checks of motor operated valves, actuators, control valves etc., without any extra charges.

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

.

VOLUME-IA PART- I CHAPTER-XIX
PAINTING

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

1.19 FINAL PAINTING

1.19.1 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 mentioned under Volume-IA Part-II Chapter-3 of this booklet that forms the part of this tender for the components of all LP piping equipments.

1.19.2 Though Pipes with Glass Flake Coating (Sea Water Intake Piping & CT Blow down) will be supplied, at open ends of each pipe upto 200 mm length (on both sides), the Glass Flake Coating will not be done to facilitate welding while supplying the pipes. Hence the scope of this contract includes surface cleaning, supply and application of Glass Flake coating for the welded portion of the pipes upto the maximum of 200mm length or HAZ on both sides of the joint.

1.19.3 Surface cleaning and painting of the internal and external surface of piping shall be carried out by the contractor as per the painting schedule (Volume-IA Part-II Chapter-3)

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

1.19.5 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 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.

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

1.19.7 Paint shall be applied by brushing or by spray painting as per the instruction of BHEL Engineer. It shall be ensured that brush marks are minimal.

1.19.8 If needed and insisted either by BHEL / Customer in certain cases, spray painting has to be carried out within the Quoted rates. Spray painting gun and compressed air arrangement has to be made by the contractor himself.

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

1.19.10 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.,

1.19.11 The scope of painting includes application of colour bands, lettering the names of the systems equipments; tag Nos of valves, marking the directions of flow and other data required by BHEL within the quoted rate.

1.19.12 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.

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

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

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

1.19.16 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.

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

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

1.19.19 Required paints, thinner other consumables such as wire, 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 except where clearly mentioned as BHEL scope.

1.19.20 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.

1.19.21 Necessary scaffolding, required for painting of surfaces at various locations/ elevations shall be arranged by the contractor at their own cost. All the materials, required for scaffoldings shall be arranged by the contractor at their own cost.

1.19.22 PRESERVATION / TOUCH UP PAINTING

1.19.22.1 Due to atmospheric conditions erected materials are likely to get rusted more frequently. It is the responsibility of the contractor to preserve the erection materials drawn from stores for erection till these are commissioned and handed over to customer. The required consumables for this purpose like paint, thinner, rust converter compound (Ruskill or Ferropro) or any other equivalent shall be arranged by bidder. However, the contractor should also arrange other consumables like wire brushes, emery paper, cotton waste, cloth etc., at their cost. The contractor should ensure that the materials are not rusted on any account till they are handed over to customer. The decision of the BHEL Engineer is final with regard to frequency of application of paint and rust converter compound.

1.19.22.2 Mostly the equipment / items/ components will be supplied with one coat of primer paint and one coat of finish paint. However during storage and handling, the same may get peeled off / deteriorate. All such surfaces are to be thoroughly cleaned and to be touch up painted with suitable approved primer and finish paint matching with shop paint / approved final colour. Besides above two coats of approved primer paint is to be applied on all the bare / unpainted surfaces.

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

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

1.19.22.5 Equipment / items/ components supplied during storage and handling, may get peeled off / deteriorate. All such surfaces are to be thoroughly cleaned and to be touch up painted with suitable approved primer and finish paint matching with shop paint / approved final colour.

1.19.22.6 Paint Schedule enclosed in Chapter 3 VOL1A PART-II

1.19.22.7 Paint Supply and application Matrix

Sl No.	System	Qty	Scope of supply [PRIMER+PAINT]	Application of [PRIMER + PAINT]
1	LP PIPING	Full	Contractor	Contractor
2	Sea Water Intake System & Piping	Full	Contractor	Contractor
3	PT-RO-DM System	Full	Contractor	Contractor
4	Piping for Fire Protection system	5000 Ltr to be supplied by PESD/HYD	PESD/HYD/BHEL and refer (note B)	Contractor

NOTE:

A. DFT is to be carried for measuring the thickness of paint as a sampling method

B. Any additional requirement of paints for pipe Sl no-4 , primer & paint both supply and application is within the scope of contractor within the quoted rates.

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.

Clause 4.2.2.9 alone is revised as below.
In construction projects of this magnitude it is possible that all the areas/ approaches may not be ready. In such cases backfilling of approaches where ever necessary, consolidation of ground and arrangement of sleepers / sand bag filling etc for safe operation / movement of equipment including cranes / trailers etc shall be the responsibility of the contractor at his cost. No compensation on this account shall be payable.

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 Rev 01) 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

EARNEST MONEY DEPOSIT

The EARNEST MONEY DEPOSIT (EMD) clause 1.9 published in General Conditions of Contract (Volume IC Book-II) is revised as under.

Void (Explanation: EARNEST MONEY DEPOSIT is not applicable for this tender).

Bid Security Declaration: Bidders to submit Bid Security Declaration as per format provided in NIT.

Sl No. 5

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.: 6

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.: 7

PRICE VARIATION COMPENSATION (PVC)

Clause 2.17.5 under The PRICE VARIATION COMPENSATION (PVC) clause 2.17 published in General Conditions of Contract (Volume IC Book-II) is revised as under.

"Base date shall be calendar month of the scheduled completion date (i.e. actual start date + scheduled contractual completion period as per letter of intent/ award and/or work order)".

Sl. No.: 8

Procedure 2.3 that forms the part of Forms and Procedures is published as *Chapter 14 in Volume IA Part II* of this booklet (Volume-I Book-I).

Sl No.: 9

The chapter Reverse auction procedure published in 'Forms and Procedures' of Volume I Book-II stands deleted. 'Guidelines for Reverse Auction-2021' available in the website http://www.bhel.com -> Supplier Registration, shall be applicable**.**

Sl No.: 10

Existing format for BANK GUARANTEE FOR SECURITY DEPOSIT, as available in Form No. F-11 (Rev 00) of Volume ID Forms and procedures stands deleted. Refer Proforma of Bank Guarantee (in lieu of Security Deposit)-Form WAM 22 provided in *Chapter- 13, Part-II of Volume-IA* Technical Conditions of Contract.

Sl No.: 11

Existing format on Monthly Performance Evaluation 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.

Sl No.: 12

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 03) is enclosed.

Sl No.: 13

Existing format for Integrity Pact, as available in Volume ID Forms and procedure stands Deleted. Refer revised format for Integrity Pact provided in *Annexure – 7* of Notice Inviting Tender (NIT).

VOLUME-IA PART – II

CHAPTER 2 to 13

Next pages are as below

Chapter 2	Erection welding Schedule- LP PIPING	10
Chapter 3	Painting schedule/Customer painting specification for LP Piping	18
Chapter 4	P&ID & other layout for LP Piping Works	14
Chapter 5	Guidelines for Heat Treatment	18
Chapter 6	Guidelines for Welding	98
Chapter 7	Guidelines for NDE and Heat Treatment Agency	13
Chapter 8	T&P Hire Charges	13
Chapter 9	"HSE Plan for Site Operations by Subcontractor" (Document No. HSEP: 14 Rev01)	82
Chapter 10	Format for Form no.: F-14 (Rev 01); Monthly Plan and Review with Contractors	06
Chapter 11	Format for Form no.: F-15 (Rev 03); Monthly Performance Evaluation of contractor	08
Chapter 12	Proforma of Bank Guarantee (in lieu of Earnest Money)- Form WAM 23	03
Chapter 13	Proforma of Bank Guarantee (in lieu of Security Deposit)- Form WAM 22	03
Chapter 14	Procedure 2.3-Procedure for Conduct of Conciliation Proceedings	11

ERECTION / FIELD WELDING SCHEDULE

PROJECT : 2x660MW ENNORE SEZ SUPERCRITICAL THERMAL POWER PROJECT AT ASH DYKE OF NCTPS,CHENNAI

CONTRACTOR : M/s. BHEL

CONTRACT NO :

CUST. NO : 7273

PGMA : 80-470

SYSTEM : SEA WATER INTAKE PIPING

DOC.NO. :

REV. NO. : 00

WELDING CODE : IBR / 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
		PART-1	PART-1																
		PART-2	PART-2				QTY												
01		PF PIPE	IS3589/IS2062	1320	12	ARC	12 ▽	---	E7018			1213 REV 00	--	--	--	10% RT, 100 % RT FOR ALL T-JOINTS	*	*	NIL
		PF PIPE/FITTING	IS3589/IS2062				802	---	143651	44912	32882								
02		PF PIPE	IS3589/IS2062	1524	14	ARC	14 ▽	---	E7018			1213 REV 00	--	--	--	10% RT, 100 % RT FOR ALL T-JOINTS	*	*	NIL
		PF PIPE/FITTING	IS3589/IS2062				402	---	83616	26130	38592								
03		PF PIPE	IS3589/IS2062	610	8	ARC	8 ▽	---	E7018			1213 REV 00	--	--	--	10% RT, 100 % RT FOR ALL T-JOINTS	*	*	NIL
		PF PIPE/FITTING	IS3589/IS2062				24	---	2160	450	---								
04		PF PIPE	IS3589/IS2062	1016	10	ARC	10 ▽	---	E7018			1213 REV 00	--	--	--	10% RT, 100 % RT FOR ALL T-JOINTS	*	*	NIL
		PF PIPE/FITTING	IS3589/IS2062				30	---	4530	1440	---								
05		PF PIPE	IS3589/IS2062	1829	16	ARC	16 ▽	---	E7018			1213 REV 00	--	--	--	10% RT, 100 % RT FOR ALL T-JOINTS	*	*	NIL
		PF PIPE/FITTING	IS3589/IS2062				8	---	2200	700	1600								
06		PF PIPE	IS3589/IS2062	964	10	ARC	10 ▽	---	E7018			1213 REV 00	--	--	--	10% RT, 100 % RT FOR ALL T-JOINTS	*	*	NIL
		PF PIPE/FITTING	IS3589/IS2062				4	---	572	200	---								

REV	DATE	ALTERED:
01		APPROVED:
ZONE		

NOTES:

01. LPI / MPI ,UT WHEREVER APPLICABLE SHALL BE CARRIED AFTER PWHT.

02. * REFER NDE MANUAL NO. PSQ :NDM:COM:REV NO.R00/04-02 AMD.02

03. 3% HARDNESS CHECKING ON BUTT WELDS OF ALLOYSTEEL,OTHER THAN P91 & F91

PREPARED	DESIGN/CHD.	DESIGN/APPD.	CHD./APPD. - QA	DATE	DRAWING NO.	REV .
BABU HARIHARAN G	P.SURESH	SARAVANAN C	VIVEK	19.12.2018	4-80-470-82875	00

ERECTION / FIELD WELDING SCHEDULE

PROJECT : 2x660MW ENNORE SEZ SUPERCRITICAL THERMAL POWER PROJECT AT ASH DYKE OF NCTPS,CHENNAI

CONTRACTOR : M/s. BHEL

CONTRACT NO :

CUST. NO : 7273

PGMA : 80-470

SYSTEM : SEA WATER INTAKE PIPING

DOC.NO. :

REV. NO. : 00

WELDING CODE : IBR / 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	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	SA790-S32205	219.1	3.76	ARC	3.76▽	ER2209-16	E2209-16			1070 REV 00	--	--	--	10% RT, 100% LPT,	*	*	NIL
		PIPE/FITTING	SA790-S32205 SA815-S32205				45	3720	155	---	---								
08		PIPE	SA790-S32205	168.3	3.4	ARC	3.4▽	ER2209-16	E2209-16			1070 REV 00	--	--	--	10% RT, 100% LPT,	*	*	NIL
		PIPE/FITTING	SA790-S32205 SA815-S32205				120	11225	---	---	---								
09		PIPE	SA790-S32205	60.3	3.91	ARC	3.91▽	ER2209-16	E2209-16			1070 REV 00	--	--	--	10% RT, 100% LPT,	*	*	NIL
		PIPE/FITTING	SA790-S32205 SA815-S32205				28	670	35	---	---								
10		PIPE	SA790-S32205	33.4	3.38	ARC	10▽	ER2209-16	E2209-16			1070 REV 00	--	--	--	10% RT, 100% LPT,	*	*	NIL
		PIPE/FITTING	SA790-S32205 SA815-S32205				20	290	25	---	---								
11		PIPE	IS1239	114.3	6.02	ARC	6.02▽	---	E7018			1213 REV 00	--	--	--	10% RT, 100 % RT FOR ALL T-JOINTS	*	*	NIL
		PIPE/FITTING	IS1239/IS2062				4	---	40	---	---								
12		PIPE	SA790-S32205	219.1	3.76	ARC	3.76◺	ER2209-16	E2209-16			1070 REV 00	--	--	--	10% RT, 100% LPT,	*	*	NIL
		FITTING	SA815-S32205				4	---	23	---	---								

REV	DATE	ALTERED:
01		APPROVED:
ZONE		

NOTES:

01. LPI / MPI ,UT WHEREVER APPLICABLE SHALL BE CARRIED AFTER PWHT.

02. * REFER NDE MANUAL NO. PSQ :NDM:COM:REV NO.R00/04-02 AMD.02

03. 3% HARDNESS CHECKING ON BUTT WELDS OF ALLOYSTEEL,OTHER THAN P91 & F91

PREPARED	DESIGN/CHD.	DESIGN/APPD.	CHD./APPD. - QA	DATE	DRAWING NO.	REV .
BABU HARIHARAN G	P.SURESH	SARAVANAN C	VIVEK	19.12.2018	4-80-470-82875	00

ERECTION / FIELD WELDING SCHEDULE

PROJECT : 2x660MW ENNORE SEZ SUPERCRITICAL THERMAL POWER PROJECT AT ASH DYKE OF NCTPS,CHENNAI

CONTRACTOR : M/s. BHEL

CONTRACT NO :

CUST. NO : 7273

PGMA : 80-470

SYSTEM : SEA WATER INTAKE PIPING

DOC.NO. :

REV. NO. : 00

WELDING CODE : IBR / 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 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								
13		PIPE	SA790-S32205	219.1	3.76	ARC	6◺	ER2209-16	E2209-16			1070 REV 00				10% RT, 100% LPT,	*	*	NIL
		FITTING	SA815-S32205				4	---	48	---	---								
14		PIPE	SA790-S32205	168.3	3.4	ARC	3.4◺	ER2209-16	E2209-16			1070 REV 00				10% RT, 100% LPT,	*	*	NIL
		FITTING	SA815-S32205				4	---	18	---	---								
15		PIPE	SA790-S32205	168.3	3.4	ARC	6◺	ER2209-16	E2209-16			1070 REV 00				10% RT, 100% LPT,	*	*	NIL
		FITTING	SA815-S32205				4	---	35	---	---								
16		PIPE	IS1239	114.3	6.02	ARC	6◺	---	E7018			1213 REV 00				10% RT, 100 % RT FOR ALL T-JOINTS	*	*	NIL
		FITTING	IS1239/IS2062				30	---	300	---	---								

REV	DATE	ALTERED:
01		APPROVED:
ZONE		

NOTES:

01. LPI / MPI ,UT WHEREVER APPLICABLE SHALL BE CARRIED AFTER PWHT.

02. * REFER NDE MANUAL NO. PSQ :NDM:COM:REV NO.R00/04-02 AMD.02

03. 3% HARDNESS CHECKING ON BUTT WELDS OF ALLOYSTEEL,OTHER THAN P91 & F91

PREPARED	DESIGN/CHD.	DESIGN/APPD.	CHD./APPD. - QA	DATE	DRAWING NO.	REV .
BABU HARIHARAN G	P.SURESH	SARAVANAN C	VIVEK	19.12.2018	4-80-470-82875	00

ERECTION/ FIELD WELDING SCHEDULE

PROJECT:	2X660MW ENNORE SEZ STPP	**CUST. NO:**	7273
		PGMA:	80-473
NAME OF THE CUSTOMER:	TAMILNADU GENERATION & DISTRIBUTION COPORATION LIMITED	**CUST. DOC. NO.**	
		SYSTEM DESCRIPTION:	DEMINERALISED WATER SYSTEM

Sl.No.	Drg. No. for weld location	Description of parts to be welded	Matl. Spec.	Dimensions		Process of Welding	Type of weld	Electrode filler spec.				W.P.S no.	Min pre heat temp.	Heat Treatment		NDT method/ Quantum	Ref. Spec. No.	Acc. Norm. Ref.	Remarks
				ID/ OD	Thick			TIG	Arc spec					Temp.	Hold time per mm in minutes				
		Part-1	Part-1	Size				Qty (gms)	Qty(nos)										
		Part-2	Part-2	mm	mm		Qty	Dia2.4	Dia2.5	Dia3.2	Dia4.0		in deg C	in deg C					
1		PIPE	SA312TP304H	OD	6.35	TIG & ARC	6.35 V	ER347	E316			1032/R EV01	20	NIL	NIL(NIL)	#N/A	REFER NOTE-1	REFER NOTE-1	REFER NOTE-3
		PIPE	SA312TP304H	219.1			80	5680	2960	0	0								
2		PIPE	SA312TP304H	OD	3.04	TIG & ARC	3.04 V	ER347	E316			1032/R EV01	20	NIL	NIL(NIL)	#N/A	REFER NOTE-1	REFER NOTE-1	REFER NOTE-3
		PIPE	SA312TP304H	168.3			180	9900	4320	0	0								
3		PIPE	SA312TP304H	OD	3.05	TIG & ARC	3.05 V	ER347	E316			1032/R EV01	20	NIL	NIL(NIL)	#N/A	REFER NOTE-1	REFER NOTE-1	REFER NOTE-3
		PIPE	SA312TP304H	114.3			170	4522	2720	0	0								
4		PIPE	SA312TP304H	OD	3.05	TIG & ARC	3.05 V	ER347	E316			1032/R EV01	20	NIL	NIL(NIL)	#N/A	REFER NOTE-1	REFER NOTE-1	REFER NOTE-3
		PIPE	SA312TP304H	88.9			125	2625	1625	0	0								
5		PIPE	SA312TP304H	OD	3.91	TIG & ARC	3.91 V	ER347	E316			1032/R EV01	20	NIL	NIL(NIL)	#N/A	REFER NOTE-1	REFER NOTE-1	REFER NOTE-3
		PIPE	SA312TP304H	60.3			170	10336	0	0	0								
6		PIPE	SA312TP304H	OD	3.38	TIG & ARC	3.38 V	ER347	E316			1032/R EV01	20	NIL	NIL(NIL)	#N/A	REFER NOTE-1	REFER NOTE-1	REFER NOTE-3
		PIPE	SA312TP304H	33.4			400	2560	2000	0	0								
7		PIPE	SA312TP304H	OD	4.19	TIG & ARC	4.19 V	ER347	E316			1032/R EV01	20	NIL	NIL(NIL)	#N/A	REFER NOTE-1	REFER NOTE-1	REFER NOTE-3
		PIPE	SA312TP304H	273.1			30	3240	720	300	0								
8		PIPE	SA312TP304H	OD	7.11	TIG & ARC	7.11 V	ER347	E316			1032/R EV01	20	NIL	NIL(NIL)	#N/A	REFER NOTE-1	REFER NOTE-1	REFER NOTE-3
		PIPE	SA312TP304H	168.3			15	795	225	165	0								

Notes:

(1) Refers to NDE Manual no. PSQ-NDEM-COM-2010/R01

(2) Drain & vent piping: 100% RT upto the last root valve. Beyond the last root valve, 10% RT is applicable.

(3)100% LPI on all Butt welds after PWHT for Non-P91 piping. 100% MPI on all Butt welds after PWHT for P91 piping.

Rev.no.	Date:	Altered:	
		Approved:	

Rev.no.	Date:	Altered:	
		Approved:	

PREPARED BY	DESIGN/ CHD.	DESIGN/ APPD.	QA-CHD./ APPRD.	DATE	DRAWING NO:	SHEET NO:			REV. NO.
J.SUDHAKARAN	TRINADHA RAO	VENKAT		13-12-2019	4-80-473-83904	01	OF	02	00

ERECTION/ FIELD WELDING SCHEDULE

PROJECT:	2X660MW ENNORE SEZ STPP	**CUST. NO:**	7273
		PGMA:	80-473
NAME OF THE CUSTOMER:	TAMILNADU GENERATION & DISTRIBUTION COPORATION LIMITED	**CUST. DOC. NO.**	
		SYSTEM DESCRIPTION:	DEMINERALISED WATER SYSTEM

Sl.No.	Drg. No. for weld location	Description of parts to be welded	Matl. Spec.	Dimensions		Process of Welding	Type of weld	Electrode filler spec.				W.P.S no.	Min pre heat temp.	Heat Treatment		NDT method/ Quantum	Ref. Spec. No.	Acc. Norm. Ref.	Remarks
				ID/ OD	Thick			TIG	Arc spec					Temp.	Hold time per mm in minutes				
		Part-1	Part-1	Size				Qty (gms)	Qty(nos)										
		Part-2	Part-2	mm	mm		Qty	Dia2.4	Dia2.5	Dia3.2	Dia4.0		in deg C	in deg C					
9		PIPE	SA312TP304H	OD	3.05	TIG & ARC	3.05 V	ER347	E316			1032/ REV01	20	NIL	NIL(NIL)	#N/A	REFER NOTE-1	REFER NOTE-1	REFER NOTE-3
		PIPE	SA312TP304H	73			10	210	130	0	0								
10		PIPE	SA312TP304H	OD	3.73	TIG & ARC	3.73 V	ER347	E316			1032/ REV01	20	NIL	NIL(NIL)	#N/A	REFER NOTE-1	REFER NOTE-1	REFER NOTE-3
		PIPE	SA312TP304H	21.3			20	270	0	0	0								
11		PIPE	SA312TP304H	OD	3.38	NIL	3.38	ER347	E316			1032/ REV01	20	NIL	NIL(NIL)	#N/A	REFER NOTE-1	REFER NOTE-1	REFER NOTE-3
		PIPE	SA312TP304H	33.4			10	NIL	7	0	0								
12		PIPE	SA312TP304H	OD	3.73	NIL	3.73	ER347	E316			1032/ REV01	20	NIL	NIL(NIL)	#N/A	REFER NOTE-1	REFER NOTE-1	REFER NOTE-3
		PIPE	SA312TP304H	21.3			15	NIL	7	0	0								
																			REFER NOTE-3
																			REFER NOTE-3
																			REFER NOTE-3
																			REFER NOTE-3

Notes:

(1) Refers to NDE Manual no. PSQ-NDEM-COM-2010/R01

(2) Drain & vent piping: 100% RT upto the last root valve. Beyond the last root valve, 10% RT is applicable.

(3)100% LPI on all Butt welds after PWHT for Non-P91 piping. 100% MPI on all Butt welds after PWHT for P91 piping.

Rev.no.	Date:	Altered:		Rev.no.	Date:	Altered:	
		Approved:				Approved:	

PREPARED BY	DESIGN/ CHD.	DESIGN/ APPD.	QA-CHD./ APPRD.	DATE	DRAWING NO:	SHEET NO:			REV. NO.
J.SUDHAKARAN	TRINADHA RAO	VENKAT		13-12-2019	4-80-473-83904	02	OF	02	00

ERECTION/ FIELD WELDING SCHEDULE

PROJECT:	2X660MW ENNORE SEZ STPP	**CUST. NO:**	7273
		PGMA:	80-477
NAME OF THE CUSTOMER:	TAMILNADU GENERATION & DISTRIBUTION COPORATION LIMITED	**CUST. DOC. NO.**	
		SYSTEM DESCRIPTION:	SERVICE WATER PIPING

Sl.No.	Drg. No. for weld location	Description of parts to be welded	Matl. Spec.	Dimensions		Process of Welding	Type of weld	Electrode filler spec.				W.P.S no.	Min pre heat temp.	Heat Treatment		NDT method/ Quantum	Ref. Spec. No.	Acc. Norm. Ref.	Remarks
				ID/ OD	Thick			TIG	Arc spec					Temp.	Hold time per mm in minutes				
		Part-1	Part-1	Size				Qty (gms)	Qty(nos)										
		Part-2	Part-2	mm	mm		Qty	Dia2.4	Dia2.5	Dia3.2	Dia4.0		in deg C	in deg C					
1		PIPE	IS1239	OD	4.8	TIG & ARC	4.8 V	E6013	E7018			1001/R EV01	10	NIL	NIL(NIL)	10% RT	REFER NOTE-1	REFER NOTE-1	REFER NOTE-3
		PIPE	IS1239	88.9			350	7350	4550	0	0								
2		PIPE	IS1239	OD	4	TIG & ARC	4 V	E6013	E7018			1001/R EV01	10	NIL	NIL(NIL)	10% RT	REFER NOTE-1	REFER NOTE-1	REFER NOTE-3
		PIPE	IS1239	34.2			110	1089	880	0	0								
3		PIPE	IS1239	OD	4	TIG & ARC	4 V	E6013	E7018			1001/R EV01	10	NIL	NIL(NIL)	10% RT	REFER NOTE-1	REFER NOTE-1	REFER NOTE-3
		PIPE	IS1239	48.8			200	12160	0	0	0								
4		PIPE	IS1239	OD	4.5	TIG & ARC	4.5 V	E6013	E7018			1001/R EV01	10	NIL	NIL(NIL)	10% RT	REFER NOTE-1	REFER NOTE-1	REFER NOTE-3
		PIPE	IS1239	60.8			330	6930	4290	0	0								
5		PIPE	IS1239	OD	5.4	TIG & ARC	5.4 V	E6013	E7018			1001/R EV01	10	NIL	NIL(NIL)	10% RT	REFER NOTE-1	REFER NOTE-1	REFER NOTE-3
		PIPE	IS1239	115			275	14850	7425	0	0								
6		PIPE	IS1239	OD	5.4	TIG & ARC	5.4 V	E6013	E7018			1001/R EV01	10	NIL	NIL(NIL)	10% RT	REFER NOTE-1	REFER NOTE-1	REFER NOTE-3
		PIPE	IS1239	166.5			450	24300	12150	0	0								
7		PIPE	IS3589	OD	6.4	TIG & ARC	6.4 V	NIL	E7018			1213/R EV00	10	NIL	NIL(NIL)	10% RT	REFER NOTE-1	REFER NOTE-1	REFER NOTE-3
		PIPE	IS3589	219.1			165	NIL	6105	0	0								
8		PIPE	IS3589	OD	6.4	TIG & ARC	6.4 V	NIL	E7018			1213/R EV00	10	NIL	NIL(NIL)	10% RT	REFER NOTE-1	REFER NOTE-1	
		PIPE	IS3589	273.1			20	NIL	480	340	0								

Notes:

(1) Refers to NDE Manual no. PSQ-NDEM-COM-2010/R01

(2) Drain & vent piping: 100% RT upto the last root valve. Beyond the last root valve, 10% RT is applicable.

(3)100% LPI on all Butt welds after PWHT for Non-P91 piping. 100% MPI on all Butt welds after PWHT for P91 piping.

Rev.no.	Date:	Altered:		Rev.no.	Date:	Altered:	
		Approved:				Approved:	

PREPARED BY	DESIGN/ CHD.	DESIGN/ APPD.	QA-CHD./ APPRD.	DATE	DRAWING NO:	SHEET NO:			REV. NO.
SUDHAKARAN	TRINADHA RAO	VENKAT		12-12-2019	4-80-477-81476	01	OF	02	00

ERECTION/ FIELD WELDING SCHEDULE

PROJECT:	2X660MW ENNORE SEZ STPP	**CUST. NO:**	7273
		PGMA:	80-477
NAME OF THE CUSTOMER:	TAMILNADU GENERATION & DISTRIBUTION COPORATION LIMITED	**CUST. DOC. NO.**	
		SYSTEM DESCRIPTION:	SERVICE WATER PIPING

Sl.No.	Drg. No. for weld location	Description of parts to be welded	Matl. Spec.	Dimensions		Process of Welding	Type of weld	Electrode filler spec.				W.P.S no.	Min pre heat temp.	Heat Treatment		NDT method/ Quantum	Ref. Spec. No.	Acc. Norm. Ref.	Remarks
				ID/ OD	Thick			TIG	Arc spec					Temp.	Hold time per mm in minutes				
		Part-1	Part-1	Size				Qty (gms)	Qty(nos)										
		Part-2	Part-2	mm	mm		Qty	Dia2.4	Dia2.5	Dia3.2	Dia4.0		in deg C	in deg C					
9		PIPE	IS3589	OD	8	TIG & ARC	8 V	E6013	E7018			1001/REV01	10	NIL	NIL(NIL)	10% RT	REFER NOTE-1	REFER NOTE-1	REFER NOTE-3
		PIPE	IS3589	457			20	NIL	680	720	0								
10		PIPE	IS3589	OD	6.4	TIG & ARC	6.4 V	E6013	E7018			1001/REV01	10	NIL	NIL(NIL)	10% RT	REFER NOTE-1	REFER NOTE-1	REFER NOTE-3
		PIPE	IS3589	355.6			80	NIL	2160	1520	0								
11		PIPE	IS3589	OD	9.5	TIG & ARC	9.5 V	E6013	E7018			1001/REV01	10	NIL	NIL(NIL)	10% RT	REFER NOTE-1	REFER NOTE-1	REFER NOTE-3
		PIPE	IS3589	323.9			35	NIL	840	1295	0								
12		PIPE	IS1239	OD	4	NIL	4									10% RT	REFER NOTE-1	REFER NOTE-1	REFER NOTE-3
		PIPE	IS1239	34.2			150	NIL	101	0	0								
13		PIPE	IS1239	OD	4.5	NIL	4.5	#N/A	#N/A			#N/A	#N/A	#N/A	#N/A	10% RT	REFER NOTE-1	REFER NOTE-1	REFER NOTE-3
		PIPE	IS1239	60.8			500	NIL	974	0	0								
14		PIPE	IS1239	OD	4	NIL	4	#N/A	#N/A			#N/A	#N/A	#N/A	#N/A	10% RT	REFER NOTE-1	REFER NOTE-1	REFER NOTE-3
		PIPE	IS1239	48.8			80	NIL	80	0	0								
																			REFER NOTE-3

Rev.no.	Date:	Altered:		Rev.no.	Date:	Altered:	
		Approved:				Approved:	

PREPARED BY	DESIGN/ CHD.	DESIGN/ APPD.	QA-CHD./ APPRD.	DATE	DRAWING NO:	SHEET NO:			REV. NO.
SUDHAKARAN	TRINADHA RAO	VENKAT		12-12-2019	4-80-477-81476	02	OF	02	00

ERECTION/ FIELD WELDING SCHEDULE

PROJECT:	2X660MW ENNORE SEZ STPP	**CUST. NO:**	7273
		PGMA:	80-610
NAME OF THE CUSTOMER:	TAMILNADU GENERATION & DISTRIBUTION COPORATION LIMITED	**CUST. DOC. NO.**	
		SYSTEM DESCRIPTION:	SERVICE AIR PIPING

Sl.No.	Drg. No. for weld location	Description of parts to be welded	Matl. Spec.	Dimensions		Process of Welding	Type of weld	Electrode filler spec.				W.P.S no.	Min pre heat temp.	Heat Treatment		NDT method/ Quantum	Ref. Spec. No.	Acc. Norm. Ref.	Remarks
				ID/ OD	Thick			TIG	Arc spec					Temp.	Hold time per mm in minutes				
		Part-1	Part-1	Size				Qty (gms)	Qty(nos)										
		Part-2	Part-2	mm	mm		Qty	Dia2.4	Dia2.5	Dia3.2	Dia4.0		in deg C	in deg C					
1		PIPE	SA312TP304H	OD	3.76	TIG & ARC	3.76 V	ER347	E316			1032/REV01	20	NIL	NIL(NIL)	#N/A	REFER NOTE-1	REFER NOTE-1	REFER NOTE-3
		PIPE	SA312TP304H	219.1			75	5400	2100	0	0								
2		PIPE	SA312TP304H	OD	3.38	TIG & ARC	3.38 V	ER347	E316			1032/REV01	20	NIL	NIL(NIL)	#N/A	REFER NOTE-1	REFER NOTE-1	REFER NOTE-3
		PIPE	SA312TP304H	33.4			4	26	20	0	0								
3		PIPE	SA312TP304H	OD	3.4	TIG & ARC	3.4 V	ER347	E316			1032/REV01	20	NIL	NIL(NIL)	#N/A	REFER NOTE-1	REFER NOTE-1	REFER NOTE-3
		PIPE	SA312TP304H	168.3			4	220	96	0	0								
																			REFER NOTE-3
																			REFER NOTE-3
																			REFER NOTE-3
																			REFER NOTE-3
																			REFER NOTE-3

Notes:

(1) Refers to NDE Manual no. PSQ-NDEM-COM-2010/R01

(2) Drain & vent piping: 100% RT upto the last root valve. Beyond the last root valve, 10% RT is applicable.

(3)100% LPI on all Butt welds after PWHT for Non-P91 piping. 100% MPI on all Butt welds after PWHT for P91 piping.

Rev.no.	Date:	Altered:		Rev.no.	Date:	Altered:	
		Approved:				Approved:	

PREPARED BY	DESIGN/ CHD.	DESIGN/ APPD.	QA-CHD./ APPRD.	DATE	DRAWING NO:	SHEET NO:			REV. NO.
J.SUDHAKARAN	TRINADHA RAO	VENKAT		13-12-2019	4-80-610-83905	01	OF	01	00

ERECTION/ FIELD WELDING SCHEDULE

PROJECT:	2X660MW ENNORE SEZ STPP	**CUST. NO:**	7273
		PGMA:	80-614
NAME OF THE CUSTOMER:	TAMILNADU GENERATION & DISTRIBUTION COPORATION LIMITED	**CUST. DOC. NO.**	
		SYSTEM DESCRIPTION:	INSTRUMENT AIR PIPING

Sl.No.	Drg. No. for weld location	Description of parts to be welded	Matl. Spec.	Dimensions		Process of Welding	Type of weld	Electrode filler spec.				W.P.S no.	Min pre heat temp.	Heat Treatment		NDT method/ Quantum	Ref. Spec. No.	Acc. Norm. Ref.	Remarks
				ID/ OD	Thick			TIG	Arc spec					Temp.	Hold time per mm in minutes				
		Part-1	Part-1	Size				Qty (gms)	Qty(nos)										
		Part-2	Part-2	mm	mm		Qty	Dia2.4	Dia2.5	Dia3.2	Dia4.0		in deg C	in deg C					
1		PIPE	SA312TP304H	OD	3.76	TIG & ARC	3.76 V	ER347	E316			1032/REV01	20	NIL	NIL(NIL)	#N/A	REFER NOTE-1	REFER NOTE-1	REFER NOTE-3
		PIPE	SA312TP304H	219.1			75	5400	2100	0	0								
2		PIPE	SA312TP304H	OD	3.38	TIG & ARC	3.38 V	ER347	E316			1032/REV01	20	NIL	NIL(NIL)	#N/A	REFER NOTE-1	REFER NOTE-1	REFER NOTE-3
		PIPE	SA312TP304H	33.4			4	26	20	0	0								
3		PIPE	SA312TP304H	OD	3.4	TIG & ARC	3.4 V	ER347	E316			1032/REV01	20	NIL	NIL(NIL)	#N/A	REFER NOTE-1	REFER NOTE-1	REFER NOTE-3
		PIPE	SA312TP304H	168.3			4	220	96	0	0								
																			REFER NOTE-3
																			REFER NOTE-3
																			REFER NOTE-3
																			REFER NOTE-3
																			REFER NOTE-3

Notes:

(1) Refers to NDE Manual no. PSQ-NDEM-COM-2010/R01

(2) Drain & vent piping: 100% RT upto the last root valve. Beyond the last root valve, 10% RT is applicable.

(3)100% LPI on all Butt welds after PWHT for Non-P91 piping. 100% MPI on all Butt welds after PWHT for P91 piping.

Rev.no.	Date:	Altered:		Rev.no.	Date:	Altered:	
		Approved:				Approved:	

PREPARED BY	DESIGN/ CHD.	DESIGN/ APPD.	QA-CHD./ APPRD.	DATE	DRAWING NO:	SHEET NO:			REV. NO.
J.SUDHAKARAN	TRINADHA RAO	VENKAT		13-12-2019	4-80-614-83906	01	OF	01	00

PROJECT	2x660MW ENNORE SEZ SUPERCRITICAL THERMAL POWER PROJECT AT ASH DYKE OF NCTPS, CHENNAI	
	OWNER	TAMILNADU GENERATION & DISTRIBUTION CORPORATION LIMITED
	OWNER'S CONSULTANT:-	DESEIN PRIVATE LIMITED DESEIN HOUSE, NEW DELHI
	EPC CONTRACTOR:-	BHARAT HEAVY ELECTRICALS LTD POWER SECTOR PROJECT ENGINEERING MANAGEMENT NEW DELHI
LOGO	EPC CONSULTANT:-	XXXXXXXXXXXXXXXXXXXXX
LOGO	VENDOR	XXXXXXXXXX

DOCUMENT TITLE:

QUALITY PLAN FOR PAINTING SCHEME FOR LP PIPING
(CW ,ACW,ECW , Plant Water, Air Piping)

DOCUMENT NO.	7270:QPC:12	REV 02
SUB VENDER DOCUMENT NO.		

BHARAT HEAVY ELECTRICALS LIMITED
PIPING CENTRE, CHENNAI– 17
QUALITY ASSURANCE & CONTROL DEPT.

PAINTING SCHEME FOR LP PIPING

(CW / ACW / ECW / Plant water, Air Piping, etc…,)

PROJECT NAME : - ENNORE SEZ STPP - (2X660MW)
BHEL CUSTOMER Nos : 7270, 7271, 7272(Aux.Boiler) & 7273(Outside TG Hall).

QPNo: 7270:QPC:12
REV.NO: 02
Dt : 16.05.2017

Sl. NO	PGMA / Description	Surface Preparation & Surface Profile	Primer coat		Intermediate coat			Finish coat			Total DFT Microns (Min.)	REMARKS
			Primer	No of coats	Paint	No of coats	Shade	Paint	No of coats	Shade		
1	2	3	4	5	6	7	8	9	10	11	12	13
1	(a) Internal Surface - Steel Pipe - Seawater handling	Blast Cleaning SSPC SP-10 / SA 2½ *(Refer Note 1)*	Isophthalic polyester / acrylic co-polymer filled with glass flakes coating								1000 Microns (min)	(Refer Note 2)
	(b) Holiday test (Refer Note 3)	Holiday testing as per Paint Manufacturer's Quality Plan approved by BHEL. Holiday test Equipment shall be calibrated before testing.										
2	External Surface --Buried Piping / Encased in concrete (Temporary Protection for transportation from works to site). **Further protection to be done by BHEL Erection Group as per Contract requirement.	SSPC-SP3 / Power Tool Cleaning	Red Oxide Zinc Phosphate (Alkyd base to IS 12744)	1 (30 Microns per coat)	-----	-----	-----	-----	-----	-----	30 Microns	
2A	External Surface --Buried Piping - Not Encased in concrete	Blast cleaning to SSPC SP-10 / SA 2½	Primer : Coal Tar primer compatible with coal tar enamel grade. 2 coats of 35 microns each. Total DFT:70microns. Finish Coat : Coal tar enamel (25mm overlap min) Type-I to IS7193-1974 conforming to table of 10 of IS10221-1982. Tickness - 4.0mm (or) Coal Tar Wrapping conforming to IS 15337-2003; Tickness - 4.0mm Test : Bond/Adhesion; Holiday test									Shall be done by BHEL's Erection Group.
3	Internal Surface -Other than Sea water handling - (For 800Nb and above diameters)	Blast cleaning to SSPC SP-10 / SA 2½	Epoxy Polyamide resin based Zinc Phosphate Primer	2 (35 microns per coat)	Epoxy resin with MIO	1 (75 microns per coat.)	-----	Epoxy Polyamide finish Paint	1 $ (40 microns per coat)	Smoke Grey Shade No 692 of IS 5 (Refer Note-4)	145 at shop + 40 at site	$: 1 coat of DFT-40 microns finish coat at site
4	External Surface - Over ground piping (For all diameters)	Blast cleaning to SSPC SP-10 / SA 2½	Epoxy Polyamide resin based Zinc Phosphate Primer	2 (35 microns per coat)	Epoxy resin with MIO	1 (75 microns per coat.)	-----	Epoxy Polyamide finish Paint	1 $ (40 microns per coat)	Smoke Grey Shade No 692 of IS 5 (Refer Note-4)	145 at shop + 40 at site	$: 1 coat of DFT-40 microns finish coat at site
5	Galvanised and Stainless steel Piping	No painting . Site painting requirements as indicated in specification (Vol-III, cl.13.10.5) shall be done by BHEL's erection group.										

Notes:

1. Blast cleaning to near white metal to obtain roughness as per paint manufacturer's recommendations.
2. Application and inspection (including DFT) of Isophthalic polyester / acrylic co-polymer filled with glass flakes shall be as per Paint manufacturer's QP and Painting procedure approved by BHEL.
3. Witness by BHEL / BHEL nominated inspection agency.
4. Shade for finish coat to be done at site shall be as per project specification/contract requirement.

PREPARED BY :	APPROVED BY:	For Customer use :	
VIVEKANANDA YELLU, Dy.Mgr/QA	A.P.MADHAVANKUTTY, AGM/Q		Page 1/1

PROJECT : ENNORE SEZ STPP - (2X660MW)

BHEL Doc No : QPNo: 7270:QPC:12

Document Description : PAINTING SCHEME FOR LP PIPING

Customer/Consultant ref : Lr.No.:SE/E/THP/EE-7/M/AEE-1/M/F.En SEZ STPP/D.185/2017 dt.11.05.2017

Sl.No	TANGEDCO / Desein Comments	BHEL Response	TANGEDCO / Desein Comments	BHEL Response dt:16-05-17
1	S.No.1–Internal protection details indicated for CW piping shall be applicable for ACW and other metal pipes with Sea Water application. Revise accordingly.	Reply is not furnished.	Noted.	----
2	S.No.1–Internal protection details has been indicated for CW piping only. Please incorporate internal protection details for all other piping like DMCW, Service Water, HVAC Make UP, APH/ ESP Wash Water, Potable Water, CHP make UP, Air (IA & SA) etc. in line with specification.	Reply is not furnished.	Comment not Incorporated.	Internal protection incorporated in revised(02) painting scheme (7270:QPC:12) - Refer Sl.3. Refer MOM Sl.no:27 for document no: PE-DG-412-172-N001(Rev02) dt27-04-2017 b/n TANGEDCO/DESEIN/BHEL-PEM for pipe size.(attached)
3	S. No. 2 – External Protection details has been indicated for CW piping only. Please incorporate external protection details for all other buried piping like ACW, DMCW, Service Water, HVAC Make UP, APH/ ESP Wash Water, Potable Water, CHP make UP, Air (IA & SA) etc.in line with specification.	Reply is not furnished.	Incorporated for CW Pipes alone. Surface preparation is as per SA21/2 as per Vol.2, Cl.3.2, page 100.	Already External protection for all piping is indicated as SSPC-SP10/SA2 ½ in Rev01 document. Refer Sl.No.4 of Rev02.
4	S. No. 3 – Primer coat shall be 35 microns each in line with specification. Revise accordingly.	Reply is not furnished.	Noted.	----

PROJECT : ENNORE SEZ STPP - (2X660MW)

BHEL Doc No : QPNo: 7270:QPC:12

Document Description : PAINTING SCHEME FOR LP PIPING

Customer/Consultant ref : Lr.No.:SE/E/THP/EE-7/M/AEE-1/M/F.En SEZ STPP/D.185/2017 dt.11.05.2017

5	S. No. 3 – Finish coat shall be two coats of 35 microns each in line with specification. Revise accordingly.	Reply is not furnished.	Noted.	----
6	S. No. 4 – Enamel based paint and primer is not acceptable. Revise in line with specification furnished.	Reply is not furnished.	Deleted	----
7	S. No. 4 – Primer coat shall be 35 microns each in line with specification. Revise accordingly.	Reply is not furnished.	Deleted	----
8	S.No.2-For external painting also, it shall be blast cleaning by SSPC SP-10/SA21/2 for CW Pipes and other LP Piping as per Vol.2, Cl.3.2, page 100	Reply is not furnished.	Comment stands.	Already External protection for all piping is indicated as SSPC-SP10/SA2 ½ in Rev01 document. Refer Sl.No.4 of Rev02.
9	For Sea Water Treatment Plant Pipes refer Vol.3, Data Sheet, page.296	Reply is not furnished.	Incorporated.	----
10	For ACW Pipings, refer Vol.3, Cl.13.3.6, page.467	Reply is not furnished.	Incorporate for external coating as per comment. (Are you willing to encase all pipes?)	For Buried Pipes not encased: Shall be painted as per specification (Vol-II-6.6.1-page-107) by BHEL erection group.
11	For other piping Vol.2, Cl.6.6, Page. 107 to 109 and Vol.3, Cl.13.12.00, Page. 306, 475 & 476	Reply is not furnished.	Comment not Incorporated.	Refer Sl.No:3&4
12		----	For Galvanised Piping, the welded area shall be painted as per spec, which shall be included as note.	All galvanised pipes shall be supplied with threaded ends. Hence no welded connection envisaged. Any other painting requirements as indicated in specification (Vol-III, cl.13.10.5) shall be done by BHEL's erection group.

CHAPTER - 6

PAINTING

1.0 SCOPE

This section defines the technical requirements for surface preparation, selection and application of paints on equipment, vessels, machinery, piping, ducts etc. However, manufacturers shall follow their standard procedures for painting their equipment. The bidder shall submit a detailed painting procedure for approval of owner/ owner's representative after the award of contract.

The following surface and material shall require painting:

a. All un-insulated carbon steel and alloy steel equipment like columns, vessels, storage tanks, pumps, heat exchangers etc.
b. All un-insulated carbon steel and low alloy piping, fitting and valves (including painting of identification marks).
c. All pipe structural steel supports, walkways, platforms, handrails, ladders etc.

The following surfaces and materials shall not require painting :

a. Non-ferrous materials
b. Austentic stainless steel
c. Plastic and / or plastic coated materials
d. Insulated surface of equipment and pipes except color coating wherever required.
e. Painted equipment like blowers, pumps, valves etc. with finishing coats in good condition and with matching color code.

2.0 CODES AND STANDARDS

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

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

IS:5	:	Colours for ready mixed paints and enamels
IS:1303	:	Glossary of terms relating to paints
IS:2379	:	Colour code for identification of pipelines
IS:1477	:	Code of practice for painting of ferrous metals in buildings (Parts I & II)
IS:2524	:	Code of practice for painting of non-ferrous metals in buildings (Parts I & II)
IS:2395	:	Code of practice for painting of concrete, masonry and plaster surfaces (Parts I & II)

IS:2338	:	Code of practice for finishing of wood and wood based materials (Parts I & II)
IS:158	:	Ready mixed paint, brushing, bituminous, black, lead free, acid, alkali, water and heat resisting.
IS:2074	:	Ready mixed paint, air drying, red Oxide Zinc Chrome, priming
IS:104	:	Ready mixed paint, brushing, Zinc Chrome, priming
IS:2932	:	Enamel Synthetic exterior (a) Undercoating (b) finishing
IS:4682	:	Code of practice for lining of vessels & equipment
SIS 559000	:	Swedish standard for blasting
ISO 8504-2	:	Preparation of steel substrates before application of paints and related products. Surface preparation methods Part 2 Abrasive blast cleaning
ISO 8501-1	:	Preparation of steel substrates before application of paints and related products. Visual assessment of surface cleanliness. Part 1 : Rust grades and preparation grades of uncoated steel substrates and of steel substrates after overall removal of previous coatings.
SIS 05 5800	:	Surface preparation by acid pickling
SSPC SP08	:	Surface preparation by acid pickling
IS 2629	:	Recommended practice for hot dip galvanizing of iron and steel
ASTM A780	:	Standard practice for repair of damaged galvanized coatings
SSPC	:	Steel structures painting council
NACE	:	National association of Corrosion Engineers
DIN	:	Deutsehes Institute for Normung
BS	:	British Standard
ASTM	:	American Society for Testing material
AWWA	:	American Water works association

3.0 SURFACE PREPARATION

The surface shall be prepared in a manner suitable for coatings. Chemical derusters or rust converters shall not be applied. Acid cleaning is subject to approval of Purchaser/ Purchaser's representative.

3.1 BLASTING

The surface of the part/ component shall be blasted before the coating material is applied.
Compressed air supply for blast cleaning shall be free of water and oil. Air compressors shall not be allowed to deliver air above 1100C. Blasting activity shall be performed at temperatures 30C above due point and substrata temperature between 50C & 500C and relative humidity not exceeding 85% shall be maintained during painting. Necessary safety precautions for equipment and operator shall be adhered to and shall comply with applicable laws, regulations, ordinances etc., of the local authority, state or the nation pertains to the work.

Abrasive used for blast cleaning carbon steel and alloy steel shall be as per ISO 8504-2 and SSPC painting manual. Suggested abrasives are chilled iron grit, shot steel, malleable iron grit and shots of non metallic abrasive (aluminum oxide, copper slag, garnet etc.).
The grade of blasting shall be performed in line with the approved painting scheme.
The nature, quality and grain size of abrasives and the parameter of their use are to be chosen to obtain the required surface profile depth and cleanliness.
Surfaces prepared for coating shall be coated the same day and before any visible rusting occurs (the time elapsed between blast cleaning and commencement pf painting shall under no circumstances exceed 4 hours, but in any case must commence before signs of degradation occur).

The grades of surface finish

	ISO 8501-1	SIS 055900	SSPC	NACE
White metal	Sa3	Sa3	SP5	1
Near White metal	Sa 2½	Sa 2½	SP10	2
Commercial Blast	Sa2	Sa2	SP6	3
Brush off blast	Sa1	Sa1	SP7	4

Unless otherwise specified in the documents, the surface shall satisfy the following requirements after blasting
(a) Blasting according to SIS 055900, Grade Sa 2½

Primer paint shall be Zinc Silicate of approved brand. Dry film thickness of each primer coat shall be 15-25 µm.

3.2 Manual Rust Removal

Manual rust removal shall be allowed for welded zones and for touching up installed components.

3.3 Cleaning

Removal of impurity

	Impurity	Removal
a)	Dust, Loose deposits	Vacuum cleaning, brushing
b)	Adhesive deposits	Power brushing
c)	Oils, greasy impurities	Wet Blasting, Use of Detergent Additives by agreement
d)	Salt deposits	Rinsing
e)	Markings (eg felt up pen)	Organic solvents to manufacturer's specifications eg Trichloro trifluoro ethane and solvents containing acetone (renew solvent and rag frequently)

3.4 Acid Pickling

Prior to galvanizing the surface preparation shall be done by acid pickling as per SSPC-SP-08.

4.0 PROCESSING

4.1 General
Application Conditions

The primer shall be applied to properly prepared surfaces only. The specifications of the coating material manufacturers shall be observed. The minimum temperature shall be + 5^0C and the relative humidity shall not exceed 80%. The temperature of the work piece shall be at least 3^0C above dew point.

4.2 Application Procedure

The primer shall be applied by means of brush or by spary. The top coats shall be applied by means of brush, roller or spray.

At points where coating application is interrupted, the individual layers shall be adequately stepped to ensure proper layer sequence when coating operations are resumed.

4.3 Touching Up

Before each layer is applied, previous coating shall be touched up where necessary by way of rust removal and cleaning according coating manufacturers specification. The final top shall be reapplies completely.

4.4 Uncoated Surfaces

Moving parts of machines (e.g stems, shafts, sliding and locating bearings), nameplates, instruments and sealing surface shall not be coated. Welds shall be left free of coating upto a distance of 30 mm on each side of the weld edge until erection and weld examinations, if any, have been completed.

4.5 Bond Strength

The pill off stress determined using the pull off test method for adhesion shall not be less than 1.5 N/mm2, according to ISO 4624.

5.0 SURFACE CONDITIONS OF COATING SURFACES

The coating surface shall have a uniform film thickness, shade and gloss and shall be free from inclusions, sags and wrinkles.

6.0 COATING SYSTEMS

6.1 General Requirements for Coating Systems

Coating materials according to SSPC, BS 5493 or DIN 55 928 shall be used. Intermediate coats are to be pigmented with micaceous iron oxide. The materials shall be matched with each other so that they are compatible. Coatings deviating this

specification shall be subject to approval. Standards of surface preparation and painting shall give a time to first maintenance of 10 years.

The colour and gloss of top coats shall be in accordance with sub clause suggested colour codes for painting (Sub Clause 6.8)

6.2 Standard Coating System (External Coatings)

(a) Steel Surfaces

(i) All steel structures shall receive two primer coats and two sandwich coat of MIO Epoxy paint and one finish coat of painting. First coat of primer shall be given in shop after fabrication before dispatch to erection site after surface preparation as described below. The second coat of primer shall be applied after erection and final alignment of the erected structures. Two intermediate coats and one finished coat shall also be applied after erection.

(ii) Steel surface which is to be painted shall be cleaned of dust and grease and the heavier layers of rust shall be removed by chipping prior to actual surface preparation. The surface shall be abrasive blasted as explained in clause 3.1 to Sa 2½ finish as per SIS05-5900. Primer paint shall be Zinc Silicate of approved brand. Dry film thickness of each primer shall be 60 microns.

(iii) Two intermediate MIO Epoxy paint, and one top polyurethane coating of approved brand shall be applied. Dry film thickness of each intermediate coat shall be 90 microns and top polyurethane coating shall be 30 microns. The under coat and finish coat shall be of different tint to distinguish the same from finish paint. The total dry film thickness shall be 330 microns. All paints shall be of approved brand and shade as per owner's requirement.

(iv) Joints to be site welded shall have weldable primer applied within 100 mm of welding zone. Similarly where friction grip fasteners are to be used removable anti corrosive coating shall be provided. On completion of the joint the surfaces shall receive the paint as specified.

(v) Surfaces inaccessible after assembly shall receive two coats of primer prior to assembly. Surfaces inaccessible after erection including top surfaces of floor beams, supporting gratings or chequered plate shall receive one additional coat of finish paint over the above number of coats specified before erection. Portion of steel member embedded/ to be encased in concrete shall not be painted.

(b) Gratings and Step Threads

(i) Surface Preparation

Gratings and step threads shall be cleared by acid pickling as per SSPC-SP-08

(ii) Hot Dip galvanizing

The hot dip galvanizing shall be done as per IS 2629. The average mass of coating shall be 610 gm/m2.

(iii) Post Treatment

Immediately after galvanizing post treatment such as chromating shall be applied to retard white rust attack.

(iv) Touch up mechanical damages

The repair of damages coatings shall be done as per the recommended practice ASTM A780.

6.3 Painting of Indoor components such as valves, pumps, motors, electrical parts, tanks etc.

At Works

Surface Preparation

Blasting according to SIS 055900 grade Sa 2½. Depending on production flow, a weldable, inorganic ethyl zinc silicate shop primer of minimum dry film thickness 25 µm may be used.

Prime Coat

Two (2) layers of Zinc phosphate epoxy, total dry fim thickness 75µm.

At Site

Thorough cleaning to remove oil, grease, dirt and any other contaminants. Derusting of all mechanical damages according to SIS 055900 Grade ST3. Touch up with dry film thickness 50 µm.

Finish Coat

Application of two (2) finishing coats of chlorinated rubber paint in approved shades at 30-40 microns DFT each coat in approved shades.

Remarks

Equipment coated with a standard application system can be accepted if the quality of this application system is corresponding with the quality of the above mentioned system.

6.4 Painting of Outdoor equipment (external surfaces) such as piping, valves, pumps, motors, electrical parts, tanks etc.

Weather exposure, weather resistance, temperature upto 120^0C as per clause 6.1 & 6.3. However

Surface Preparation

Blasting according to SIS 055900 grade Sa 2½. Depending on production flow, a weldable, inorganic ethyl zinc silicate shop primer of minimum dry film thickness 15-25 µm may be used.

Prime Coat

Two (2) layers of Zinc phosphate epoxy, total dry fim thickness 75µm.

Intermediate Coat

One (1) layer 2 pack high build epoxy polyamide MIO, DFT 100µm.

Finish Coat

Application of two (2) finishing coats of chlorinated rubber paint in approved shades at 50 microns DFT each coat in approved shades.

6.5 Special Coating

(a) Parts exposed to temperatures above 120^0C, upto 200^0C, not insulated

(i) At Works

Surface Preparation

Blasting according to SIS 055900 grade Sa 2½ and ISO 8501-1:1958. Depending on production flow, a weldable, inorganic ethyl zinc silicate shop primer of minimum dry film thickness 15-25 µm may be used.

Prime Coat

Inorganic ethyl Zinc silicate, total dry fim thickness 75µm.

(ii) At Site

Pretreatment

Dersuting of all mechanical damages, according to ISO 8501-1:1989, grade St 3 touch up with 1 pack inorganic ethyl zinc silicate, dry film thickness 50µm.

Intermediate Coat

I pack silicon acrylic dry film thickness 35 µm.

Final Coat

1 pack silicon acrylic, dry film thickness as 35µm.
Total system dry film thickness 145µm.
Final coat according to colour code.

(b) **Parts exposed to temperatures above 200^{0}C, upto 400^{0}C, not insulated**

(i) At Works

Surface Preparation

Blasting according to ISO 8501-1:1958 grade Sa-2½. Depending on production flow, a weldable, inorganic ethyl zinc silicate shop primer of minimum dry film thickness 15-25 µm may be used.

Prime Coat

Inorganic ethyl Zinc silicate, total dry film thickness 75µm.

(ii) At Site

Pretreatment

Derusting of all mechanical damages, according to standard Sa 2½ to ISO 8501-1:1988. Touch up with coating system according to manufacturer's recommendations.

(c) **Insulated parts continuously exposed to condensing water or parts exposed to temperatures**

For parts that are provided with insulation on site.

(i) **Insulated parts exposed to condensing water**

At Works

Surface Preparation

Blasting according to Sa 2½ to ISO 8501-1:1988. Depending on production flow, a weldable, inorganic ethyl zinc silicate shop primer of minimum dry film thickness 15-25 µm shall be used.

Prime Coat

Inorganic ethyl Zinc silicate, total dry film thickness 75µm

(ii) **Insulated parts exposed to temperatures**

Parts exposed to temperatures upto < 400^{0}C

Surface Preparation

Blasting according to Sa 2½ to ISO 8501-1:1988. Depending on production flow, a weldable, inorganic ethyl zinc silicate shop primer of minimum dry film thickness 15-25 µm shall be used.

Parts exposed to temperature above 400^0C at works (Steam pipes, pressure tubes and parts for the HRSG, such as heating surfaces, heaters and superheaters, reheaters etc)

Temporary Primer

Varnish

(d) **Intermittent exposure due to condensing water/ chemicals (Indoors)**

(i) At Works

Surface Preparation

Blasting according to Sa 2½ and ISO 8501-1:1988. Depending on production flow, a weldable, inorganic ethyl zinc silicate shop primer of minimum dry film thickness 15-25 µm may be used.

Prime Coat

Two layers of Zinc phosphate primer, total dry fim thickness 75µm.

(ii) At Site

Pretreatment

Dersuting of all mechanical damages, according to standard Sa3 to ISO 8501-1:1988, touch up with 2 pack high build epoxy with volume solid content of more than 85%, 75µm.

Intermediate Coat

2 pack high build epoxy, dry film thickness 80 µm.

Finish Coat

2 pack silicon acrylic, dry film thickness of 50µm.

Total system dry film thickness 205µm.

When exposed o weathering, weather resistance finish coat shall be applied.

(e) **Water Exposure**

(i) At Site/ Works

Pretreatment

Removal of all welding pearls.

Blasting according to Sa 3 to ISO 8501-1:1988

Coat
4 coats 2 pack coal tar epoxy, dry film thickness 125 µm each.

Total system dry film thickness 500µm
Touch up after erection as required.

6.6 Painting of Pipes

6.6.1 Buried Piping

Internal surfaces

(i) Surface cleaning by sand blasting.

(ii) Two (2) coats of epoxy primer coats. The minimum DFT of each coat shall be 35 microns.

(iii) Finish coat-Two (2) coats of high build epoxy paint. The minimum DFT of each coat shall be 35 microns.

The total dry film thickness of 150 microns.

Note : All steel pipes carrying sea water shall be internally coated with corrocoat/ polyurea coating having thickness 1500 DFT.

Tests to be carried out after application : Bond/ Adhesion test, Holiday test

External surfaces

(i) Surface cleaning by Sand Blasting.

(ii) Coal tar primer compatible with coal tar enamel grade. The number of coats shall be two with a DFT of 35 microns each.

(iii) Coal tar enamel shall be applied. A single spiral inner wrap of glass fibre tissues shall be applied overlapping at least 25 mm ensuring impregnation of glass fibre tissues in the first coat. The second coat of enamel and second outer wrap of glass fibre felt, Type – I to IS: 7193-1974 will be applied in the same way confirming to Table – 10 of IS – 10221 – 1982.

The total thickness of the coating will not be less than 4.0 mm

(iv) Alternatively Wrapping with coal tar based anticorrosion tape conforming to IS 15337: 2003 is also acceptable in lieu of s.no. (iii) above. Wrapping thickness shall be 4.0 mm.

Tests to be carried out after application : Bond/ Adhesion test, Holiday test

6.6.2 Overground Piping

Internal surfaces

(i) Surface cleaning by sand blasting.

(ii) Two (2) coats of epoxy primer coats. The minimum DFT of each coat shall be 35 microns.

(iii) Finish coat-Two (2) coats of high build epoxy paint. The minimum DFT of each coat shall be 35 microns.

The total dry film thickness of 150 microns.

Note : All steel pipes carrying sea water shall be internally coated with corrocoat/ polyurea coating having thickness 1500 DFT.

External surfaces

(i) Surface cleaning by Sand Blasting.

(ii) Two (2) coats of epoxy primer coats. The minimum DFT of each coat shall be 35 microns.

(iii) Finish coat-Two (2) coats of high build epoxy paint. The minimum DFT of each coat shall be 35 microns.

6.7 Internal Coatings

6.7.1 Tanks (Internal surfaces) as specified in relevant sections of specification

Industrial deionised, demineralised and potable water upto 60^0C pH range 4.5-9.5

Blasting according to Sa 2½ and ISO 8501-1:1988.

Prime Coat

Two layers of Zinc phosphate epoxy primer, total dry fim thickness >75µm.

Pretreatment

Dersuting of all mechanical damages, according to standard Sa3 to ISO 8501-1:1988, touch up with 2 pack high build epoxy with volume solid content of more than 85%, 75µm.

Intermediate Coat

2 pack high build epoxy, dry film thickness 80 µm.

Finish Coat

2 pack silicon acrylic, dry film thickness of 150µm per coat.

In case of service or potable water tanks, the coating material selected shall not taint the water. The paint system shall confirm to regulations issued by Food & drug administration/ National Public Health service/ AWWA/ OSHA and comply with applicable laws, regulations, ordinances etc. of the local authority, state or the nation pertains to work.

QA/ QC Procedure including pinhole inspection, shall be submitted for approval by Owner/ Owner's representative.

6.6.2 Rubber Lining of Pipes, Valves and Tanks for DM Water

Pretreatment

Blasting according to Sa 2½ and ISO 8501-1:1988

Rubber Lining

Hard rubber 5 mm for DM water applications as IS – 4682

6.7 Painting for Electrical items

6.7.1 All the steel work shall be thoroughly cleaned of rust, scale, oil, grease, dirt and swarf by pickling, emulsion cleaning etc. The sheet steel shall be phosphate/ oven dried and then painted with two coats of zinc rich primer paint. After application of the primer, two coats of finishing epoxy paint shall be applied. The colour of the finishing coats inside shall be glossy white and exterior of the treated sheet steel shall be shade 631 of IS-5/ RAL 7032 for all switchboard/ MCC/ Distribution boards, control panels etc.

6.7.2 All electrical equipment shall be given tropical and fungicidal treatment and outdoor equipment shall be provided with rain hood to prevent entry of rain water into the equipment.

6.7.3 Painting of I & C equipment : Epoxy coating required for all I & C equipment.

6.8 SUGGESTED COLOUR CODES FOR PAINTING

SL. NO.	ITEM/SERVICE	COLOUR	IS-5	COLOUR (BAND)	IS-5
1.	Structures, platforms, galleries, ladders and handrails	Dark Admirality Grey	632	-	-
2.	Boiler casing, ducting	Nut Brown	413	-	-

SL. NO.	ITEM/SERVICE	COLOUR	IS-5	COLOUR (BAND)	IS-5
3.	Crane				
3.1	Crane structure	Golden Yellow	356	Black	-
3.2	Trolley & hook	Crimson	540	-	-
4.	Fans, pumps, motors, compressors	Light Grey	631	-	-
5.	Tanks (without insulation and cladding)				
5.1	Outdoor	Aluminium	-	-	-
5.2	Indoor	Light grey	631	-	-
6.	Vessels & all other proprietary equipment (without insulation & cladding)	Light grey	631	-	-
7.	Switchgear	Light grey (Powder coated)		-	-
8.	Control & relay panels	Light grey (Powder coated)	631/70 78 of IS 1650	-	-
9.	Turbines	Light Grey	631	-	-
10.	Generators & Exciter	Light Grey	631	-	-
11.	Transformers	Aluminum	-	-	-
12.	Machinery guards	Signal red	537	-	-
13.	Piping (without insulation and cladding)				
13.1	Water System				
a	Boiler feed	Sea Green	217	-	-

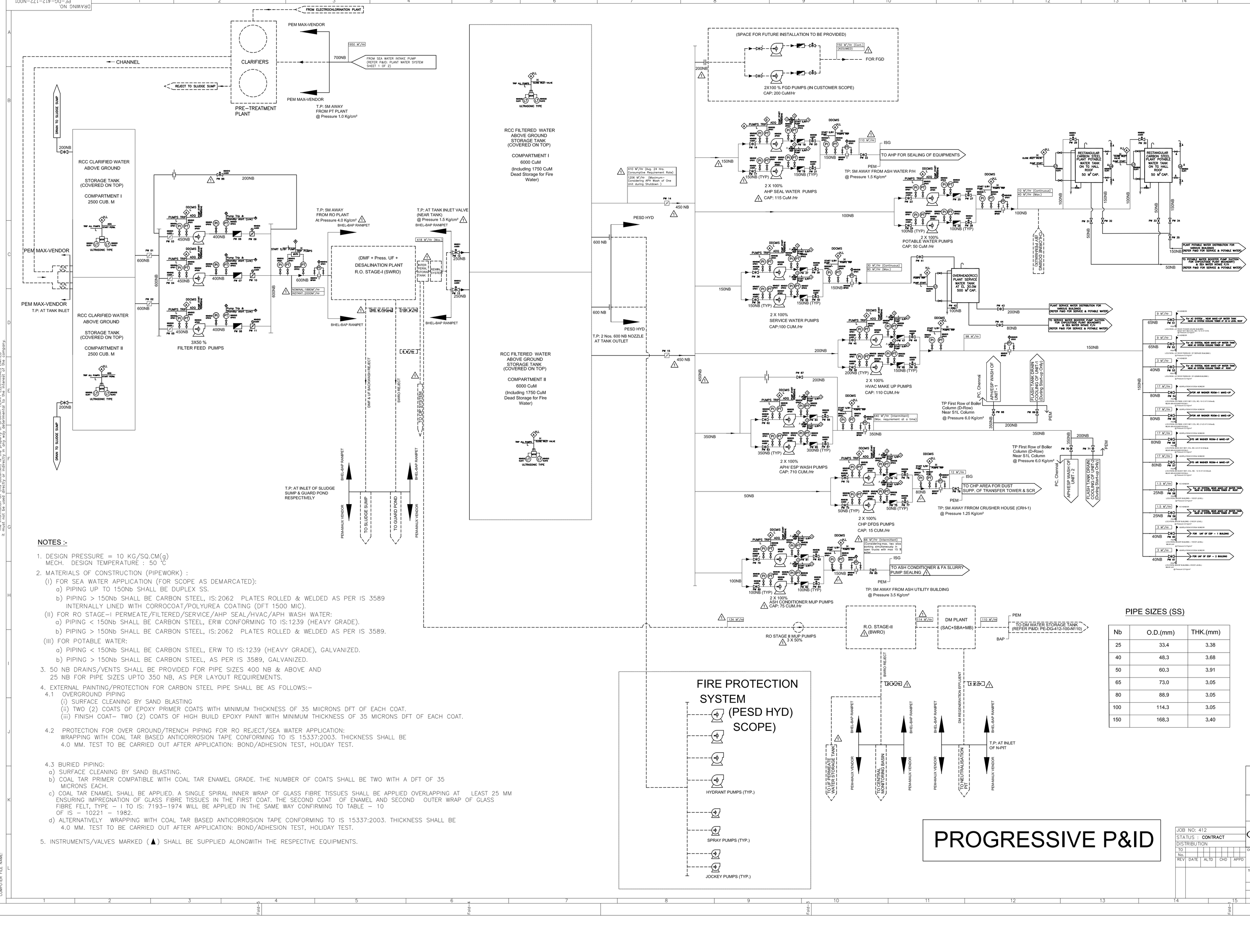
SL. NO.	ITEM/SERVICE	COLOUR	IS-5	COLOUR (BAND)	IS-5
b	Condenstae	Sea Green	217	Light Brown	410
c	DM Water	Sea Green	217	Light Orange	557
d	Soft Water	Sea Green	217	French Blue	166
e	Bearing Cooling Water	Sea Green	217	French Blue	166
f	Potable & filtered Water	Sea Green	217	French Blue	166
g	Service and clarified water	Sea Green	217	French Blue	166
h	Cooling water	Sea Green	217	French Blue	166
I	Sea Water	Sea Green	217	White	-
14.	Ash Transmitting Vessels and pipe lines	Aluminium	-	-	
15.	**Air System**				
15.1	Station air	Sky blue	101	-	-
15.2	Control air	Sky blue	101	White	-
16.	**Oil system**				
16.1	Fuel oil	Light brown	410	French	166
16.2	Light oil (HSD)	Light Brown	410	Brilliant green	221
16.3	Lubricating oil	Light brown	410	Light grey	631
16.4	Transformer oil	Light brown	410	Light orange	557
17.	Gas System				
17.1	Carbon dioxide	Canary yellow	309	Light grey	631
17.2	Hydrogen	Canary yellow	309	Signal red	537
18.	Fire services	Fire red	536	-	-
19.	Effluent pipes	Black	-	-	-
20.	Vacuum pipes	Sky blue	101	Black	-

Notes :

1. This colour code basically refers to IS:2379 for piping with necessary modifications

2. Where band colour is specified, same shall be provided at 30 meter intervals on long uninterrupted lines and also adjacent to valves and junctions.

   Bidder shall furnish his painting specification to suit corrosive atmosphere of coastal area along with the bid. The specification shall in general be in line with the above requirements.



NOTES :-

1. DESIGN PRESSURE = 10 KG/SQ.CM(g)
   MECH. DESIGN TEMPERATURE : 50 °C
2. MATERIALS OF CONSTRUCTION (PIPEWORK) :
   (I) FOR SEA WATER APPLICATION (FOR SCOPE AS DEMARCATED):
   a) PIPING UP TO 150Nb SHALL BE DUPLEX SS.
   b) PIPING > 150Nb SHALL BE CARBON STEEL, IS:2062 PLATES ROLLED & WELDED AS PER IS 3589 INTERNALLY LINED WITH CORROCOAT/POLYUREA COATING (DFT 1500 MIC).
   (II) FOR RO STAGE–I PERMEATE/FILTERED/SERVICE/AHP SEAL/HVAC/APH WASH WATER:
   a) PIPING < 150Nb SHALL BE CARBON STEEL, ERW CONFORMING TO IS:1239 (HEAVY GRADE).
   b) PIPING > 150Nb SHALL BE CARBON STEEL, IS:2062 PLATES ROLLED & WELDED AS PER IS 3589.
   (III) FOR POTABLE WATER:
   a) PIPING < 150Nb SHALL BE CARBON STEEL, ERW TO IS:1239 (HEAVY GRADE), GALVANIZED.
   b) PIPING > 150Nb SHALL BE CARBON STEEL, AS PER IS 3589, GALVANIZED.
3. 50 NB DRAINS/VENTS SHALL BE PROVIDED FOR PIPE SIZES 400 NB & ABOVE AND 25 NB FOR PIPE SIZES UPTO 350 NB, AS PER LAYOUT REQUIREMENTS.
4. EXTERNAL PAINTING/PROTECTION FOR CARBON STEEL PIPE SHALL BE AS FOLLOWS:–
   4.1 OVERGROUND PIPING
   (i) SURFACE CLEANING BY SAND BLASTING
   (ii) TWO (2) COATS OF EPOXY PRIMER COATS WITH MINIMUM THICKNESS OF 35 MIICRONS DFT OF EACH COAT.
   (iii) FINISH COAT– TWO (2) COATS OF HIGH BUILD EPOXY PAINT WITH MINIMUM THICKNESS OF 35 MICRONS DFT OF EACH COAT.
   4.2 PROTECTION FOR OVER GROUND/TRENCH PIPING FOR RO REJECT/SEA WATER APPLICATION: WRAPPING WITH COAL TAR BASED ANTICORROSION TAPE CONFORMING TO IS 15337:2003. THICKNESS SHALL BE 4.0 MM. TEST TO BE CARRIED OUT AFTER APPLICATION: BOND/ADHESION TEST, HOLIDAY TEST.
   4.3 BURIED PIPING:
   a) SURFACE CLEANING BY SAND BLASTING.
   b) COAL TAR PRIMER COMPATIBLE WITH COAL TAR ENAMEL GRADE. THE NUMBER OF COATS SHALL BE TWO WITH A DFT OF 35 MICRONS EACH.
   c) COAL TAR ENAMEL SHALL BE APPLIED. A SINGLE SPIRAL INNER WRAP OF GLASS FIBRE TISSUES SHALL BE APPLIED OVERLAPPING AT LEAST 25 MM ENSURING IMPREGNATION OF GLASS FIBRE TISSUES IN THE FIRST COAT. THE SECOND COAT OF ENAMEL AND SECOND OUTER WRAP OF GLASS FIBRE FELT, TYPE – I TO IS: 7193–1974 WILL BE APPLIED IN THE SAME WAY CONFIRMING TO TABLE – 10 OF IS – 10221 – 1982.
   d) ALTERNATIVELY WRAPPING WITH COAL TAR BASED ANTICORROSION TAPE CONFORMING TO IS 15337:2003. THICKNESS SHALL BE 4.0 MM. TEST TO BE CARRIED OUT AFTER APPLICATION: BOND/ADHESION TEST, HOLIDAY TEST.
5. INSTRUMENTS/VALVES MARKED (▲) SHALL BE SUPPLIED ALONGWITH THE RESPECTIVE EQUIPMENTS.

PIPE SIZES (CARBON STEEL)

Nb	O.D.(mm)	THK.(mm)
15	21.8	3.2
25	34.2	4.0
40	48.8	4.0
50	60.8	4.5
65	76.6	4.5
80	89.5	4.8
100	115.0	5.4
150	166.5	5.4
200	219.1	6.4
250	273.0	6.4
300	323.9	6.4
350	355.6	8.0
400	406.4	8.0
450	457.0	8.0
500	508.0	8.0
600	610.0	8.0
700	711.2	10.0
800	813.0	10.0

PIPE SIZES (SS)

Nb	O.D.(mm)	THK.(mm)
25	33.4	3.38
40	48.3	3.68
50	60.3	3.91
65	73.0	3.05
80	88.9	3.05
100	114.3	3.05
150	168.3	3.40

PROGRESSIVE P&ID

PROJECT	2x660MW ENNORE SEZ SUPERCRITICAL THERMAL POWER PROJECT AT ASH DYKE OF NCTPS, CHENNAI
OWNER	TAMILNADU GENERATION & DISTRIBUTION CORPORATION LIMITED
OWNER'S CONSULTANT:-	DESEIN PRIVATE LIMITED DESEIN HOUSE, NEW DELHI
JOB NO: 412	
STATUS : CONTRACT	
DISTRIBUTION	
CONTRACTOR	BHARAT HEAVY ELECTRICALS LTD POWER SECTOR PROJECT ENGINEERING MANAGEMENT NOIDA
TITLE	P&ID–PLANT WATER SYSTEM
DRAWING NO.	PE–DG–412–172–N001
SHEET 2 OF 2	REV 01

REV	DATE	ALTD	CHD	APPD
TO No.				

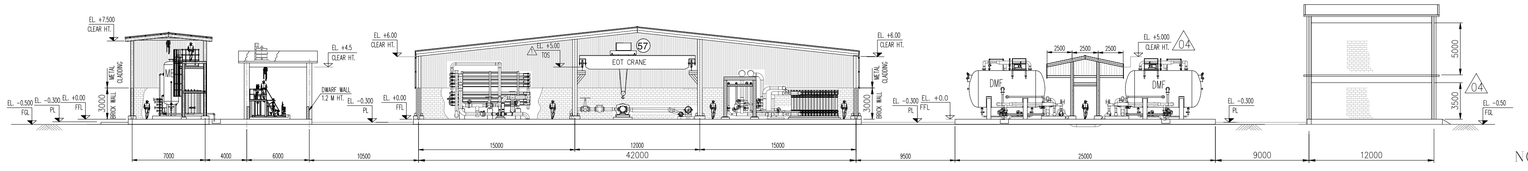
	DEPT	NAME	SIGN	DATE
CODE	DRN	PA	SD	19.02.15
N	DESN	PA	SD	19.02.15
	CHD	VK	SD	19.02.15
	APPD	AK	SD	19.02.15

SIZE–A0

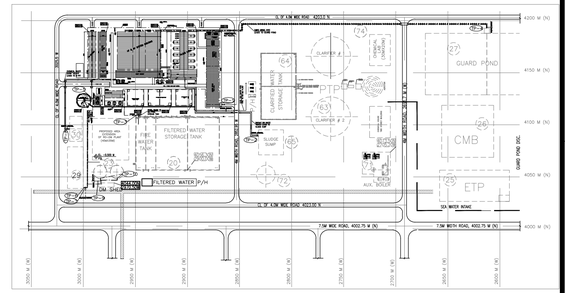
CONFIDENTIAL
COPYRIGHT AND CONFIDENTIAL – This drawing is the property of BHARAT HEAVY ELECTRICALS LIMITED. It must not be used directly or indirectly in any way detrimental to the interest of the company.

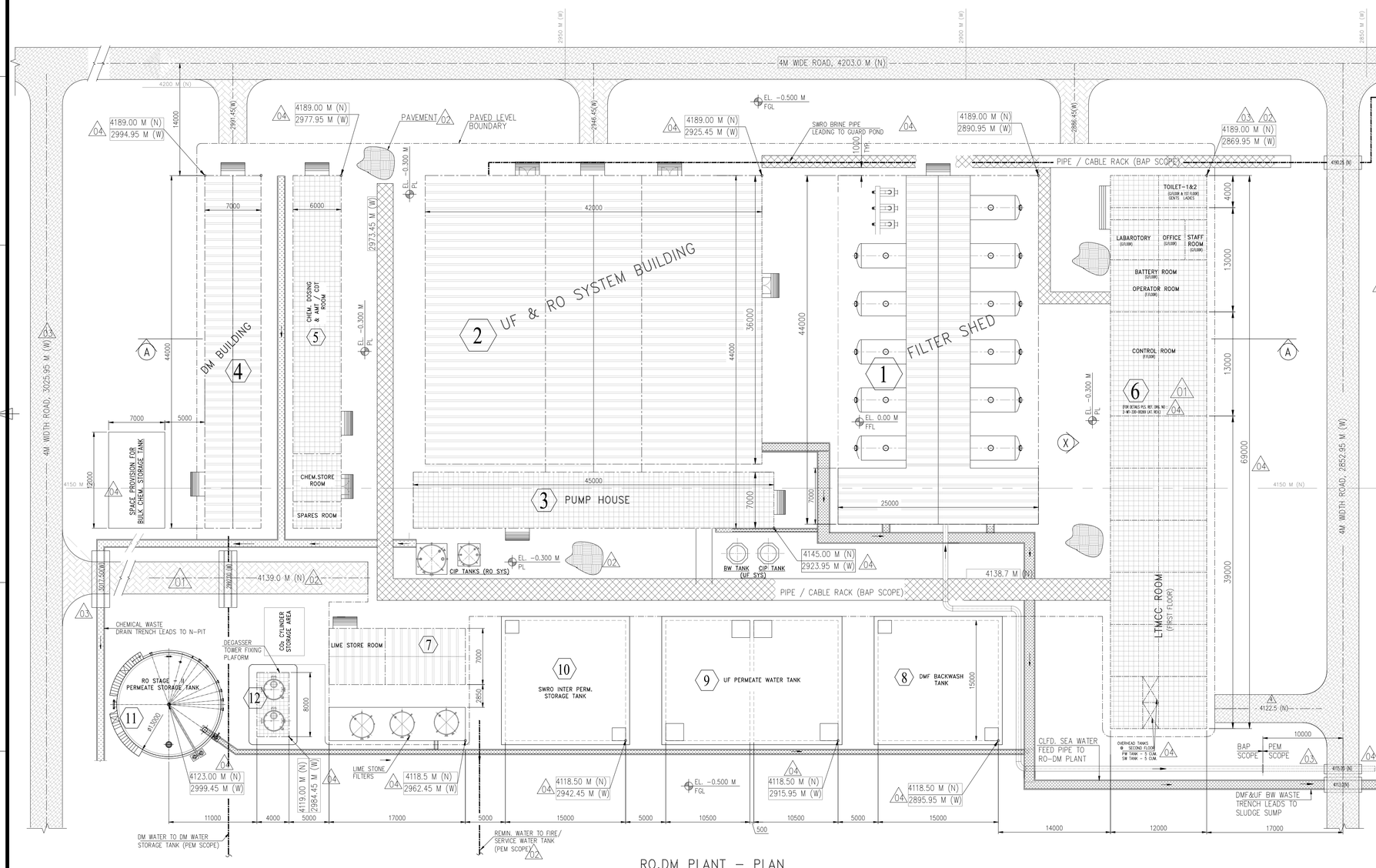
DRAWING NO. 1 - WT - 220 - 00491

ALL DIMENSIONS ARE IN MILLIMETRES



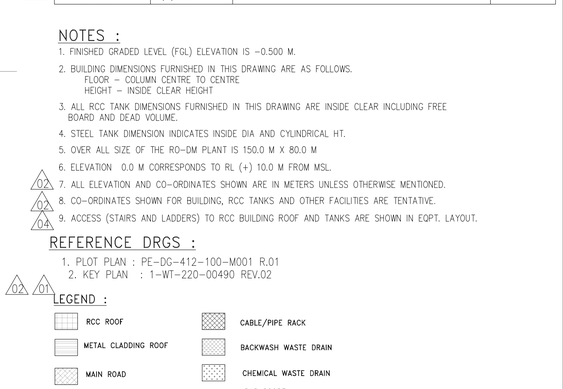
NORTH





RO,DM PLANT – PLAN

KEY PLAN



BUILDING AND TANK DETAILS

SL NO	NAME	SIZE – L x W x H (IN METERS)	DESCRIPTION	REMARKS
1	FILTER SHED	44 x 7.5 x 5.0	STRUCTURAL STEEL FRAMED STRUCTURE WITH METAL SHEET ROOFING. SIDE OPEN TYPE STRUCTURE. SIDE CLADDNG STARTS AT ~4.0M HEIGHT FROM FFL CONTINUING UP TO ROOF LEVEL	
2	UF–RO SYS BLDG.	42.0 x 36.0 x 6.0	STRUCTURAL STEEL FRAMED STRUCTURE WITH METAL SHEET ROOFING. BRICK WALL UPTO 3.0M Ht. ON THREE SIDES (NORTH, EAST & WEST) SIDE CLADDNG STARTS AT ~3.0M LEVEL FROM FFL UP TO ROOF LEVEL	
3	PUMP HOUSE	45.0 x 7.0 x 4.5	RCC FRAMED STRUCTURE WITH RCC ROOF & BRICK WALL ON THREE SIDES (SOUTH, EAST & WEST).	
4	DM SYS BLDG.	44.0 x 7.0 x 7.5	STRUCTURAL STEEL FRAMED STRUCTURE WITH METAL SHEET ROOFING. BRICK WALL UPTO 3.0M Ht. ON FOUR SIDES.SIDE CLADDNG STARTS AT ~3.0M LEVEL FROM FFL UP TO ROOF LEVEL	
5	CHEM. DOSING SYS ROOM	44.0 x 6.0 x 4.5	RCC FRAMED STRUCTURE WITH RCC ROOF & BRICK WALL UPTO 1.2 M IN DOSING SYSTEM AREA.	
6	LTMCC & CONTROL ROOM I & II BLDG.	1st FLOOR –69.0 x 12.0 x 5.0 Gr. FLOOR –69.0 x 12.0 x 3.5	RCC FRAMED STRUCTURES (TWO STORED BUILDING) WITH RCC ROOF & BRICK CLADDING. CLOSED TYPE STRUCTURE	G. FLOOR– CABLE VAULT,BAT.ROOM, LAB,OFFICE,STAFF ROOM & TOILET–1 1st FLOOR–LTMCC,CTRL. ROOM, &TOILET –2
7	REMIN. BLDG.	17.0 x 7.0 x 4.0	STRUCTURAL STEEL FRAMED STRUCTURE WITH METAL SHEET ROOFING. SIDE OPEN TYPE STRUCTURE. SIDE CLADDNG STARTS AT ~3.0M HEIGHT FROM FFL CONTINUING UP TO ROOF LEVEL	
8	DMF BACKWASH TANK–600 CU.M	15.0 x 15.0 x 3.35	RCC TANK – TOP COVERED & ABOVE GROUND TANK	
9	UF PERMEATE WATER TANK	15.0 x 10.5 x 3.35 (EACH COMPT.–400 CU.M)	RCC TANK – TWO COMPARTMENT, TOP COVERED & ABOVE GROUND TANK	TWIN COMPT.
10	SWRO INT. PER. STORAGE TANK	15.0 x 15.0 x 3.15 (600 CU.M)	RCC TANK – TOP COVERED & ABOVE GROUND TANK	
11	RO–II PER. STORAGE TANK	ø 13.0 x 9.7 H (1200 CU.M)	MS CYLINDRICAL TANK (EPOXY PAINTED) RESTING ON RCC RING WALL FOUNDATION	
12	DEGASSER TOWER PLATFORM	8.0 x 4.0 AT EL(+)9.50	RCC FRAMED STRUCTURE SUPPORTING PLATFORM	OPEN TO SKY

NOTES :

1. FINISHED GRADED LEVEL (FGL) ELEVATION IS –0.500 M.
2. BUILDING DIMENSIONS FURNISHED IN THIS DRAWING ARE AS FOLLOWS.
   FLOOR – COLUMN CENTRE TO CENTRE
   HEIGHT – INSIDE CLEAR HEIGHT
3. ALL RCC TANK DIMENSIONS FURNISHED IN THIS DRAWING ARE INSIDE CLEAR INCLUDING FREE BOARD AND DEAD VOLUME.
4. STEEL TANK DIMENSION INDICATES INSIDE DIA AND CYLINDRICAL HT.
5. OVER ALL SIZE OF THE RO–DM PLANT IS 150.0 M X 80.0 M
6. ELEVATION 0.0 M CORRESPONDS TO RL (+) 10.0 M FROM MSL.
7. ALL ELEVATION AND CO–ORDINATES SHOWN ARE IN METERS UNLESS OTHERWISE MENTIONED.
8. CO–ORDINATES SHOWN FOR BUILDING, RCC TANKS AND OTHER FACILITIES ARE TENTATIVE.
9. ACCESS (STAIRS AND LADDERS) TO RCC BUILDING ROOF AND TANKS ARE SHOWN IN EQPT. LAYOUT.

REFERENCE DRGS :

1. PLOT PLAN : PE–DG–412–100–M001 R.01
2. KEY PLAN : 1–WT–220–00490 REV.02

LEGEND :

- RCC ROOF
- METAL CLADDING ROOF
- MAIN ROAD
- APROACH ROAD
- CABLE/PIPE RACK
- BACKWASH WASTE DRAIN
- CHEMICAL WASTE DRAIN
- BAP SCOPE
- OTHER'S / SISTER UNIT SCOPE

CUSTOMER NO. R4K4

ZONE	REV	DATE	ALTD:	CHD:	APPD:
	04	10.10.17	BBS	GR	MN

REVISED BASED ON CUSTOMER COMMENTS VIDE LR. NO : SE/E/Th&Hyp/EE/AEE/M/F.En SEZ STPP/D.247/2017 dt 18.09.17

ZONE	REV	DATE	ALTD:	CHD:	APPD:
	03	26.07.17	BBS	GR	MN

REVISED BASED ON CUSTOMER COMMENTS ON EQUIPMENT LAYOUT DTD. 04–07–2017
UF–RO BUILDING, DM BUILDING & LTMCC BUILDING SIZE ALTERED
TOILET–2 ADDED ON THE FIRST FLOOR OF LTMCC BUILDING
APPROACH ROAD PROVIDED TO DM BUILDING

ZONE	REV	DATE	ALTD:	CHD:	APPD:
	02	26.08.15	BBS	GR	MN

1. ALL BUILDINGS, RCC TANKS, OTHER FACILITIES AND ROADS CO–ORDINATES SHOWN.
2. REVISED BASED ON MOM DTD. 26.05.15
3. REVISED BASED ON EQPT. LAYOUT

ZONE	REV	DATE	ALTD:	CHD:	APPD:
	01	18.05.15	BBS	GR	MN

1. LTMCC BLDG. RELOCATED
2. APPROACH ROAD NEAR DM BUILDING RELOCATED.
3. REVISED BASED ON PEM COMMENTS VIDE e–MAIL DTD. 13.05.2015

CAUTION: THE INFORMATION ON THIS DOCUMENT IS THE PROPERTY OF BHARAT HEAVY ELECTRICALS LIMITED. IT MUST NOT BE USED DIRECTLY OR INDIRECTLY IN ANY WAY DETRIMENTAL TO THE INTEREST OF THE COMPANY

PROJECT	2 X 660MW ENNORE SEZ SUPERCRITICAL TPP AT ASH DYKE OF NCTPS, CHENNAI	
OWNER	TAMILNADU GENERATION & DISTRIBUTION CORPORATION LTD.	
OWNER'S CONSULTANT	DESEIN PRIVATE LIMITED DESIEN HOUSE, NEW DELHI	
EPC CONTRACTOR	BHARAT HEAVY ELECTRICALS LIMITED, NEW DELHI UNIT : BOILER AUXILARIES PLANT ; RANIPET PACKAGE : RO-DM UF - 1600 M³ / Hr. ; RO - I (SWRO) - 560 M³ / Hr. ; RO - II (BWRO) - 114 M³ / Hr. ; DM - 110 M³ / Hr. (Net)	

TITLE: RO-DM PLANT LAYOUT

	NAME	SIGN.	DATE
DRAWN	B B SAHU	Sd/-	13.04.15
CHECKED	G RAJENDIRAN	Sd/-	13.04.15
APPROVED	M NATRAJAN	Sd/-	13.04.15

ALL DIMENSIONS ARE IN MILLIMETRES

PROJECTION

SCALE N.T.S

BHEL DRAWING NO. 1–WT–220–00491

REV 04

Size A1

FIRST ANGLE PROJECTION

(ALL DIMENSIONS ARE IN mm)

DRG. NO.

SHT. 1 OF 1

THE INFORMATION ON THIS DOCUMENT IS THE PROPERTY OF BHARAT HEAVY ELECTRICALS LIMITED. IT MUST NOT BE USED DIRECTLY OR INDIRECTLY IN ANY WAY DETRIMENTAL TO THE INTEREST OF THE COMPANY

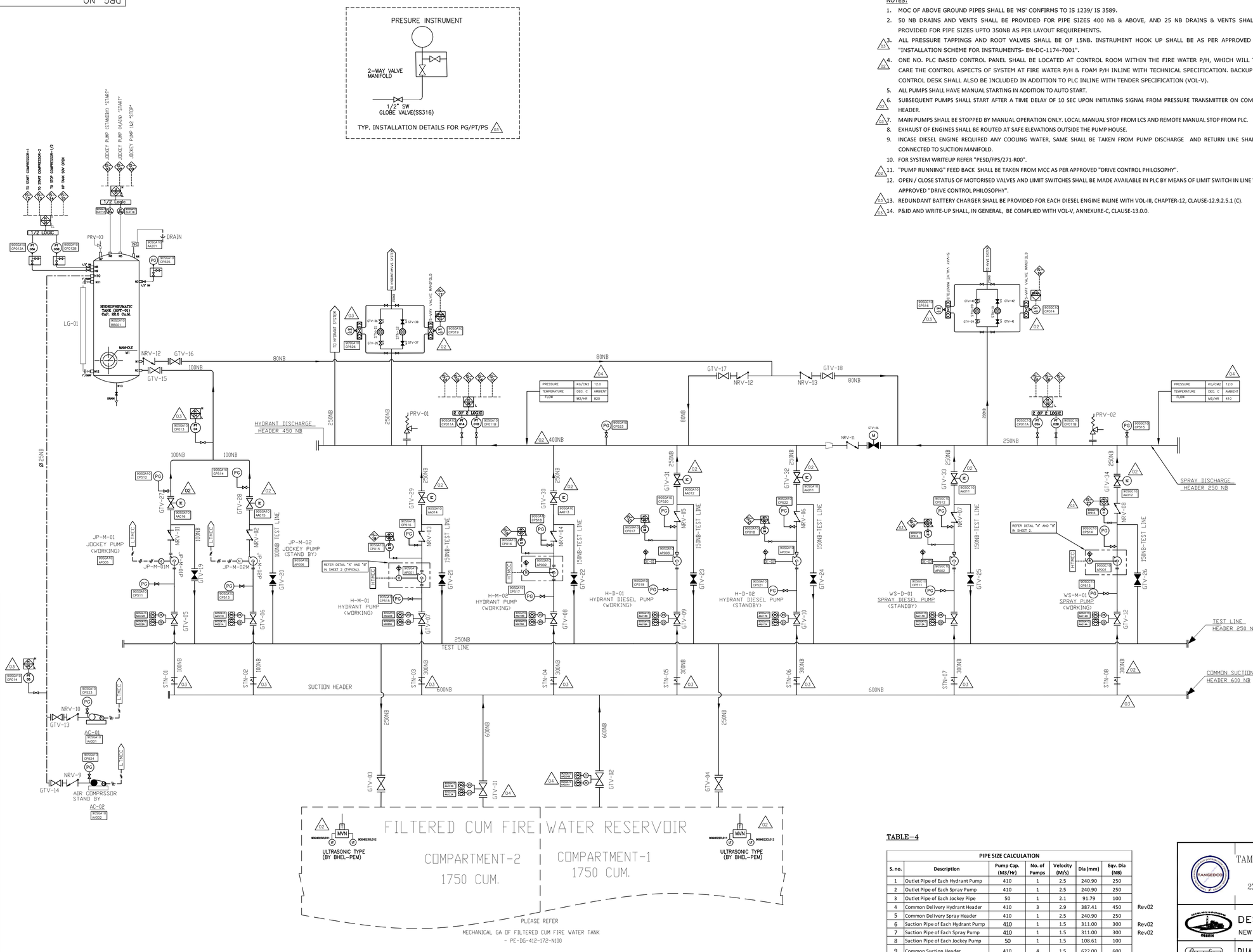
GENERAL DIMENSIONAL LIMITS,FITS & TOLERANCES AS PER HY0230261

PRESURE INSTRUMENT

2-WAY VALVE MANIFOLD

1/2" SW GLOBE VALVE(SS316)

TYP. INSTALLATION DETAILS FOR PG/PT/PS △03



NOTES:

1. MOC OF ABOVE GROUND PIPES SHALL BE 'MS' CONFIRMS TO IS 1239/ IS 3589.
2. 50 NB DRAINS AND VENTS SHALL BE PROVIDED FOR PIPE SIZES 400 NB & ABOVE, AND 25 NB DRAINS & VENTS SHALL BE PROVIDED FOR PIPE SIZES UPTO 350NB AS PER LAYOUT REQUIREMENTS.
3. △03 ALL PRESSURE TAPPINGS AND ROOT VALVES SHALL BE OF 15NB. INSTRUMENT HOOK UP SHALL BE AS PER APPROVED DRG "INSTALLATION SCHEME FOR INSTRUMENTS- EN-DC-1174-7001".
4. △02 ONE NO. PLC BASED CONTROL PANEL SHALL BE LOCATED AT CONTROL ROOM WITHIN THE FIRE WATER P/H, WHICH WILL TAKE CARE THE CONTROL ASPECTS OF SYSTEM AT FIRE WATER P/H & FOAM P/H INLINE WITH TECHNICAL SPECIFICATION. BACKUP AND CONTROL DESK SHALL ALSO BE INCLUDED IN ADDITION TO PLC INLINE WITH TENDER SPECIFICATION (VOL-V).
5. ALL PUMPS SHALL HAVE MANUAL STARTING IN ADDITION TO AUTO START.
6. △03 SUBSEQUENT PUMPS SHALL START AFTER A TIME DELAY OF 10 SEC UPON INITIATING SIGNAL FROM PRESSURE TRANSMITTER ON COMMON HEADER.
7. △03 MAIN PUMPS SHALL BE STOPPED BY MANUAL OPERATION ONLY. LOCAL MANUAL STOP FROM LCS AND REMOTE MANUAL STOP FROM PLC.
8. EXHAUST OF ENGINES SHALL BE ROUTED AT SAFE ELEVATIONS OUTSIDE THE PUMP HOUSE.
9. INCASE DIESEL ENGINE REQUIRED ANY COOLING WATER, SAME SHALL BE TAKEN FROM PUMP DISCHARGE AND RETURN LINE SHALL BE CONNECTED TO SUCTION MANIFOLD.
10. FOR SYSTEM WRITEUP REFER "PESD/FPS/271-R00".
11. △03 "PUMP RUNNING" FEED BACK SHALL BE TAKEN FROM MCC AS PER APPROVED "DRIVE CONTROL PHILOSOPHY".
12. OPEN / CLOSE STATUS OF MOTORISED VALVES AND LIMIT SWITCHES SHALL BE MADE AVAILABLE IN PLC BY MEANS OF LIMIT SWITCH IN LINE WITH APPROVED "DRIVE CONTROL PHILOSOPHY".
13. △03 REDUNDANT BATTERY CHARGER SHALL BE PROVIDED FOR EACH DIESEL ENGINE INLINE WITH VOL-III, CHAPTER-12, CLAUSE-12.9.2.5.1 (C).
14. △03 P&ID AND WRITE-UP SHALL, IN GENERAL, BE COMPLIED WITH VOL-V, ANNEXURE-C, CLAUSE-13.0.0.

TABLE 1: LIST OF ANNUNCIATION

S. No.	Window Details	EQUIPMENT DETAILS	INTERLOCK NO.	SOURCE	SET PRESS. (KG/CM2)/LEVEL(MM)
1.	ELEC. MOTOR HYDRANT MAIN PUMP (H-M-01)	START SIGNAL	IS-01	PT-01	10
		PUMP RUNNING		MCC	--
		FAIL TO START	IS-18	PT-06	10
2.	ELEC. MOTOR HYDRANT MAIN PUMP (H-M-02)	START SIGNAL	IS-02	PT-01	9
		PUMP RUNNING		MCC	--
		FAIL TO START	IS-19	PT-07	9
3.	DIESEL HYDRANT MAIN PUMP (H-D-01)	START SIGNAL	IS-03	PT-01	8
		PUMP RUNNING		MCC	--
		FAIL TO START	IS-20	PT-08	8
4.	DIESEL HYDRANT STANDBY PUMP (H-D-02)	START SIGNAL	IS-04	PT-01	7
		PUMP RUNNING		MCC	--
		FAIL TO START	IS-21	PT-09	7
5.	ELEC. MOTOR SPRAY MAIN PUMP (WS-M-01)	START SIGNAL	IS-05	PT-02	10
		PUMP RUNNING		MCC	--
		FAIL TO START	IS-22	PT-10	10
6.	DIESEL SPRAY STANDBY PUMP (WS-D-01)	START SIGNAL	IS-06	PT-02	9
		PUMP RUNNING		MCC	--
		FAIL TO START	IS-23	PT-11	9
7.	MAIN JOCKEY PUMP (JP-M-01)	START SIGNAL	IS-07	LT01	500mm Less than HIGH level (LT01-H)
		PUMP RUNNING		MCC	
		STOP	IS-09	LT01	2/3 of Tank Height
8.	STANDBY JOCKEY PUMP (JP-M-02)	START SIGNAL	IS-08	LT01	250mm Less than LOW level (LT01-L)
		PUMP RUNNING		MCC	--
		STOP	IS-09	LT01	2/3 of Tank Height
9.	HYDRANT HEADER PRESSURE	LOW	IS-10	PT-1	5
10.	SPRAY HEADER PRESSURE/MOV OPEN	LOW/MOV-01 Open	IS-11	PT-2	7
11.	MAIN AIR COMPRESSOR (AC-01)	START	IS-12	PT-03	11.5
		RUNNING SIGNAL		MCC	--
		STOP	IS-14	PT-03	12.3
12.	STANDBY AIR COMPRESSOR (AC-02)	START	IS-13	PT-03	11
		RUNNING SIGNAL		MCC	--
		STOP	IS-14	PT-03	12.3
13.	SOLENOID VALVE FOR HPT (SV-01)	OPEN	IS-15	PT-03	13
14.	HVWS HEADER STRAINER	CLOGGED	IS-16	DPS-01	0.5
15.	MVWS HEADER STRAINER	CLOGGED	IS-17	DPS-02	0.5

THE "FAIL TO START" ANNUNCIATION FOR FIRE PUMP IS DERIVED FROM PRESSURE TRANSMITTER PLACED ON DISCHARGE OF INDIVISUAL PUMP BEFORE NRV. SUITBALE TIME DELAY SHALL BE CONSIDERED AFTER START COMMAND IS RECEIVED FOR THE RESPECTIVE PUMP.

THE "FAIL TO START" ANNUNCIATION FOR AIR COMPRESSOR IS DERIVED FROM PRESSURE TRANSMITTER (PT-05) PLACED ON COMMON DISCHARGE HEADER OF AIR COMPRESSOR

TABLE-2

SET POINT AND INSTRUMENT SCHEDULE FOR AIR COMPRESSORS & HP TANK

SR. No.	EQUIPT TAG No.	Pr.Transmitter TAG No.	Level Transmitter TAG No.	Setting kg/cm²(g)	SETTING kg/cm²(g)	SIGNAL
1	AC-01 AC-02	PT-03	– –	12.3 11.0	–	AC-01/AC-02 STOP AC-01 START AC-02 START
3	JP-M-01/ JP-M-02	–	LT-01 A/B	–	AT 2/3 HT OF HP TANK (LVL-H)	JP-M-01 / JP-M-02 STOP
3	JP-M-01	–	LT-01-A/B	–	500MM LESS THEN THE LVL OF "H"(LVL-L)	START
4	JP-M-02	–	LT-01-A/B	–	250MM LESS THEN THE LVL OF "L"(LVL-LL)	START
5	HPT-01	PT-03	–	13.0		HP TANK AIR PRESSURE HIGH/ SOLENOID VALVE OPEN
6	MOV-01	PT-02	–	7.0		OPEN

TABLE-3

EQUIPMENT DATA

SL. NO.	TAG NO.	DESCRIPTION	QTY	CAPACITY (M^3/Hr)	HEAD (TDH)
1	H-M-01	MOTOR DRIVEN HYDRANT MAIN PUMP	01	410	120
2	H-M-02	MOTOR DRIVEN HYDRANT MAIN PUMP	01	410	120
3	H-D-01	DIESEL ENGINE HYDRANT MAIN PUMP	01	410	120
4	H-D-02	DIESEL ENGINE HYDRANT STANDBY PUMP	01	410	120
5	WS-M-01	MOTOR DRIVEN SPRAY MAIN PUMP	01	410	105
6	WS-D-01	DIESEL ENGINE SPRAY STANDBY PUMP	01	410	120
7	JP-M-01	MOTOR DRIVEN JOCKEY MAIN PUMP	01	50	125
8	JP-M-02	MOTOR DRIVEN JOCKEY STANDBY PUMP	01	50	125
9	AC-01	AIR COMPRESSOR (WORKING)	01	25	–
10	AC-02	AIR COMPRESSOR (STANDBY)	01	25	–
11	HPT-01	HYDRO-PNEUMATIC TANK	01	22.5M3	–

LEGEND:–

- WATER PIPE LINE
- COMPRESSED AIR PIPING
- GATE VALVE
- GATE VALVE (NORMALLY CLOSE)
- GLOBE VALVE
- NON RETURN VALVE
- BASKET TYPE STRAINER
- HORIZONTAL PUMP
- CONCENTRIC REDUCER
- ECCENTRIC REDUCER
- PRESSURE RELIEF VALVE
- FW FIRE WATER
- BUTTERFLY VALVE
- FIRE SURVIVAL CONTROL CABLE(MICA TYPE)
- SUCTION LINE
- A ALARM/ANNUNCIATION
- TEST LINE
- LS LEVEL SWITCH
- LG LEVEL INDICATOR
- PS PRESSURE SWITCH
- PG PRESSURE GAUGE
- DPS DIFFERENTIAL PRESSURE SWITCH
- DE DIESEL ENGINE
- M ELECTRIC MOTOR
- 'Y' TYPE STRAINER
- NO NORMALLY OPEN
- NC NORMALLY CLOSE
- CONTROLLER

△02 REFERENCE DRG:

1. PLOT PLAN : PE-DG-412-100-M001
2. P&ID OF PLANT WATER SYSTEM : PE-DG-412-172-N001
3. P&ID (SCHEMATIC) OF HVWS : PY-FP-1-M066-8315-02
4. P&ID (SCHEMATIC) OF MVWS_PY-FP-1-M066-8315-03
5. COMPOSITE LAYOUT OF HYDRANT & SPRAY: PY-LP-0-M066-8315-01
6. DESIGN BASIS OF FPS : PY-S0-4-M066-8315-01
7. DRIVE CONTROL PHILOSOPHY : PE-DM-412-145-I002

TABLE-4

PIPE SIZE CALCULATION

S. no.	Description	Pump Cap. (M3/Hr)	No. of Pumps	Velocity (M/s)	Dia (mm)	Eqv. Dia (NB)	
1	Outlet Pipe of Each Hydrant Pump	410	1	2.5	240.90	250	
2	Outlet Pipe of Each Spray Pump	410	1	2.5	240.90	250	
3	Outlet Pipe of Each Jockey Pipe	50	1	2.1	91.79	100	
4	Common Delivery Hydrant Header	410	3	2.9	387.41	450	RevO2
5	Common Delivery Spray Header	410	1	2.5	240.90	250	
6	Suction Pipe of Each Hydrant Pump	410	1	1.5	311.00	300	RevO2
7	Suction Pipe of Each Spray Pump	410	1	1.5	311.00	300	RevO2
8	Suction Pipe of Each Jockey Pump	50	1	1.5	108.61	100	
9	Common Suction Header	410	4	1.5	622.00	600	

Note : Velocities are considered as per clause 12.6.1.6 chapter 12 of FPS Tender Spec.

REV.	DATE	ALTERED	CHD/APPD
03	30.10.2018	AMT	CHD/APPD KD/MNSR
ZONE		1. REVISED AS PER CUST COMMENT	
02	03.08.18		CHD/APPD
ZONE		1. REVISED AS PER CUST COMMENT	
01	17.07.18		CHD/APPD
ZONE		1. REVISED AS PER CUST COMMENT	

TAMILNADU GENERATION AND DISTRIBUTION CORPORATION

2X660MW ENNORE SEZ SUPERCRITICAL THERMAL POWER PROJECT AT ASH DYKE OF NCTPS, CHENNAI

DESEIN CONSULTING ENGINEERS

NEW DELHI – INDIA

BHARAT HEAVY ELECTRICALS LTD.

PROJECT ENGINEERING AND SYSTEMS DIVISION
R.C. PURAM, HYDERABAD-32

	NAME	SIGN	DATE
DRN.	AMIT		04.12.17
CHD.	KD		04.12.17
APPD.	MNSR		04.12.17

TITLE : P&ID OF FIRE WATER PUMP HOUSE (FIRE PROTECTION SYSTEM)

UNIT :

SCALE :

BHEL DWG. NO. : PY-FP-1-M066-8315-01

SHEET NO. 1 NO. OF SHEET 02

REV. 04

FIRST ANGLE PROJECTION

(ALL DIMENSIONS ARE IN mm)

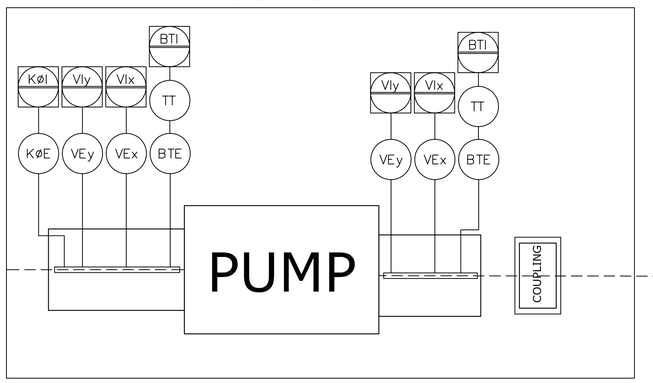
DRG. NO.

SHT. 1 OF 1

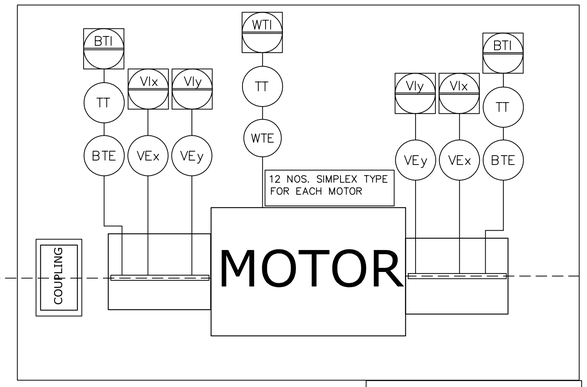
THE INFORMATION ON THIS DOCUMENT IS THE PROPERTY OF BHARAT HEAVY ELECTRICALS LIMITED. IT MUST NOT BE USED DIRECTLY OR INDIRECTLY IN ANY WAY DETRIMENTAL TO THE INTEREST OF THE COMPANY

GENERAL DIMENSIONAL LIMITS,FITS & TOLERANCES AS PER HY0230261

△02 DETAIL "A"



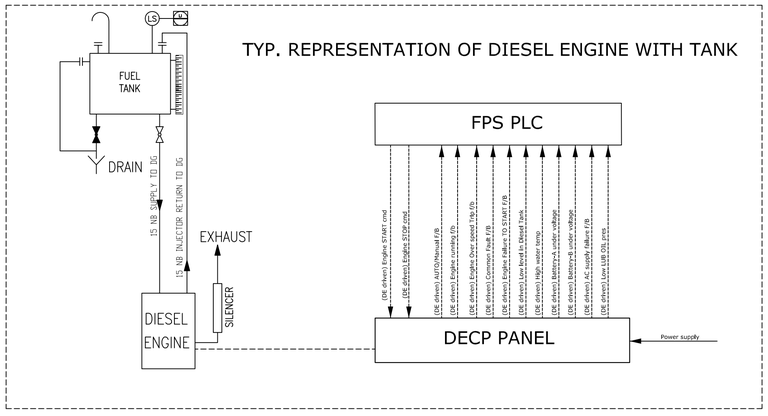
△02 DETAIL "B"



TEMPERATURE TRANSMITTER WILL BE PROVIDED FOR TEMPERATURE MEASURING DEVICES.

VEx / VEy	VIBRATION SENSOR
KØE	KEY PHASOR
BTE	BEARING RTD
WTE	WINDING RTD

△02 DETAIL "C"



REV.	DATE	ALTERED	REV.	DATE	ALTERED	REV.	DATE	ALTERED	REV.	DATE	ALTERED	REV.	DATE	ALTERED	REV.	DATE	ALTERED	REV.	DATE	ALTERED
		CHD/APPD			CHD/APPD			CHD/APPD			CHD/APPD			CHD/APPD	03	30.10.2018	CHD/APPD KD/MNSR AMT	02	03.08.18	CHD/APPD	01	17.07.18	CHD/APPD
ZONE			ZONE			ZONE		—	ZONE			ZONE			ZONE		1. REVISED AS PER CUST COMMENT			1. REVISED AS PER CUST COMMENT	ZONE		1. REVISED AS PER CUST COMMENT

TAMILNADU GENERATION AND DISTRIBUTION CORPORATION

2X660MW ENNORE SEZ SUPERCRITICAL THERMAL POWER PROJECT AT ASH DYKE OF NCTPS, CHENNAI

DESEIN CONSULTING ENGINEERS
NEW DELHI – INDIA

BHARAT HEAVY ELECTRICALS LTD.
PROJECT ENGINEERING AND SYSTEMS DIVISION
R.C. PURAM, HYDERABAD-32

	NAME	SIGN	DATE
DRN.	AMIT		04.12.17
CHD.	KD		04.12.17
APPD.	MNSR		04.12.17

TITLE : P&ID OF FIRE WATER PUMP HOUSE (FIRE PROTECTION SYSTEM)

UNIT :

SCALE :

BHEL DWG. NO. : PY-FP-1-M066-8315-01

SHEET NO. 2 / NO. OF SHEET 02

REV. 04

COPYRIGHT AND CONFIDENTIAL
The information on this document is the property of BHARAT HEAVY ELECTRICALS LIMITED.
It must not be used directly or indirectly in any way detrimental to the interest of the company.

FIRE PROTECTION SYSTEM

WRITE-UP FOR
P&ID OF FIRE WATER PUMP HOUSE

COPYRIGHT AND CONFIDENTIAL
The information on this document is the property of BHARAT HEAVY ELECTRICALS LIMITED.
It must not be used directly or indirectly in any way detrimental to the interest of the company.

1.0.0 GENERAL

The purpose of this P&ID is to describe the piping of the process flow together with the installed equipment, instruments, their operation & control logic.

In this write-up the following systems have been briefly described. Also, the various control functions as well as the interlocks and logics of the process have been explained and elaborated:

- Fire Water Pressurization System
- Hydrant System
- Spray System

1.1.0 Following major equipment shall be located in the Fire Water Pump house:

S. No.	Tag No.	Description	Qty	Capacity (M3/hr)	Head (M)
1.	H-M-01	Elec. Motor Driven Hydrant Main Pump	1	410	120
2.	H-M-02	Elec. Motor Driven Hydrant Main Pump	1	410	120
3.	H-D-01	Diesel Engine Driven Hydrant Main Pump	1	410	120
4.	H-D-02	Diesel Engine Driven Hydrant Standby Pump	1	410	120
5.	WS-M-01	Elec. Motor Driven Spray Main Pump	1	410	120
6.	WS-D-01	Diesel Engine Driven Spray standby Pump	1	410	120
7.	JP-M-01	Elec. Motor Driven Jockey Main Pump	1	50	125
8.	JP-M-02	Elec. Motor Driven Jockey Standby Pump	1	50	125
9.	AC-01	Air Compressor – Main	1	25	-
10.	AC-02	Air Compressor- Standby	1	25	-
11.	HPT-01	Hydro pneumatic Tank	1	22.5 M3	-

COPYRIGHT AND CONFIDENTIAL
The information on this document is the property of BHARAT HEAVY ELECTRICALS LIMITED.
It must not be used directly or indirectly in any way detrimental to the interest of the company.

1.2.0 List of Annunciation:

TABLE 1: LIST OF ANNUNCIATION

3

S. No.	Window Details	EQUIPMENT DETAILS	INTERLOCK NO.	SOURCE	SET PRESS. (KG/CM2)/ LEVEL(MM)
1.	ELEC. MOTOR HYDRANT MAIN PUMP (H-M-01)	START SIGNAL	IS-01	PT-01	10
		PUMP RUNNING		MCC	--
		FAIL TO START	IS-18	PT-06	10
2.	ELEC. MOTOR HYDRANT MAIN PUMP (H-M-02)	START SIGNAL	IS-02	PT-01	9
		PUMP RUNNING		MCC	--
		FAIL TO START	IS-19	PT-07	9
3.	DIESEL HYDRANT MAIN PUMP (H-D-01)	START SIGNAL	IS-03	PT-01	8
		PUMP RUNNING		MCC	--
		FAIL TO START	IS-20	PT-08	8
4.	DIESEL HYDRANT STANDBY PUMP (H-D-02)	START SIGNAL	IS-04	PT-01	7
		PUMP RUNNING		MCC	--
		FAIL TO START	IS-21	PT-09	7
5.	ELEC. MOTOR SPRAY MAIN PUMP (WS-M-01)	START SIGNAL	IS-05	PT-02	10
		PUMP RUNNING		MCC	--
		FAIL TO START	IS-22	PT-10	10
6.	DIESEL SPRAY STANDBY PUMP (WS-D-01)	START SIGNAL	IS-06	PT-02	9
		PUMP RUNNING		MCC	--
		FAIL TO START	IS-23	PT-11	9
7.	MAIN JOCKEY PUMP (JP-M-01)	START SIGNAL	IS-07	LT01	500mm Less than HIGH level (LT01-H)
		PUMP RUNNING		MCC	--
		STOP	IS-09	LT01	2/3 of Tank Height
8.	STANDBY JOCKEY PUMP (JP-M-02)	START SIGNAL	IS-08	LT01	250mm Less than LOW level (LT01-L)
		PUMP RUNNING		MCC	--
		STOP	IS-09	LT01	2/3 of Tank

COPYRIGHT AND CONFIDENTIAL
The information on this document is the property of BHARAT HEAVY ELECTRICALS LIMITED.
It must not be used directly or indirectly in any way detrimental to the interest of the company.

					Height
9.	HYDRANT HEADER PRESSURE	LOW	IS-10	PT-1	5
10.	SPRAY HEADER PRESSURE/MOV OPEN	LOW/MOV-01 Open	IS-11	PT-2	7
11.	MAIN AIR COMPRESSOR (AC-01)	START	IS-12	PT-03	11.5
		STOP	IS-14	PT-03	12.3
12.	STANDBY AIR COMPRESSOR (AC-02)	START	IS-13	PT-03	11
		STOP	IS-14	PT-03	12.3
13.	SOLENOID VALVE FOR HPT (SV-01)	OPEN	IS-15	PT-03	13
14.	HVWS HEADER STRAINER	CLOGGED	IS-16	DPT-01	0.5
15.	MVWS HEADER STRAINER	CLOGGED	IS-17	DPT-02	0.5
THE 'FAIL TO START' ANNUNCIATION FOR FIRE PUMP IS DERIVED FROM PRESSURE TRANSMITTER PLACED ON DISCHARGE OF INDIVIDUAL PUMP BEFORE NRV. SUITABLE TIME DELAY SHALL BE CONSIDERED AFTER START COMMAND IS RECEIVED FOR THE RESPECTIVE PUMP.					

LEGEND:
PS: PRESSURE SWITCH, PT: PRESSURE TRANSMITTER, LT: LEVEL TRANSMITTER, DPT: DIFFERENTIAL PRESSURE STRANSMITTER.

2.0.0 FIRE WATER STORAGE SYSTEM

2.1.0 Water for the fire protection system shall be drawn from the common Filtered cum Fire Water reservoir.

2.2.0 A reserve storage of water 3500 CMH shall be provided for fire protection system in line with TAC requirements for operation of all working pumps for a period of 2 hours.

3.0.0 FIRE WATER PRESSURISATION SYSTEM (OPERATIONAL PHILOSOPHY FOR JOCKEY PUMP, AIR COMPRESSOR & HPT)

3.1.0 The pressurization of both hydrant system and water spray system shall be done through the combination of hydro-pneumatic tank, Jockey pumps and air compressors.

3.2.0 In normal condition entire system is maintained at system pressure (12.0 kg/cm2) by Hydro-pneumatic tank (HPT), which is connected to the delivery side of Jockey pump.

3.3.0 The HPT must first be filled with water until the normal level (2/3 level i.e. High water level) is reached, and then raised to normal pressure with compressed air when the system is set into operation for the first time.

COPYRIGHT AND CONFIDENTIAL
The information on this document is the property of BHARAT HEAVY ELECTRICALS LIMITED.
It must not be used directly or indirectly in any way detrimental to the interest of the company.

3.4.0 Initially the system has been kept at normal system pressure (12.0 kg/cm2). **In case of small system leakages,** there will be a pressure drop in the Delivery Header.

3.5.0 The air pressure in the HPT will feed the water to the system and thus the water level in tank start decreasing from High water level. This decrease in water level will allow the compressed air to expand and will reduce the air pressure in the tank in turn. The Pressure Transmitter (PT-03) in the tank set at 11.5 kg/cm2 shall sense this pressure reduction and send the start signal to the air compressor (AC-01) through the control panel. In case the main Air compressor fail to start, the pressure will drop further and when it reaches 11.0 kg/cm2 the stand-by Air compressor (AC-02) will start automatically by receiving a start signal from PT-03 till pressure reaches 12.3 kg/cm2 and stops automatically (by PT-03 set at 12.3 kg/cm2).

3.6.0 To protect the tank against excessive pressure, a solenoid valve is provided which will receive 'Open Signal' for Pressure Transmitter PT-03 (set at 13.0 kg/cm2). A Pressure relief Valve (PRV-03) is also provided to protect the HPT against excessive pressure as a safety measure.

3.7.0 The decrease in water level in the tank shall be sensed by a level Transmitter-Low Level (LT01) at a preset point and send the start signal to main Jockey Pump (JP-M-01). The air compressor and jockey pumps are interlocked in such a way that both are not running simultaneously.

3.8.0 The operation of jockey pump will deliver the water to the tank as well as system. Once the level reaches preset High Level in the tank, the LT01-H will stop the Main jockey pump (JP-M-01) automatically. If Main Jockey Pump does not start due to any fault, the level in the tank further reduces. This further reduction in water level is sensed by level transmitter-Low Low Level (LT01-LL) which will give a start signal to Stand-by Jockey Pump (JP-M-02).

3.8.0 FIRE HYDRANT SYSTEM (OPERATIONAL PHILOSOPHY FOR HYDRANT PUMPS)

4.0.0 The system will consist of a network of piping installed underground and above ground around areas to be protected, hydrant valves (external/internal), hoses, hose cabinets, couplings, branch pipe & nozzles.

4.1.0 External hydrants will be located all around the periphery of buildings and internal hydrants will be provided at the landing floor of staircases through above ground main. Outdoor type fixed water monitors will be provided for ESP area, boiler & mills area, bunker area, coal storage yard and areas of transfer towers & coal conveyors at locations where water cannot reach from hydrant system.

4.2.0 Hose housing standard accessories like hoses, couplings, branch pipes & nozzles will be provided at each hydrant points. All length fitted with standard accessories like branch pipes will be located in Central Hose Houses (for outdoor hydrants) and in Hose Boxes (for indoor hydrants). Accessories required for external and internal hydrants will be stored in Hose houses/hose boxes located alongside of each hydrant.

4.3.0 The pump head shall be so designed that when the aggregate pumping capacity is being discharged at the farthest or hydraulically remotest hydrant point a minimum running pressure of 3.5 Kg/sq.cm is available at that point.

COPYRIGHT AND CONFIDENTIAL
The information on this document is the property of BHARAT HEAVY ELECTRICALS LIMITED.
It must not be used directly or indirectly in any way detrimental to the interest of the company.

The velocity of flow of water is generally not exceeding 5 m/sec in delivery header and anywhere in the system (as per Cl. 7.5.10 of FP Manual-TAC).

4.4.0 In the event of fire when hydrant valves are opened, the pressure in the header will drop due to the resulting flow. This reduction in pressure is sensed by pressure Transmitter (PT-01) mounted on the hydrant header set at 10.0 kg/cm2 and gives a start signal to Hydrant main pump (H-M-01).

'PUMP RUNNING' signal shall be received from respective MCC as per "Drive Control Philosophy". The 'Fail to Start' signal shall be received from PT-01 only with a suitable time delay.

4.5.0 If the first hydrant main pump fails to start, subsequent pump (H-M-02) will start after receiving a signal from PT-01 which is set at 9.0 kg/cm2.

4.6.0 Subsequent pumps shall start after a time delay of 10 seconds upon receiving a signal from Pressure Transmitter on Common discharge Header.

4.7.0 Stopping of all the fire pumps shall always be manual. Local Manual stop shall be from LCS and Remote manual stop shall be from PLC.

5.0.0 SPRAY WATER SYSTEM (OPERATIONAL PHILOSOPHY FOR SPRAY PUMPS)

5.1.0 Fire Water Spray System includes fixed water spray arrangement, strategically installed in specified areas of plant buildings and major equipment such as Transformers, BFP area, Boiler Burner Fronts, Oil Tanks etc. for protection against fire damage.

5.2.0 This application requires a forceful directional water discharged achieved by specially designed nozzles according to the risk and environment. The discharged is broken into droplets of water traveling at high velocity which provide the necessary mechanical agitation and cooling at the surface of the burning liquid.

5.3.0 Spray pumps shall also start in the same manner as explained above.

5.4.0 The hydrant discharge header and spray water discharge header have been interconnected through a motor operated isolation valve (MOV-01) and a non-return valve. In this arrangement, water from hydrant discharge header can be used for spray water system but not vice versa. Opening/Closing of Motorised valve with status indication shall be made available in PLC located in fire water pump house.

5.5.0 In case the Stand-by Spray Diesel pump (WS-D-01) is also not able to maintain desired flow in the network, the pressure in spray header will fall subsequently. This drop in pressure is sensed by pressure transmitter (PT-2) mounted on spray header and Spray Header LOW indication in given in the panel. Simultaneously, OPEN signal is given to MOV-01 also from PT-2.
Provision shall be made to provide OPEN signal to MV-01 from "FAIL to START" signal of Stand-by Spray Diesel pump (WS-D-01) generated by pressure transmitter (PT-02) as a redundancy.

COPYRIGHT AND CONFIDENTIAL
The information on this document is the property of BHARAT HEAVY ELECTRICALS LIMITED,
It must not be used directly or indirectly in any way detrimental to the interest of the company.

RECORD OF REVISIONS

Rev. No.	Date	Revision Details	Revised By	Checked By	Approved By
00	25.09.2017	FIRST ISSUE	Amit	KD	PCS
01	17.07.2018	REVISED AS PER CUST COMMENT	Amit	KD	PCS
02	07.09.2018	REVISED AS PER CUST COMMENT	Amit	KD	PCS
03	31.10.2018	REVISED AS PER CUST COMMENT	Amit	KD	PCS

FIRST ANGLE PROJECTION

(ALL DIMENSIONS ARE IN mm)

DRG. NO.

SHT. 1 OF 1

THE INFORMATION ON THIS DOCUMENT IS THE PROPERTY OF BHARAT HEAVY ELECTRICALS LIMITED. IT MUST NOT BE USED DIRECTLY OR INDIRECTLY IN ANY WAY DETRIMENTAL TO THE INTEREST OF THE COMPANY

GENERAL DIMENSIONAL LIMITS,FITS & TOLERANCES AS PER HY0230261

LIST OF KKS TAG NO- HVWS

S. NO.	Equipment Protected	Type of Instrument	KKS
1	Cable Cellar in TG Hall at 0.01mm.b	DELUGE VALVE	10 SGC 02 AA 301
2	Cable Cellar in TG Hall at 0.01mm.b	PRESSURE SWITCH-SPRAY LINE	10 SGC 02 CP 301
3	Cable Cellar in TG Hall at 0.01mm.b	SOLENOID VALVE	10 SGC 02 AA 301
4	Cable Cellar in TG Hall at 8.51mm.b	DELUGE VALVE	10 SGC 02 AA 302
5	Cable Cellar in TG Hall at 8.51mm.b	PRESSURE SWITCH-SPRAY LINE	10 SGC 02 CP 302
6	Cable Cellar in TG Hall at 8.51mm.b	SOLENOID VALVE	10 SGC 02 AA 302
7	Cable Cellar in TG Hall at 0.01mm.b	DELUGE VALVE	20 SGC 02 AA 303
8	Cable Cellar in TG Hall at 0.01mm.b	PRESSURE SWITCH-SPRAY LINE	20 SGC 02 CP 303
9	Cable Cellar in TG Hall at 0.01mm.b	SOLENOID VALVE	20 SGC 02 AA 303
10	Cable Cellar in TG Hall at 8.51mm.b	DELUGE VALVE	20 SGC 02 AA 304
11	Cable Cellar in TG Hall at 8.51mm.b	PRESSURE SWITCH-SPRAY LINE	20 SGC 02 CP 304
12	Cable Cellar in TG Hall at 8.51mm.b	SOLENOID VALVE	20 SGC 02 AA 304
13	Cable Cellar in TG Hall at 13.0	DELUGE VALVE	90 SGC 02 AA 305
14	Cable Cellar in TG Hall at 13.0	PRESSURE SWITCH-SPRAY LINE	90 SGC 02 CP 305
15	Cable Cellar in TG Hall at 13.0	SOLENOID VALVE	90 SGC 02 AA 305
16	Cable Cellar in TG Hall at 26.0	DELUGE VALVE	90 SGC 02 AA 306
17	Cable Cellar in TG Hall at 26.0	PRESSURE SWITCH-SPRAY LINE	90 SGC 02 CP 306
18	Cable Cellar in TG Hall at 26.0	SOLENOID VALVE	90 SGC 02 AA 306
19	Cable Cellar in CHP MCC-1 (NEAR CRH)	DELUGE VALVE	90 SGC 02 AA 307
20	Cable Cellar in CHP MCC-1 (NEAR CRH)	PRESSURE SWITCH-SPRAY LINE	90 SGC 02 CP 307
21	Cable Cellar in CHP MCC-1 (NEAR CRH)	SOLENOID VALVE	90 SGC 02 AA 307
22	Cable Cellar in CHP MCC-2 (NEAR T'B)	DELUGE VALVE	90 SGC 02 AA 308
23	Cable Cellar in CHP MCC-2 (NEAR T'B)	PRESSURE SWITCH-SPRAY LINE	90 SGC 02 CP 308
24	Cable Cellar in CHP MCC-2 (NEAR T'B)	SOLENOID VALVE	90 SGC 02 AA 308
25	Cable Cellar in CHP MCC-3 (NEAR TB+B)	DELUGE VALVE	90 SGC 02 AA 309
26	Cable Cellar in CHP MCC-3 (NEAR TB+B)	PRESSURE SWITCH-SPRAY LINE	90 SGC 02 CP 309
27	Cable Cellar in CHP MCC-3 (NEAR TB+B)	SOLENOID VALVE	90 SGC 02 AA 309
28	Cable Cellar in ASH WATER PH	DELUGE VALVE	90 SGC 02 AA 310
29	Cable Cellar in ASH WATER PH	PRESSURE SWITCH-SPRAY LINE	90 SGC 02 CP 310
30	Cable Cellar in ASH WATER PH	SOLENOID VALVE	90 SGC 02 AA 310
31	Cable Cellar in CW PH	DELUGE VALVE	90 SGC 02 AA 311
32	Cable Cellar in CW PH	PRESSURE SWITCH-SPRAY LINE	90 SGC 02 CP 311
33	Cable Cellar in CW PH	SOLENOID VALVE	90 SGC 02 AA 311
34	Cable Cellar in SEA WATER INTAKE PH	DELUGE VALVE	90 SGC 02 AA 312
35	Cable Cellar in SEA WATER INTAKE PH	PRESSURE SWITCH-SPRAY LINE	90 SGC 02 CP 312
36	Cable Cellar in SEA WATER INTAKE PH	SOLENOID VALVE	90 SGC 02 AA 312
37	Cable Cellar in ESP CONTROL ROOM (UNIT-1)	DELUGE VALVE	90 SGC 02 AA 313
38	Cable Cellar in ESP CONTROL ROOM (UNIT-1)	PRESSURE SWITCH-SPRAY LINE	90 SGC 02 CP 313
39	Cable Cellar in ESP CONTROL ROOM (UNIT-1)	SOLENOID VALVE	90 SGC 02 AA 313
40	Cable Cellar in ESP CONTROL ROOM (UNIT-2)	DELUGE VALVE	90 SGC 02 AA 314
41	Cable Cellar in ESP CONTROL ROOM (UNIT-2)	PRESSURE SWITCH-SPRAY LINE	90 SGC 02 CP 314
42	Cable Cellar in ESP CONTROL ROOM (UNIT-2)	SOLENOID VALVE	90 SGC 02 AA 314

NOTE: SUFFIX A,B,C... SHALL BE USED FOR ADDITIONAL DVs IN CASE OF ZONING IN ANY AREAS.

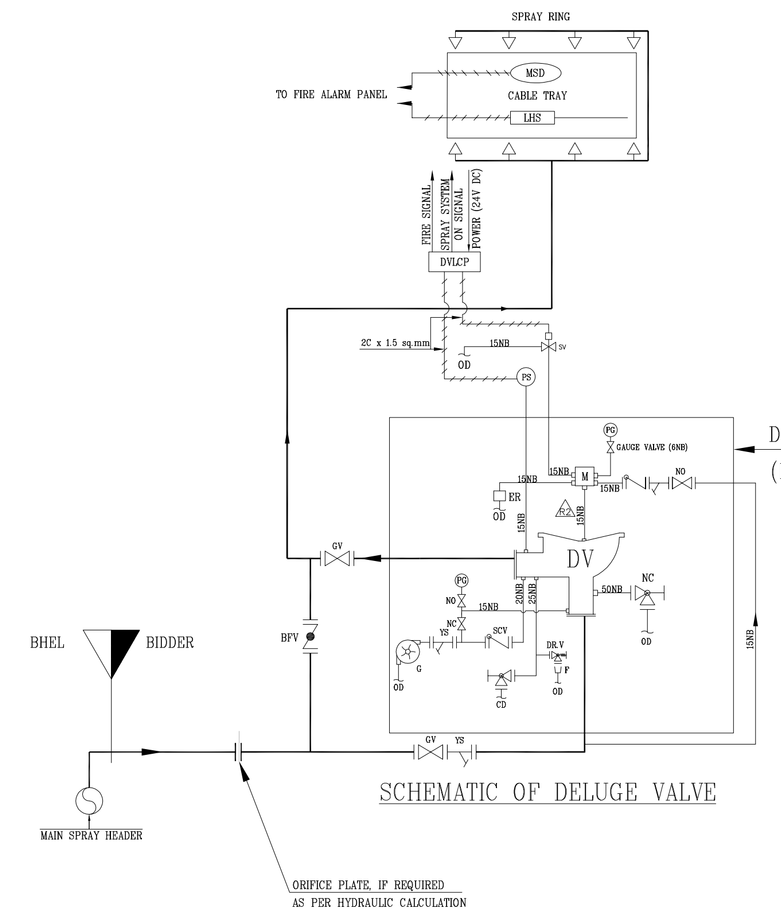
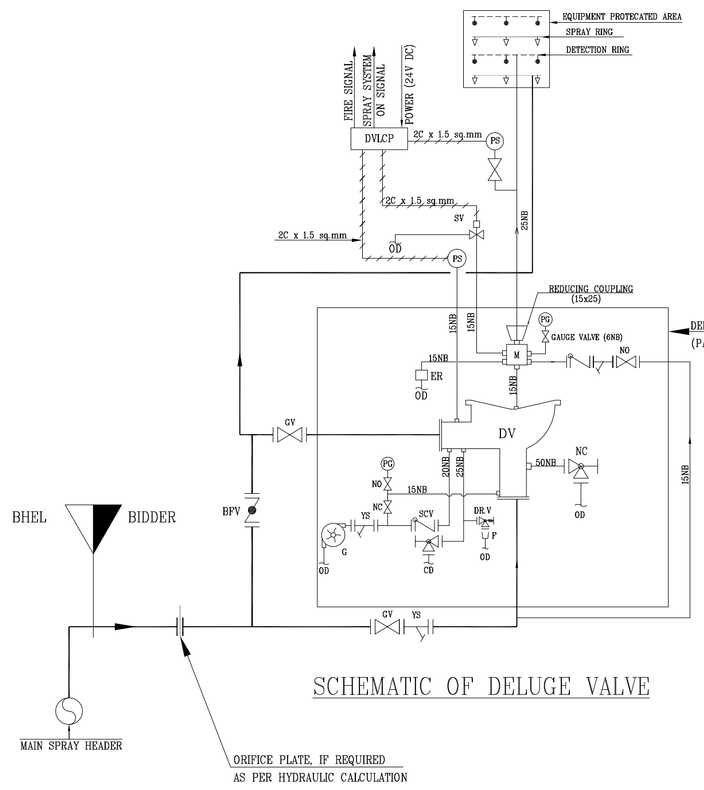


TABLE-1
EQUIPMENTS TO BE PROTECTED

SN	DESCRIPTION
1	CABLE CELLAR IN TG HALL
2	CABLE CELLAR IN CHP CONTROL ROOM
3	CABLE CELLAR IN ASH WATER PH
4	CABLE CELLAR IN CW PH
5	CABLE CELLAR IN ESP CONTROL ROOM



S. NO.	Equipment Protected	Type of Instrument	KKS
43	RECTIFIER TRANSFORMER AT ESP (UNIT-1)	DELUGE VALVE	90 SGC 02 AA 535
44	RECTIFIER TRANSFORMER AT ESP (UNIT-1)	PRESSURE SWITCH-SPRAY LINE	90 SGC 02 CP 535
45	RECTIFIER TRANSFORMER AT ESP (UNIT-1)	SOLENOID VALVE	90 SGC 02 AA 535
46	RECTIFIER TRANSFORMER AT ESP (UNIT-2)	DELUGE VALVE	90 SGC 02 AA 556
47	RECTIFIER TRANSFORMER AT ESP (UNIT-2)	PRESSURE SWITCH-SPRAY LINE	90 SGC 02 CP 556
48	RECTIFIER TRANSFORMER AT ESP (UNIT-2)	SOLENOID VALVE	90 SGC 02 AA 556
49	FUEL STORAGE TANK (HSD)	DELUGE VALVE	90 SGC 02 AA 516
50	FUEL STORAGE TANK (HSD)	PRESSURE SWITCH-SPRAY LINE	90 SGC 02 CP 517
51	FUEL STORAGE TANK (HSD)	SOLENOID VALVE	90 SGC 02 AA 517
52	FUEL STORAGE TANK (HFO-3)	DELUGE VALVE	90 SGC 02 AA 518
53	FUEL STORAGE TANK (HFO-3)	PRESSURE SWITCH-SPRAY LINE	90 SGC 02 CP 518
54	FUEL STORAGE TANK (HFO-3)	SOLENOID VALVE	90 SGC 02 AA 518
55	FUEL STORAGE TANK (HFO-2)	DELUGE VALVE	90 SGC 02 AA 519
56	FUEL STORAGE TANK (HFO-2)	PRESSURE SWITCH-SPRAY LINE	90 SGC 02 CP 519
57	FUEL STORAGE TANK (HFO-2)	SOLENOID VALVE	90 SGC 02 AA 519
58	FUEL OIL UNLOADING & PRESSURING PH	DELUGE VALVE	90 SGC 02 AA 520
59	FUEL OIL UNLOADING & PRESSURING PH	PRESSURE SWITCH-SPRAY LINE	90 SGC 02 CP 520
60	FUEL OIL UNLOADING & PRESSURING PH	SOLENOID VALVE	90 SGC 02 AA 520
61	TRANSFER TOWER TT-1	DELUGE VALVE	90 SGC 02 AA 521
62	TRANSFER TOWER TT-1	PRESSURE SWITCH-SPRAY LINE	90 SGC 02 CP 521
63	TRANSFER TOWER TT-1	SOLENOID VALVE	90 SGC 02 AA 521
64	TRANSFER TOWER TT-2	DELUGE VALVE	90 SGC 02 AA 522
65	TRANSFER TOWER TT-2	PRESSURE SWITCH-SPRAY LINE	90 SGC 02 CP 522
66	TRANSFER TOWER TT-2	SOLENOID VALVE	90 SGC 02 AA 522
67	TRANSFER TOWER TT-3	DELUGE VALVE	90 SGC 02 AA 523
68	TRANSFER TOWER TT-3	PRESSURE SWITCH-SPRAY LINE	90 SGC 02 CP 523
69	TRANSFER TOWER TT-3	SOLENOID VALVE	90 SGC 02 AA 523
70	TRANSFER TOWER TT-4	DELUGE VALVE	90 SGC 02 AA 524
71	TRANSFER TOWER TT-4	PRESSURE SWITCH-SPRAY LINE	90 SGC 02 CP 524
72	TRANSFER TOWER TT-4	SOLENOID VALVE	90 SGC 02 AA 524
73	TRANSFER TOWER TT-5	DELUGE VALVE	90 SGC 02 AA 525
74	TRANSFER TOWER TT-5	PRESSURE SWITCH-SPRAY LINE	90 SGC 02 CP 525
75	TRANSFER TOWER TT-5	SOLENOID VALVE	90 SGC 02 AA 525
76	TRANSFER TOWER TT-6	DELUGE VALVE	90 SGC 02 AA 526
77	TRANSFER TOWER TT-6	PRESSURE SWITCH-SPRAY LINE	90 SGC 02 CP 526
78	TRANSFER TOWER TT-6	SOLENOID VALVE	90 SGC 02 AA 526
79	TRANSFER TOWER TT-7	DELUGE VALVE	90 SGC 02 AA 527
80	TRANSFER TOWER TT-7	PRESSURE SWITCH-SPRAY LINE	90 SGC 02 CP 527
81	TRANSFER TOWER TT-7	SOLENOID VALVE	90 SGC 02 AA 527
82	TRANSFER TOWER TT-8	DELUGE VALVE	90 SGC 02 AA 528
83	TRANSFER TOWER TT-8	PRESSURE SWITCH-SPRAY LINE	90 SGC 02 CP 528
84	TRANSFER TOWER TT-8	SOLENOID VALVE	90 SGC 02 AA 528
85	TRANSFER TOWER TT-9	DELUGE VALVE	90 SGC 02 AA 529
86	TRANSFER TOWER TT-9	PRESSURE SWITCH-SPRAY LINE	90 SGC 02 CP 529
87	TRANSFER TOWER TT-9	SOLENOID VALVE	90 SGC 02 AA 529
88	TRANSFER TOWER RT-10	DELUGE VALVE	90 SGC 02 AA 530
89	TRANSFER TOWER RT-10	PRESSURE SWITCH-SPRAY LINE	90 SGC 02 CP 530
90	TRANSFER TOWER RT-10	SOLENOID VALVE	90 SGC 02 AA 330
91	TRANSFER TOWER TT-11	DELUGE VALVE	90 SGC 02 AA 531
92	TRANSFER TOWER TT-11	PRESSURE SWITCH-SPRAY LINE	90 SGC 02 CP 531
93	TRANSFER TOWER TT-11	SOLENOID VALVE	90 SGC 02 AA 331
94	TRANSFER TOWER RT-12	DELUGE VALVE	90 SGC 02 AA 532
95	TRANSFER TOWER RT-12	PRESSURE SWITCH-SPRAY LINE	90 SGC 02 CP 532
96	TRANSFER TOWER RT-12	SOLENOID VALVE	90 SGC 02 AA 332
97	TRANSFER HOUSE TH-1	DELUGE VALVE	90 SGC 02 AA 533
98	TRANSFER HOUSE TH-1	PRESSURE SWITCH-SPRAY LINE	90 SGC 02 CP 533
99	TRANSFER HOUSE TH-1	SOLENOID VALVE	90 SGC 02 AA 333
100	JTB-3	DELUGE VALVE	90 SGC 02 AA 534
101	JTB-3	PRESSURE SWITCH-SPRAY LINE	90 SGC 02 CP 534
102	JTB-3	SOLENOID VALVE	90 SGC 02 AA 334
103	JTB-4	DELUGE VALVE	90 SGC 02 AA 535
104	JTB-4	PRESSURE SWITCH-SPRAY LINE	90 SGC 02 CP 535
105	JTB-4	SOLENOID VALVE	90 SGC 02 AA 335
106	CRUSHER HOUSE	DELUGE VALVE	90 SGC 02 AA 536
107	CRUSHER HOUSE	PRESSURE SWITCH-SPRAY LINE	90 SGC 02 CP 536
108	CRUSHER HOUSE	SOLENOID VALVE	90 SGC 02 AA 336

NOTE: SUFFIX A,B,C... SHALL BE USED FOR ADDITIONAL DVs IN CASE OF ZONING IN ANY AREAS.

2

TABLE-2
EQUIPMENTS TO BE PROTECTED

SN	DESCRIPTION
1	FUEL OIL UNLOADING PH & PRESSURING PH
2	TRANSFER TOWERS (TT1 TO TT12)
3	TRANSFER HOUSE TH-1, SAMPLING TOWER
4	JUNCTION TOWER (JTB 3& JTB4)
5	CRUSHER HOUSE
6	RECTIFIER TRANSFORMER AT ESP ROOF TOP.

LEGEND

SPRAY LINE		PRESSURE SWITCH	
FIRE SIGNAL CONTROL CABLE		PRESSURE GAUGE	
WET DETECTION PIPE		COMMON DRAIN	CD
SOLENOID VALVE		OPEN DRAIN	OD
GATE VALVE		SIX WAY MANIFOLD	M
BUTTERFLY VALVE		SOLENOID VALVE	SV
NON RETURN VALVE		INFRA RED DETECTOR	IRD
"Y" TYPE STRAINER		MULTISENSOR DETECTOR	MSD
QUARTZOID BULB DETECTORS		SWING CHECK VALVE	SCV
WATER MOTOR GON (G)		EMERGENCY RELEASE BOX	ER
DRAIN		NORMALLY OPEN	NO
SPRAY NOZZLE		NORMALLY CLOSED	NC
		DRIP VALVE	DR V
		DELUGE VALVE	DV

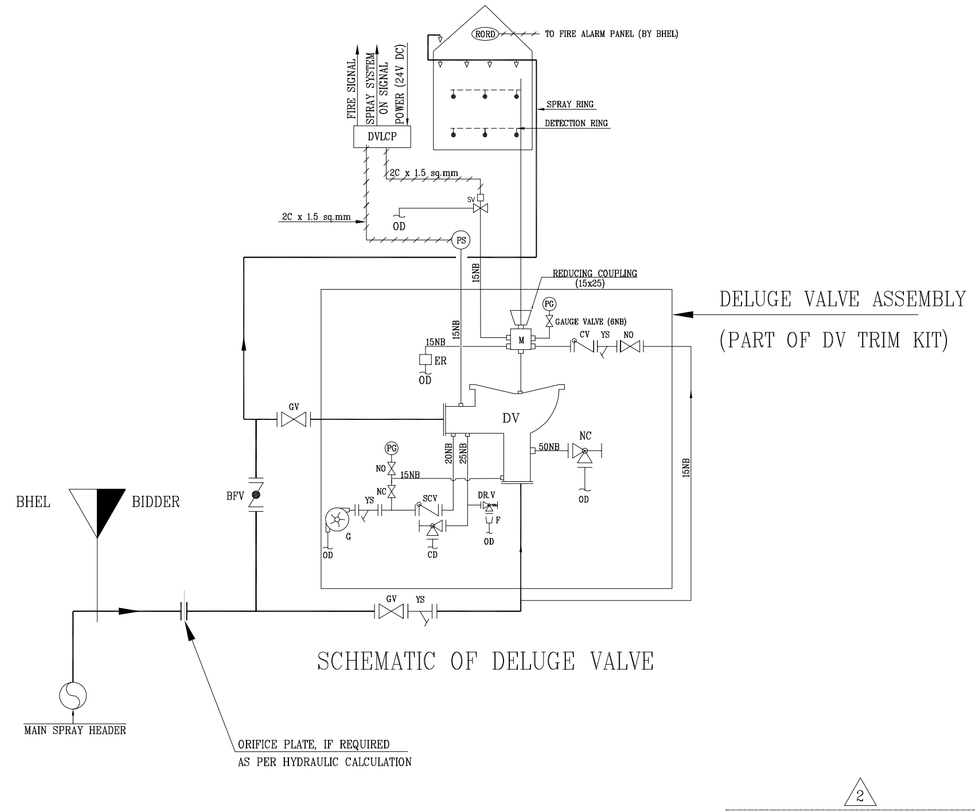
4

OPERATION PHILOSOPHY OF MVWS

1. THE DETECTION IN MVWS SYSTEM SHALL BE THROUGH LHS CABLE, HEAT DETECTORS or QBDs AS INDICATED IN THE SCHEMATIC OF RESPECTIVE AREA. THE WATER SUPPLY TO THE SPRAY SYSTEM WILL BE CONTROLLED BY WET PILOT TYPE DELUGE VALVE WHICH WILL BE OPERATED HYDRAULICALLY AND IS NORMALLY CLOSED BY WATER PRESSURE. DELUGE VALVES SHALL BE TAPPED FROM NEAREST SPRAY HEADER.
2. IN THE EVENT OF FIRE, THE SURROUNDING TEMPERATURE INCREASES. AS THE SURROUNDING TEMPERATURE REACHES THE SET POINT TEMPERATURE, THE DETECTION MEDIA GIVES A SIGNAL TO MAIN FIRE ALARM PANEL. WITH THE RECEIPT OF FIRE SIGNAL, THE MAIN FIRE ALARM PANEL ACTUATE THE SOLENOID VALVE TO DRAIN THE WATER FROM TOP CHAMBER OF DELUGE VALVE. (3)
3. THE PRESSURE DROP IN TOP CHAMBER WILL OPEN THE DELUGE VALVE AND WATER STARTS PROJECTING OUT FROM THE SPRAY NOZZLES. THIS WILL FURTHER CAUSE A DROP IN PRESSURE IN THE SPRAY HEADER FROM WHICH WATER SUPPLY IS TAKEN FOR MVWS SYSTEM. THIS PRESSURE DROP IN THE RING MAIN WILL START THE PUMPS AS EXPLAINED IN DESIGN MEMORANDUM.
4. IT IS ALSO POSSIBLE TO ACTUATE DELUGE VALVE BY OPERATING THE PUSH BUTTON PROVIDED ON LPBS OF DELUGE VALVE OR BY OPERATING A MANUAL LEVER PROVIDED ON DELUGE VALVE TRIM ASSEMBLY.
5. PROVISION IS ALSO PROVIDED IN LPBS OF DELUGE VALVE FOR THE REMOTE OPERATION OF THE SYSTEM THROUGH PLANT CONTROL SYSTEM.
6. AUDIBLE ANNUNCIATION OF FIRE WILL ALSO BE ACHIEVED THROUGH ALARM GONG PROVIDED ON DELUGE VALVE ASSEMBLY.
7. OPERATION OF DELUGE VALVES IN MVWS SYSTEM SHALL BE ANNUNCIATED IN THE LOCAL ZONAL FIRE ALARM PANEL AS WELL AS IN THE CENTRAL FIRE DETECTION AND ALARM PANEL WITH REPEAT ALARM AT FIRE STATION BUILDINGS. (2)

NOTES:

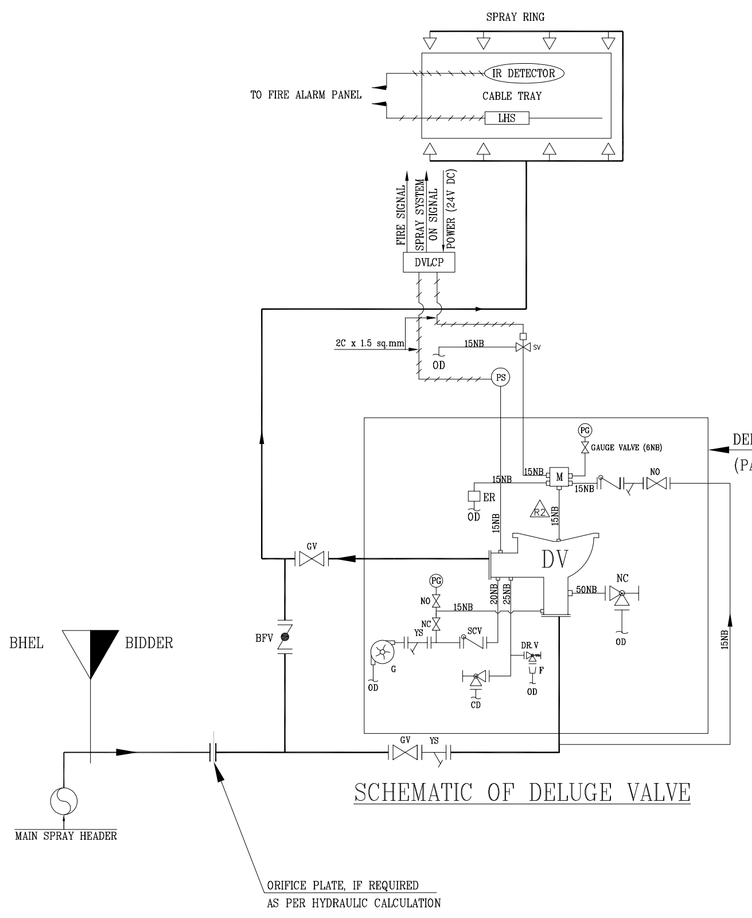
1. ALL PIPE AT THE DOWNSTREAM OF DELUGE VALVE SHALL BE GALVANISED ONLY. OTHER PIPES SHALL BE MS ERW.
2. GATE VALVES SHALL BE PROVIDED FOR EACH DELUGE VALVE ON UPSTREAM AND DOWNSTREAM AND A BYPASS LINE FOR DELUGE VALVE SHALL BE PROVIDED WITH FAST ACTING BUTTERFLY VALVE. Y- STRAINER SHALL BE PROVIDED AT UPSTREAM OF EACH DELUGE VALVE AFTER GATE VALVE.
3. SYSTEM SHALL ALSO HAVE A MANUAL OVER RIDING FACILITY ALONG WITH REGULAR TESTING FACILITY
4. FOR TESTING OF DELUGE VALVE,ONE FRANGIBLE BULB DETECTOR WITH GI PIPE & ISOLATING VALVE CONNECTED TO DETECTOR NETWORK SHALL BE PROVIDED FOR EACH HT TRANSFORMERS.
5. PRESSURE SWITCH (SPRAY SYSTEM LINE) SHALL SENSE A RISING PRESSURE AT 4 KG/SQ.CM2 DURING SPRAY SYSTEM IS ON. THIS IS APPLICABLE FOR ALL HVWS & MVWS SYSTEM. PRESSURE SWITCH (QB DETECTION SYSTEM) SHALL SENSE A FALLING PRESSURE AT 2 KG/SQ.CM. THIS IS APPLICABLE WHENEVER QB DETECTORS ARE EMPLOYED IN HVWS/MVWS SYSTEM.
6. GATE VALVE AT SUCTION AND DISCHARGE OF DV SHALL BE RISING SPINDLE TYPE. FAST ACTING BUTTERFLY VALVE SHALL BE PROVIDED INBYPASS LINE OF DV. (2)
7. DELUGE VALVES, WHICH WILL BE USED IN THE MVW SPRAY SYSTEM SHALL BE OF SOLENOID OPERATED TYPE, WILL REMAIN NORMALLY CLOSED BUT IN THE EVENT OF FIRE, THE SOLENOID WILL BE ENERGISED TO OPEN THE VALVE. (3)
8. THE SOLENOID OPERATED DELUGE VALVE SHALL ALSO HAVE MANUAL OVERRIDING AND REGULAR TESTING FACILITY. PLEASE REFER "Datasheet of Deluge Valve # PY-VD-4-M066-8315-03". (3)



2

TABLE-3
EQUIPMENTS TO BE PROTECTED

SN	DESCRIPTION
1	FUEL OIL STORAGE TANK (HFO/HSD)



2

TABLE-4
EQUIPMENTS TO BE PROTECTED

SN	DESCRIPTION
1	ALL COAL CONVEYOR (TYPICAL)
2	PIPE CONVEYOR (QBD, LHS & IR)- ONLY TROUGH PORTION NEAR TH-1 & CRH-1.
3	COAL CONVEYOR BC-1A/1B.
4	COAL CONVEYOR BC-2A/2B.
5	COAL CONVEYOR BC-3A/3B.
6	COAL CONVEYOR BC-4A/4B.
7	COAL CONVEYOR BC-5A/5B.
8	TRIPPER BELT CONVEYOR TBC 1A/1B, 1C/1D.
9	TRIPPER BELT CONVEYOR TBC 2A/2B, 2C/2D.
10	YARD BELT CONVEYOR 1A/1B.
11	BELT CONVEYOR (OSBL)- BCZ-1A/1B.
12	SACRIFICIAL BELT CONVEYOR (OSBL)- SFC-1A/1B.

S. NO.	Equipment Protected	Type of Instrument	KKS
109	PIPE CONVEYOR (NEAR CRH-1)	DELUGE VALVE	90 SGC 02 AA 537
110	PIPE CONVEYOR (NEAR CRH-1)	PRESSURE SWITCH-SPRAY LINE	90 SGC 02 CP 537
111	PIPE CONVEYOR (NEAR CRH-1)	SOLENOID VALVE	90 SGC 02 AA 337
112	PIPE CONVEYOR (NEAR TH-1)	DELUGE VALVE	90 SGC 02 AA 538
113	PIPE CONVEYOR (NEAR TH-1)	PRESSURE SWITCH-SPRAY LINE	90 SGC 02 CP 538
114	PIPE CONVEYOR (NEAR TH-1)	SOLENOID VALVE	90 SGC 02 AA 338
115	BC-1A/1B	DELUGE VALVE	90 SGC 02 AA 539
116	BC-1A/1B	PRESSURE SWITCH-SPRAY LINE	90 SGC 02 CP 539
117	BC-1A/1B	SOLENOID VALVE	90 SGC 02 AA 339
118	BC-2A/2B	DELUGE VALVE	90 SGC 02 AA 540
119	BC-2A/2B	PRESSURE SWITCH-SPRAY LINE	90 SGC 02 CP 540
120	BC-2A/2B	SOLENOID VALVE	90 SGC 02 AA 340
121	BC-3A/3B	DELUGE VALVE	90 SGC 02 AA 541
122	BC-3A/3B	PRESSURE SWITCH-SPRAY LINE	90 SGC 02 CP 541
123	BC-3A/3B	SOLENOID VALVE	90 SGC 02 AA 341
124	BC-4A/4B	DELUGE VALVE	90 SGC 02 AA 542
125	BC-4A/4B	PRESSURE SWITCH-SPRAY LINE	90 SGC 02 CP 542
126	BC-4A/4B	SOLENOID VALVE	90 SGC 02 AA 342
127	BC-5A/5B	DELUGE VALVE	90 SGC 02 AA 543
128	BC-5A/5B	PRESSURE SWITCH-SPRAY LINE	90 SGC 02 CP 543
129	BC-5A/5B	SOLENOID VALVE	90 SGC 02 AA 343
130	TBC-1A/1B	DELUGE VALVE	90 SGC 02 AA 544
131	TBC-1A/1B	PRESSURE SWITCH-SPRAY LINE	90 SGC 02 CP 544
132	TBC-1A/1B	SOLENOID VALVE	90 SGC 02 AA 344
133	TBC-1C/1D	DELUGE VALVE	90 SGC 02 AA 545
134	TBC-1C/1D	PRESSURE SWITCH-SPRAY LINE	90 SGC 02 CP 545
135	TBC-1C/1D	SOLENOID VALVE	90 SGC 02 AA 345
136	TBC-2A/2B	DELUGE VALVE	90 SGC 02 AA 546
137	TBC-2A/2B	PRESSURE SWITCH-SPRAY LINE	90 SGC 02 CP 546
138	TBC-2A/2B	SOLENOID VALVE	90 SGC 02 AA 346
139	TBC-2C/2D	DELUGE VALVE	90 SGC 02 AA 547
140	TBC-2C/2D	PRESSURE SWITCH-SPRAY LINE	90 SGC 02 CP 547
141	TBC-2C/2D	SOLENOID VALVE	90 SGC 02 AA 347
142	TBC-3A/3B	DELUGE VALVE	90 SGC 02 AA 548
143	TBC-3A/3B	PRESSURE SWITCH-SPRAY LINE	90 SGC 02 CP 548
144	TBC-3A/3B	SOLENOID VALVE	90 SGC 02 AA 348
145	BCZ-1A/1B	DELUGE VALVE	90 SGC 02 AA 549
146	BCZ-1A/1B	PRESSURE SWITCH-SPRAY LINE	90 SGC 02 CP 549
147	BCZ-1A/1B	SOLENOID VALVE	90 SGC 02 AA 349
148	SFC-1A/1B	DELUGE VALVE	90 SGC 02 AA 550
149	SFC-1A/1B	PRESSURE SWITCH-SPRAY LINE	90 SGC 02 CP 550
150	SFC-1A/1B	SOLENOID VALVE	90 SGC 02 AA 350

NOTE: SUFFIX A,B,C... SHALL BE USED FOR ADDITIONAL DVs IN CASE OF ZONING IN ANY AREAS.

REFERNCE DRAWING

1	P&ID OF FIRE WATER PH	PY-FP-1-M066-8315-01
2	DESIGN MEMORANDUM OF FPS	PY-S0-4-M066-8315-01
3	COMPOAITE LAYOUT OF HYDRANT & SPRAY	PY-LP-0-M066-8315-01

TAMILNADU GENERATION AND DISTRIBUTION CORPORATION

2X660MW ENNORE SEZ SUPERCRITICAL THERMAL POWER PROJECT AT ASH DYKE OF NCTPS, CHENNAI

DESEIN CONSULTING ENGINEERS
NEW DELHI – INDIA

BHARAT HEAVY ELECTRICALS LTD.
PROJECT ENGINEERING AND SYSTEMS DIVISION
R.C. PURAM, HYDERABAD-32

	NAME	SIGN	DATE
DRN.	AMIT		31.03.18
CHD.	KD		31.03.18
APPD.	MNSR		31.03.18

TITLE : SCHEMATIC (P&ID) OF MEDIUM VELOCITY WATER SPRAY (MVWS) (FIRE PROTECTION SYSTEM)

UNIT :

SCALE :

BHEL DWG. NO. : PY-FP-1-M066-8315-03

SHEET NO. 01 OF 01

REV. 04

REV.	DATE	ALTERED	CHD/APPD
04	28.12.18	1. REVISED AS PER CUST COMMENT.	CHD/APPD
03	08.12.18	1. REVISED AS PER CUST COMMENT.	CHD/APPD
02	30.10.18	1. REVISED AS PER CUST COMMENT.	ALTERED AMT, CHD/APPD KD
01	16.07.18	1. REVISED AS PER CUST COMMENT.	CHD/APPD

FIRST ANGLE PROJECTION

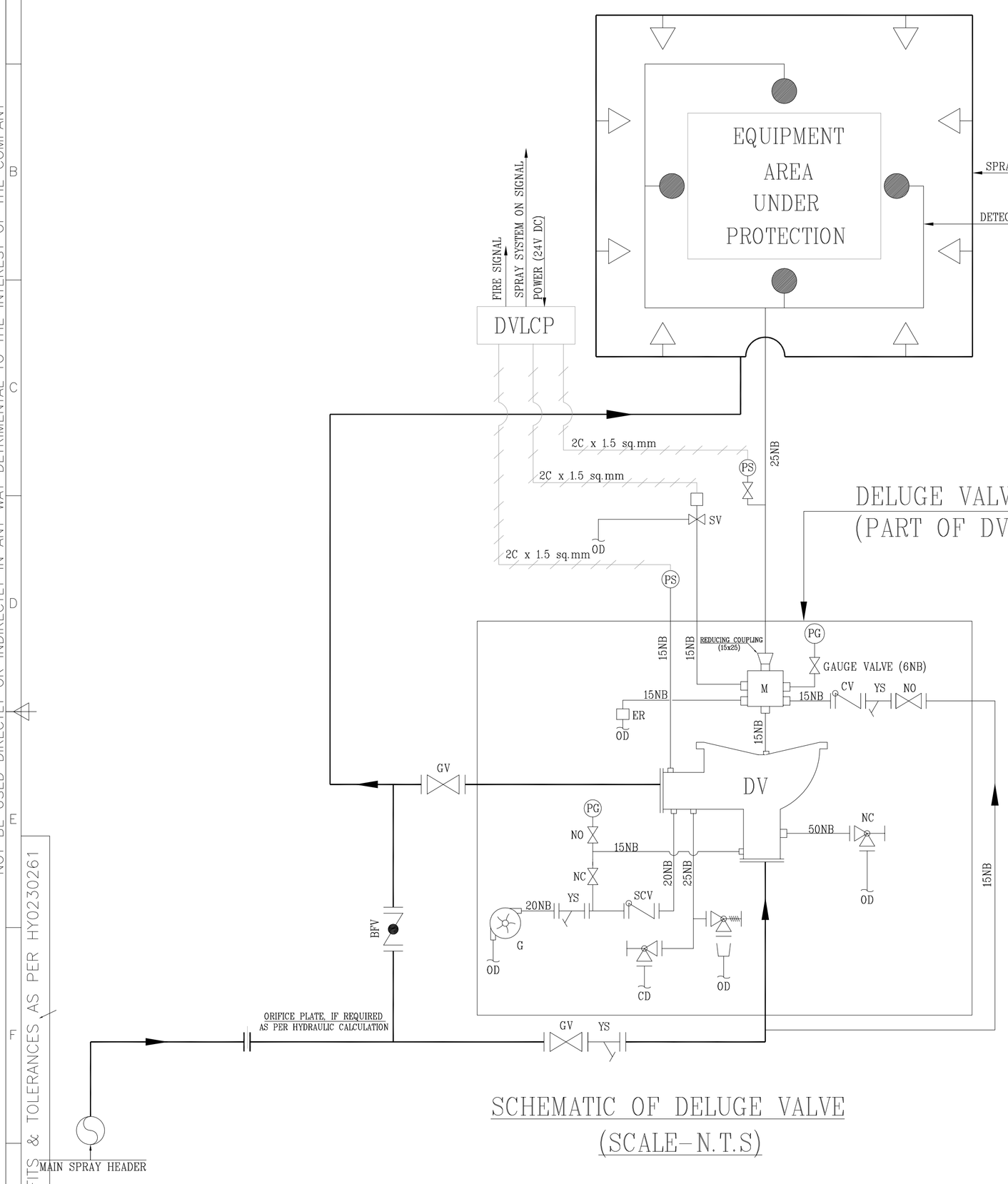
(ALL DIMENSIONS ARE IN mm)

DRG. NO.

SHT. 1 OF 1

THE INFORMATION ON THIS DOCUMENT IS THE PROPERTY OF BHARAT HEAVY ELECTRICALS LIMITED. IT MUST NOT BE USED DIRECTLY OR INDIRECTLY IN ANY WAY DETRIMENTAL TO THE INTEREST OF THE COMPANY

GENERAL DIMENSIONAL LIMITS,FITS & TOLERANCES AS PER HY0230261



SCHEMATIC OF DELUGE VALVE
(SCALE–N.T.S)

3

LIST OF EXS TAG NO- HVWS

S.NO.	Equipment Protected	Type of Instrument	EXS
1	GEN.STATOR TRANSFORMER 1 A	DELUGE V ALVE	1350CS0A A501
2	GEN.STATOR TRANSFORMER 1 A	PRESSURE SWITCH-SPRAY LINE	1010CS0CP501
3	GEN.STATOR TRANSFORMER 1 A	PRESSURE SWITCH-DETECTION LINE	1010CS0CP502
4	GEN.STATOR TRANSFORMER 1 A	SOLENOID V ALVE	1350CS0A A501
5	GEN.STATOR TRANSFORMER 1 B	DELUGE V ALVE	1350CS0A A502
6	GEN.STATOR TRANSFORMER 1 B	PRESSURE SWITCH-SPRAY LINE	1010CS0CP503
7	GEN.STATOR TRANSFORMER 1 B	PRESSURE SWITCH-DETECTION LINE	1010CS0CP504
8	GEN.STATOR TRANSFORMER 1 B	SOLENOID V ALVE	1350CS0A A502
9	GEN.STATOR TRANSFORMER 1 C	DELUGE V ALVE	1350CS0A A503
10	GEN.STATOR TRANSFORMER 1 C	PRESSURE SWITCH-SPRAY LINE	1010CS0CP505
11	GEN.STATOR TRANSFORMER 1 C	PRESSURE SWITCH-DETECTION LINE	1010CS0CP506
12	GEN.STATOR TRANSFORMER 1 C	SOLENOID V ALVE	1350CS0A A503
13	GEN.STATOR TRANSFORMER 2 A	DELUGE V ALVE	1350CS0A A504
14	GEN.STATOR TRANSFORMER 2 A	PRESSURE SWITCH-SPRAY LINE	2010CS0CP507
15	GEN.STATOR TRANSFORMER 2 A	PRESSURE SWITCH-DETECTION LINE	2010CS0CP508
16	GEN.STATOR TRANSFORMER 2 A	SOLENOID V ALVE	2350CS0A A504
17	GEN.STATOR TRANSFORMER 2 B	DELUGE V ALVE	1350CS0A A505
18	GEN.STATOR TRANSFORMER 2 B	PRESSURE SWITCH-SPRAY LINE	2010CS0CP509
19	GEN.STATOR TRANSFORMER 2 B	PRESSURE SWITCH-DETECTION LINE	2010CS0CP510
20	GEN.STATOR TRANSFORMER 2 B	SOLENOID V ALVE	1350CS0A A505
21	GEN.STATOR TRANSFORMER 2 C	DELUGE V ALVE	2350CS0A A506
22	GEN.STATOR TRANSFORMER 2 C	PRESSURE SWITCH-SPRAY LINE	2010CS0CP511
23	GEN.STATOR TRANSFORMER 2 C	PRESSURE SWITCH-DETECTION LINE	2010CS0CP512
24	GEN.STATOR TRANSFORMER 2 C	SOLENOID V ALVE	2350CS0A A506
25	STATCN TRANSFORMER 1	DELUGE V ALVE	1350CS0A A507
26	STATCN TRANSFORMER 1	PRESSURE SWITCH-SPRAY LINE	1010CS0CP513
27	STATCN TRANSFORMER 1	PRESSURE SWITCH-DETECTION LINE	1010CS0CP514
28	STATCN TRANSFORMER 1	SOLENOID V ALVE	1350CS0A A507
29	STATCN TRANSFORMER 2	DELUGE V ALVE	2350CS0A A508
30	STATCN TRANSFORMER 2	PRESSURE SWITCH-SPRAY LINE	2010CS0CP515
31	STATCN TRANSFORMER 2	PRESSURE SWITCH-DETECTION LINE	2010CS0CP516
32	STATCN TRANSFORMER 2	SOLENOID V ALVE	2350CS0A A508
33	AHT TRANSFORMER 1 A	DELUGE V ALVE	1350CS0A A509
34	AHT TRANSFORMER 1 A	PRESSURE SWITCH-SPRAY LINE	1010CS0CP517
35	AHT TRANSFORMER 1 A	PRESSURE SWITCH-DETECTION LINE	1010CS0CP518
36	AHT TRANSFORMER 1 A	SOLENOID V ALVE	1350CS0A A509
37	AHT TRANSFORMER 1 B	DELUGE V ALVE	1350CS0A A510
38	AHT TRANSFORMER 1 B	PRESSURE SWITCH-SPRAY LINE	1010CS0CP519
39	AHT TRANSFORMER 1 B	PRESSURE SWITCH-DETECTION LINE	1010CS0CP520
40	AHT TRANSFORMER 1 B	SOLENOID V ALVE	1350CS0A A510
41	AHT TRANSFORMER 2 A	DELUGE V ALVE	2350CS0A A511
42	AHT TRANSFORMER 2 A	PRESSURE SWITCH-SPRAY LINE	2010CS0CP521
43	AHT TRANSFORMER 2 A	PRESSURE SWITCH-DETECTION LINE	2010CS0CP522
44	AHT TRANSFORMER 2 A	SOLENOID V ALVE	2350CS0A A511
45	AHT TRANSFORMER 2 B	DELUGE V ALVE	2350CS0A A512
46	AHT TRANSFORMER 2 B	PRESSURE SWITCH-SPRAY LINE	2010CS0CP523
47	AHT TRANSFORMER 2 B	PRESSURE SWITCH-DETECTION LINE	2010CS0CP524
48	AHT TRANSFORMER 2 B	SOLENOID V ALVE	2350CS0A A512
49	AHT AUX TRANSFORMER 1 A	DELUGE V ALVE	1350CS0A A513
50	AHT AUX TRANSFORMER 1 A	PRESSURE SWITCH-SPRAY LINE	1010CS0CP525
51	AHT AUX TRANSFORMER 1 A	PRESSURE SWITCH-DETECTION LINE	1010CS0CP526
52	AHT AUX TRANSFORMER 1 A	SOLENOID V ALVE	1350CS0A A513
53	AHT AUX TRANSFORMER 1 B	DELUGE V ALVE	1350CS0A A514
54	AHT AUX TRANSFORMER 1 B	PRESSURE SWITCH-SPRAY LINE	1010CS0CP527
55	AHT AUX TRANSFORMER 1 B	PRESSURE SWITCH-DETECTION LINE	1010CS0CP528
56	AHT AUX TRANSFORMER 1 B	SOLENOID V ALVE	1350CS0A A514
57	AHT AUX TRANSFORMER 2 A	DELUGE V ALVE	2350CS0A A515
58	AHT AUX TRANSFORMER 2 A	PRESSURE SWITCH-SPRAY LINE	2010CS0CP529
59	AHT AUX TRANSFORMER 2 A	PRESSURE SWITCH-DETECTION LINE	2010CS0CP530
60	AHT AUX TRANSFORMER 2 A	SOLENOID V ALVE	2350CS0A A515
61	AHT AUX TRANSFORMER 2 B	DELUGE V ALVE	2350CS0A A516
62	AHT AUX TRANSFORMER 2 B	PRESSURE SWITCH-SPRAY LINE	2010CS0CP531
63	AHT AUX TRANSFORMER 2 B	PRESSURE SWITCH-DETECTION LINE	2010CS0CP532
64	AHT AUX TRANSFORMER 2 B	SOLENOID V ALVE	2350CS0A A516
65	STATT/PT TRANSFORMER	DELUGE V ALVE	9350CS0A A517
66	STATT/PT TRANSFORMER	PRESSURE SWITCH-SPRAY LINE	9010CS0CP833
67	STATT/PT TRANSFORMER	PRESSURE SWITCH-DETECTION LINE	9010CS0CP834
68	STATT/PT TRANSFORMER	SOLENOID V ALVE	9350CS0A A517
69	CHP AUX TRANSFORMER 1 (BMA ALOCA TD1)	DELUGE V ALVE	9350CS0A A518
70	CHP AUX TRANSFORMER 1 (BMA ALOCA TD1)	PRESSURE SWITCH-SPRAY LINE	9010CS0CP835
71	CHP AUX TRANSFORMER 1 (BMA ALOCA TD1)	PRESSURE SWITCH-DETECTION LINE	9010CS0CP836
72	CHP AUX TRANSFORMER 1 (BMA ALOCA TD1)	SOLENOID V ALVE	9350CS0A A518
73	CHP AUX TRANSFORMER 1 (BMA ALOCA TD2)	DELUGE V ALVE	9350CS0A A519
74	CHP AUX TRANSFORMER 1 (BMA ALOCA TD2)	PRESSURE SWITCH-SPRAY LINE	9010CS0CP837
75	CHP AUX TRANSFORMER 1 (BMA ALOCA TD2)	PRESSURE SWITCH-DETECTION LINE	9010CS0CP838
76	CHP AUX TRANSFORMER 1 (BMA ALOCA TD2)	SOLENOID V ALVE	9350CS0A A519
77	ISH & ECHS (STTP LP) 0.4kTDL	DELUGE V ALVE	9350CS0A A520
78	ISH & ECHS (STTP LP) 0.4kTDL	PRESSURE SWITCH-SPRAY LINE	9010CS0CP839
79	ISH & ECHS (STTP LP) 0.4kTDL	PRESSURE SWITCH-DETECTION LINE	9010CS0CP840
80	ISH & ECHS (STTP LP) 0.4kTDL	SOLENOID V ALVE	9350CS0A A520
81	ISH & ECHS (STTP LP) 0.4kTDE	DELUGE V ALVE	9350CS0A A521
82	ISH & ECHS (STTP LP) 0.4kTDE	PRESSURE SWITCH-SPRAY LINE	9010CS0CP841
83	ISH & ECHS (STTP LP) 0.4kTDE	PRESSURE SWITCH-DETECTION LINE	9010CS0CP842
84	ISH & ECHS (STTP LP) 0.4kTDE	SOLENOID V ALVE	9350CS0A A521
85	ISH & ECHS (STTP DG WAL DB)27DL	DELUGE V ALVE	9350CS0A A522
86	ISH & ECHS (STTP DG WAL DB)27DL	PRESSURE SWITCH-SPRAY LINE	9010CS0CP843
87	ISH & ECHS (STTP DG WAL DB)27DL	PRESSURE SWITCH-DETECTION LINE	9010CS0CP844
88	ISH & ECHS (STTP DG WAL DB)27DL	SOLENOID V ALVE	9350CS0A A522
89	SSW & ECHS (STTP DOWN) DB)27DD	DELUGE V ALVE	9350CS0A A523
90	SSW & ECHS (STTP DOWN) DB)27DD	PRESSURE SWITCH-SPRAY LINE	9350CS0CP845
91	SSW & ECHS (STTP DOWN) DB)27DD	PRESSURE SWITCH-DETECTION LINE	9350CS0CP846
92	SSW & ECHS (STTP DOWN) DB)27DD	SOLENOID V ALVE	9350CS0A A523
93	SAT	DELUGE V ALVE	9350CS0A A524
94	SAT	PRESSURE SWITCH-SPRAY LINE	9350CS0CP847
95	SAT	PRESSURE SWITCH-DETECTION LINE	9350CS0CP848
96	SAT	SOLENOID V ALVE	9350CS0A A524
97	AHP AUX TRANSFORMER OCCTTD1	DELUGE V ALVE	9350CS0A A525
98	AHP AUX TRANSFORMER OCCTTD1	PRESSURE SWITCH-SPRAY LINE	9350CS0CP849
99	AHP AUX TRANSFORMER OCCTTD1	PRESSURE SWITCH-DETECTION LINE	9350CS0CP850
100	AHP AUX TRANSFORMER OCCTTD1	SOLENOID V ALVE	9350CS0A A525
101	AHP AUX TRANSFORMER OCCTTD2	DELUGE V ALVE	9350CS0A A526
102	AHP AUX TRANSFORMER OCCTTD2	PRESSURE SWITCH-SPRAY LINE	9350CS0CP851
103	AHP AUX TRANSFORMER OCCTTD2	PRESSURE SWITCH-DETECTION LINE	9350CS0CP852
104	AHP AUX TRANSFORMER OCCTTD2	SOLENOID V ALVE	9350CS0A A526
105	FDHP AUX OCCTTD1	DELUGE V ALVE	9350CS0A A527
106	FDHP AUX OCCTTD1	PRESSURE SWITCH-SPRAY LINE	9350CS0CP853
107	FDHP AUX OCCTTD1	PRESSURE SWITCH-DETECTION LINE	9350CS0CP854
108	FDHP AUX OCCTTD1	SOLENOID V ALVE	9350CS0A A527
109	FDHP AUX OCCTTD2	DELUGE V ALVE	9350CS0A A528
110	FDHP AUX OCCTTD2	PRESSURE SWITCH-SPRAY LINE	9350CS0CP855
111	FDHP AUX OCCTTD2	PRESSURE SWITCH-DETECTION LINE	9350CS0CP856
112	FDHP AUX OCCTTD2	SOLENOID V ALVE	9350CS0A A528
113	RO DM TRANSFORMER OCCTTD1	DELUGE V ALVE	9350CS0A A529
114	RO DM TRANSFORMER OCCTTD1	PRESSURE SWITCH-SPRAY LINE	9350CS0CP857
115	RO DM TRANSFORMER OCCTTD1	PRESSURE SWITCH-DETECTION LINE	9350CS0CP858
116	RO DM TRANSFORMER OCCTTD1	SOLENOID V ALVE	9350CS0A A529
117	RO DM TRANSFORMER OCCTTD2	DELUGE V ALVE	9350CS0A A530
118	RO DM TRANSFORMER OCCTTD2	PRESSURE SWITCH-SPRAY LINE	9350CS0CP859
119	RO DM TRANSFORMER OCCTTD2	PRESSURE SWITCH-DETECTION LINE	9350CS0CP860
120	RO DM TRANSFORMER OCCTTD2	SOLENOID V ALVE	
121	BURNER FRONT OF AUX BOILER	DELUGE V ALVE	9350CS0A A531
122	BURNER FRONT OF AUX BOILER	PRESSURE SWITCH-SPRAY LINE	9350CS0CP861
123	BURNER FRONT OF AUX BOILER	PRESSURE SWITCH-DETECTION LINE	9350CS0CP862
124	BURNER FRONT OF AUX BOILER	SOLENOID V ALVE	9350CS0A A531
125	COT DDT& PURIFIER	DELUGE V ALVE	9350CS0A A532
126	COT DDT& PURIFIER	PRESSURE SWITCH-SPRAY LINE	9350CS0CP863
127	COT DDT& PURIFIER	PRESSURE SWITCH-DETECTION LINE	9350CS0CP864
128	COT DDT& PURIFIER	SOLENOID V ALVE	9350CS0A A532
129	MAIN TURBINE LUBE OIL TANK-UNIT 1	DELUGE V ALVE	9350CS0A A533
130	MAIN TURBINE LUBE OIL TANK-UNIT 1	PRESSURE SWITCH-SPRAY LINE	9350CS0CP865
131	MAIN TURBINE LUBE OIL TANK-UNIT 1	PRESSURE SWITCH-DETECTION LINE	9350CS0CP866
132	MAIN TURBINE LUBE OIL TANK-UNIT 1	SOLENOID V ALVE	9350CS0A A533
133	MAIN TURBINE LUBE OIL TANK-UNIT 2	DELUGE V ALVE	9350CS0A A534
134	MAIN TURBINE LUBE OIL TANK-UNIT 2	PRESSURE SWITCH-SPRAY LINE	9350CS0CP867
135	MAIN TURBINE LUBE OIL TANK-UNIT 2	PRESSURE SWITCH-DETECTION LINE	9350CS0CP868
136	MAIN TURBINE LUBE OIL TANK-UNIT 2	SOLENOID V ALVE	9350CS0A A534
137	BOILER BURNER FRONT-UNIT 1	DELUGE V ALVE	9350CS0A A535
138	BOILER BURNER FRONT-UNIT 1	PRESSURE SWITCH-SPRAY LINE	9350CS0CP869
139	BOILER BURNER FRONT-UNIT 1	PRESSURE SWITCH-DETECTION LINE	9350CS0CP870
140	BOILER BURNER FRONT-UNIT 1	SOLENOID V ALVE	9350CS0A A535
141	BOILER BURNER FRONT-UNIT 2	DELUGE V ALVE	3350CS0A A536
142	BOILER BURNER FRONT-UNIT 2	PRESSURE SWITCH-SPRAY LINE	3350CS0CP871
143	BOILER BURNER FRONT-UNIT 2	PRESSURE SWITCH-DETECTION LINE	3350CS0CP872
144	BOILER BURNER FRONT-UNIT 2	SOLENOID V ALVE	3350CS0A A536
145	TURBINE 'JG CANAL PIPE- UNIT 1	DELUGE V ALVE	3350CS0A A537
146	TURBINE 'JG CANAL PIPE- UNIT 1	PRESSURE SWITCH-SPRAY LINE	3350CS0CP873
147	TURBINE 'JG CANAL PIPE- UNIT 1	PRESSURE SWITCH-DETECTION LINE	3350CS0CP874
148	TURBINE 'JG CANAL PIPE- UNIT 1	SOLENOID V ALVE	3350CS0A A537
149	TURBINE 'JG CANAL PIPE- UNIT 2	DELUGE V ALVE	3350CS0A A538
150	TURBINE 'JG CANAL PIPE- UNIT 2	PRESSURE SWITCH-SPRAY LINE	3350CS0CP875
151	TURBINE 'JG CANAL PIPE- UNIT 2	PRESSURE SWITCH-DETECTION LINE	3350CS0CP876
152	TURBINE 'JG CANAL PIPE- UNIT 2	SOLENOID V ALVE	3350CS0A A538
153	GEN SEAL OIL UNIT 1	DELUGE V ALVE	3350CS0A A539
154	GEN SEAL OIL UNIT 1	PRESSURE SWITCH-SPRAY LINE	3350CS0CP877
155	GEN SEAL OIL UNIT 1	PRESSURE SWITCH-DETECTION LINE	3350CS0CP878
156	GEN SEAL OIL UNIT 1	SOLENOID V ALVE	3350CS0A A539
157	GEN SEAL OIL UNIT 2	DELUGE V ALVE	3350CS0A A540
158	GEN SEAL OIL UNIT 2	PRESSURE SWITCH-SPRAY LINE	3350CS0CP879
159	GEN SEAL OIL UNIT 2	PRESSURE SWITCH-DETECTION LINE	3350CS0CP880
160	GEN SEAL OIL UNIT 2	SOLENOID V ALVE	3350CS0A A540
161	BFP LUBE OIL - UNIT 1	DELUGE V ALVE	3350CS0A A541
162	BFP LUBE OIL - UNIT 1	PRESSURE SWITCH-SPRAY LINE	3350CS0CP881
163	BFP LUBE OIL - UNIT 1	PRESSURE SWITCH-DETECTION LINE	3350CS0CP882
164	BFP LUBE OIL - UNIT 1	SOLENOID V ALVE	3350CS0A A541
165	BFP LUBE OIL - UNIT 2	DELUGE V ALVE	3350CS0A A542
166	BFP LUBE OIL - UNIT 2	PRESSURE SWITCH-SPRAY LINE	3350CS0CP883
167	BFP LUBE OIL - UNIT 2	PRESSURE SWITCH-DETECTION LINE	3350CS0CP884
168	BFP LUBE OIL - UNIT 2	SOLENOID V ALVE	3350CS0A A542
169	DIESEL TANK OF MAIN DG	DELUGE V ALVE	9350CS0A A543
170	DIESEL TANK OF MAIN DG	PRESSURE SWITCH-SPRAY LINE	9350CS0CP885
171	DIESEL TANK OF MAIN DG	PRESSURE SWITCH-DETECTION LINE	9350CS0CP886
172	DIESEL TANK OF MAIN DG	SOLENOID V ALVE	9350CS0A A543

TABLE-1
EQUIPMENTS TO BE PROTECTED BY HVWS SYSTEM

SN	DESCRIPTION
1	Generator transformers (6 Nos.)
2	Station Transformers (2Nos.)
3	Unit Transformers (4 nos.)
4	Unit Auxiliary Transformers (4 Nos.)
5	Startup Transformers (1No.)
6	Burner front for Aux Boiler.
7	Central lube oil tanks (both clean & dirty oil tanks) & its purifier units.
8	Main turbines lube oil tanks, oil coolers & purifier unit.
9	Boiler burner fronts including fuel oil racks.
10	Turbine oil canal Pipe line in TG floor
11	Generator seal oil system tanks, cooler assembly.
12	Lube oil system for BFP lube oil tanks, coolers, consoles etc.
13	Diesel tank of main DG set.
14	ICHP Auxiliary Transformers-16MVA (2 Nos) [Near CRH-1]
15	Station Aux Transformer- 8MVA- 2nos. [Near Compressor Bldg.]
16	Sea Water Intake & ECHS Transformer (Step-Up) 20 MVA- 2 NOs. [Near ESP Control Room]
19	AHP Aux Transformer (3.5 MVA)- 2 Nos. [Near AHP HT MCC]
20	RO DM Aux Transformer (6.3 MVA) - 2 Nos. [Near RO DM LTMCC]

LEGEND

5

	SPRAY LINE	PS	PRESSURE SWITCH
	FR (MICA) CONTROL CABLE	PG	PRESSURE GAUGE
	WET DETECTION PIPE	CD	COMMON DRAIN
	SOLENOID VALVE	OD	OPEN DRAIN
	GATE VALVE	M	SIX WAY MANIFOLD
	BUTTERFLY VALVE	SV	SOLENOID VALVE
	NON RETURN VALVE	IRD	INFRA RED DETECTOR
	'Y' TYPE STRAINER	MSD	MULTISENSOR DETECTOR
	QUARTZOID BULB DCTECTORS	SCV	SWING CHECK VALVE
	WATER MOTOR GON (G)	ER	EMERGENCY RELEASE BOX
	DRAIN	NO	NORMALLY OPEN
	SPRAY NOZZLE	NC	NORMALLY CLOSED
		DR.V	DRIP VALVE
		DV	DELUGE VALVE

OPERATION PHILOSOPHY OF HVWS

1	THE WATER SUPPLY TO THE SPRAY SYSTEM WILL BE CONTROLLED BY WET PILOT TYPE DELUGE VALVE WHICH WILL BE OPERATED HYDRAULICALLY AND IS NORMALLY CLOSED BY WATER PRESSURE. DELUGE VALVES SHALL BE TAPPED FROM NEAREST SPRAY HEADER.
2	IN CASE OF HVW SPRAY SYSTEM, THE DETECTION SYSTEM WILL BE A 25NB WATER FILLED MS LINE (PRESSURISED AT 3.5 KG APPROX) CONSISTING OF HEAT SENSING DETECTORS OF FUSIBLE TYPE (QUARTZOID BULBS). IN THE EVENT OF FIRE THE SURROUNDING TEMPERATURE INCREASES MORE THAN THE RATED TEMPERATURE OF QBD (79 DEG. C), THE DETECTOR BULB COLLAPSES AND CONSEQUENTLY THERE WILL BE DROP IN PRESSURE IN THE DETECTION NETWORK. THIS DROP IN PRESSURE WILL OPEN THE DELUGE VALVE AND WATER STARTS PROJECTING OUT FROM THE PROJECTORS.
3	THIS WILL FURTHER CAUSE A DROP IN PRESSURE IN THE SPRAY HEADER FROM WHICH WATER SUPPLY IS TAKEN FOR HVWS SYSTEM. THIS PRESSURE DROP IN THE RING MAIN WILL START THE PUMPS AS EXPLAINED IN P&ID (WRITE-UP) & DESIGN MEMORANDUM.
4	IT IS ALSO POSSIBLE TO ACTUATE DELUGE VALVE BY OPERATING THE PUSH BUTTON PROVIDED ON LPBS OF DELUGE VALVE OR BY OPERATING A MANUAL LEVER PROVIDED ON DELUGE VALVE TRIM ASSEMBLY.
5	PROVISION IS ALSO PROVIDED IN LPBS OF DELUGE VALVE FOR THE REMOTE OPERATION OF THE SYSTEM THROUGH PLANT CONTROL SYSTEM.
6	AUDIBLE ANNUNCIATION OF FIRE WILL ALSO BE ACHIEVED THROUGH ALARM GONG PROVIDED ON DELUGE VALVE ASSEMBLY.
2 7	OPERATION OF DELUGE VALVES IN HVWS SYSTEM SHALL BE ANNUNCIATED IN THE LOCAL ZONAL FIRE ALARM PANEL AS WELL AS IN THE CENTRAL FIRE DETECTION AND ALARM PANEL WITH REPEAT ALARM AT FIRE STATION BUILDINGS.

NOTES:

1. ALL PIPE AT THE DOWNSTREAM OF DELUGE VALVE SHALL BE GALVANISED ONLY. OTHER PIPES SHALL BE MS ERW.
2. GATE VALVES SHALL BE PROVIDED FOR EACH DELUGE VALVE ON UPSTREAM AND DOWNSTREAM AND A BYPASS LINE FOR DELUGE VALVE SHALL BE PROVIDED WITH FAST ACTING BUTTERFLY VALVE. Y- STRAINER SHALL BE PROVIDED AT UPSTREAM OF EACH DELUGE VALVE AFTER GATE VALVE.
3. SYSTEM SHALL ALSO HAVE A MANUAL OVER RIDING FACILITY ALONG WITH REGULAR TESTING FACILITY
4. FOR TESTING OF DELUGE VALVE,ONE FRANGIBLE BULB DETECTOR WITH GI PIPE & ISOLATING VALVE CONNECTED TO DETECTOR NETWORK SHALL BE PROVIDED FOR EACH HT TRANSFORMERS.
5. PRESSURE SWITCH (SPRAY SYSTEM LINE) SHALL SENSE A RISING PRESSURE AT 4 KG/SQ.CM2 DURING SPRAY SYSTEM IS ON. THIS IS APPLICABLE FOR ALL HVWS & MVWS SYSTEM. PRESSURE SWITCH (QB DETECTION SYSTEM) SHALL SENSE A FALLING PRESSURE AT 2 KG/SQ.CM. THIS IS APPLICABLE WHENEVER QB DETECTORS ARE EMPLOYED IN HVWS/MVWS SYSTEM.
6. GATE VALVE AT SUCTION AND DISCHARGE OF DV SHALL BE RISING SPINDLE TYPE. FAST ACTING BUTTERFLY VALVE SHALL BE PROVIDED INBYPASS LINE OF DV. 3

REFERNCE DRAWING

1	P&ID OF FIRE WATER PH	PY-FP-1-M066-8315-01
2	DESIGN MEMORANDUM OF FPS	PY-S0-4-M066-8315-01
3	COMPOAITE LAYOUT OF HYDRANT & SPRAY	PY-LP-0-M066-8315-01

TAMILNADU GENERATION AND DISTRIBUTION CORPORATION

2X660MW ENNORE SEZ SUPERCRITICAL THERMAL POWER PROJECT AT ASH DYKE OF NCTPS, CHENNAI

DESEIN CONSULTING ENGINEERS
NEW DELHI – INDIA

BHARAT HEAVY ELECTRICALS LTD.
PROJECT ENGINEERING AND SYSTEMS DIVISION
R.C. PURAM, HYDERABAD-32

	NAME	SIGN	DATE
DRN.	AMIT		17.02.18
CHD.	KD		17.02.18
APPD.	MNSR		17.02.18

TITLE : SCHEMATIC (P&ID) OF HIGE VELOCITY WATER SPRAY (HVWS) SYSTEM (FIRE PROTECTION SYSTEM)

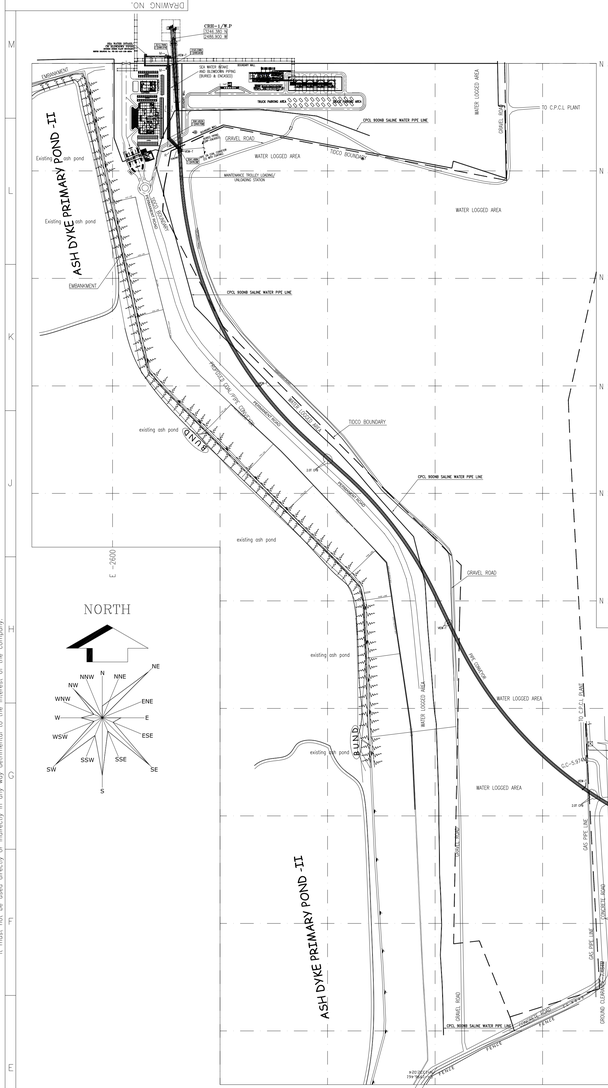
UNIT : | SCALE : | BHEL DWG. NO. : PY-FP-1-M066-8315-02 | SHEET NO. 01 | NO. OF SHEET 01 | REV. 05

REV.	DATE	ALTERED	CHD/APPD	ZONE
05	24.07.19	1. REVISED AS PER CUST COMMENT		
04	10.12.18	1. REVISED AS PER CUST COMMENT		
03	30.10.18	1. REVISED AS PER CUST COMMENT		
02	21.09.18	1. REVISED AS PER CUST COMMENT		
01	16.07.18	1. REVISED AS PER CUST COMMENT		
—				

COPYRIGHT AND CONFIDENTIAL
The information on this document is property of BHARAT HEAVY ELECTRICALS LIMITED
It must not be used directly or indirectly in any way detrimental to the interest of the company.

DRAWING NO. PE-DG-412-100-M049

FIRST ANGLE PROJECTION — ALL DIMENSIONS ARE IN MM



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	Description	Page No.
	Cover Sheet	1
	Important Note	2
	Table of Contents	3
1	Heat Treatment Procedure - Boiler and Auxiliaries	4
2	Heat Treatment Procedure - Piping with Turbine & Auxiliaries	19
	List of Annexures	21
	List of Tables	21
	List of Figures	21

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.

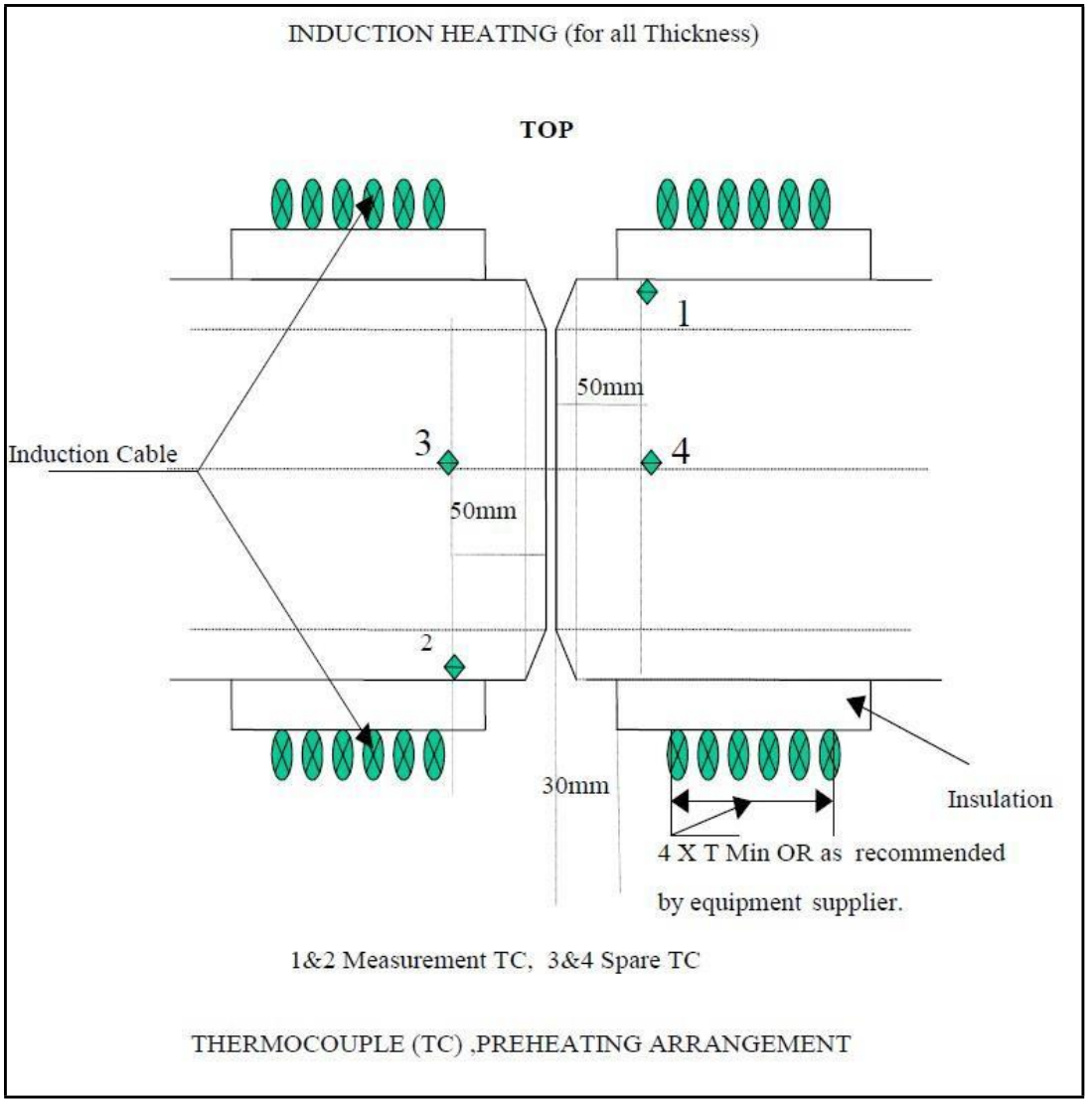


Figure 1.1: Placement of Thermocouples on P91/P92/F91/F92/C12A materials for Preheating

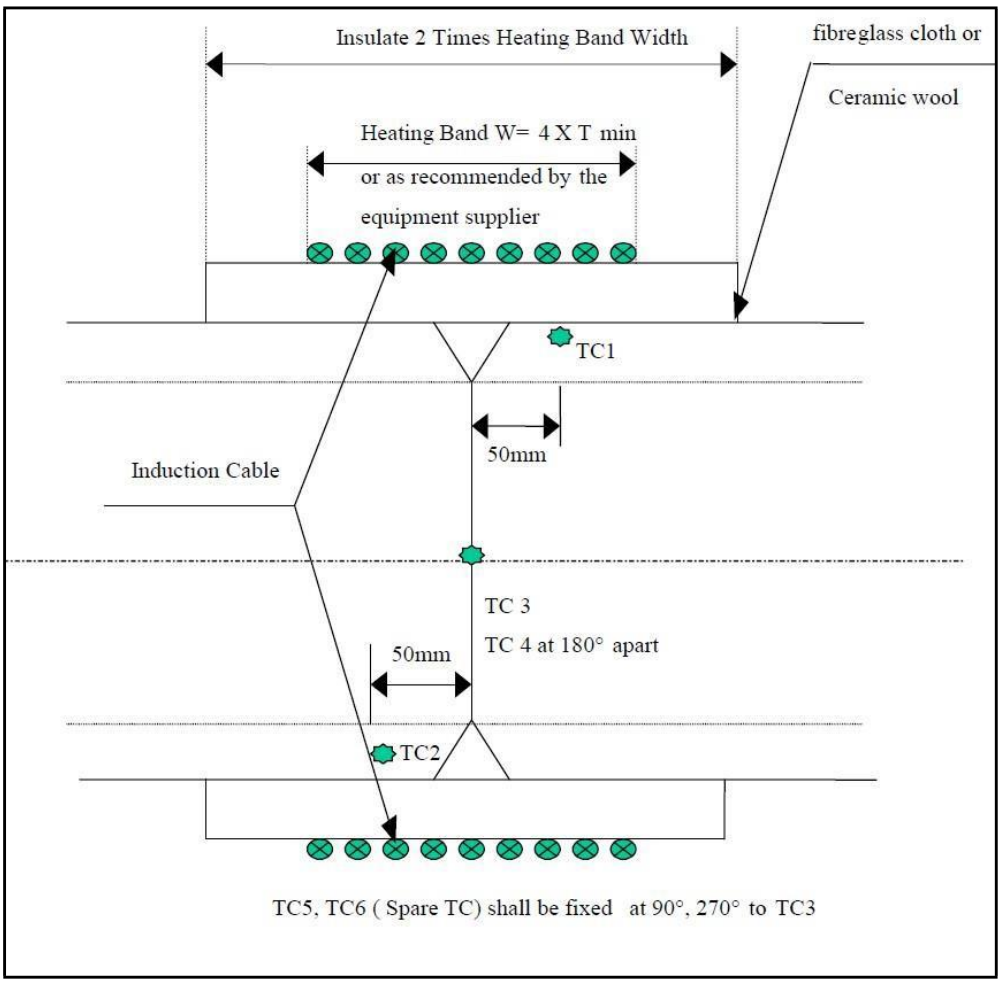


Figure 1.2: Placement of Thermocouples on P91/P92/F91/F92/C12A materials for PWHT

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.

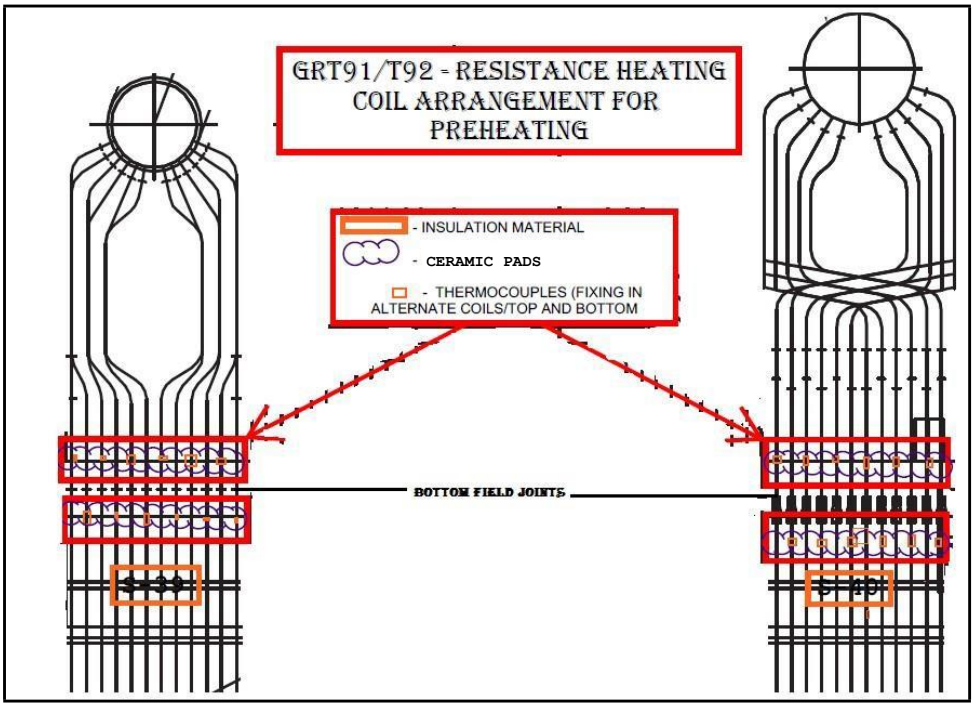


Figure 1.3: Resistance heating Coil arrangement for Preheating of T91/T92 tube assembly

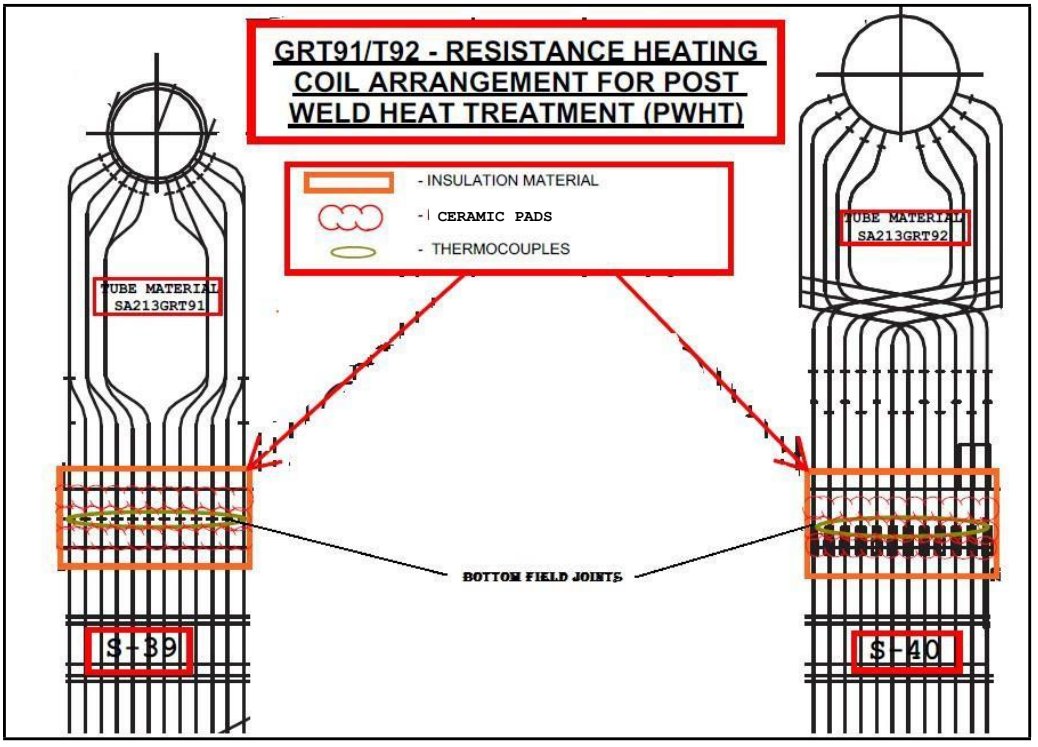


Figure 1.4: Resistance heating Coil arrangement for PWHT of T91/T92 tube assembly

3.5 **List of Tables:**

- Table-1.1: Weld preheat and PWHT for tubes and pipes outside diameter ≤ 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

S.No	Chapter No	Description
1	A1	WELDING GENERAL
2	A2	BASE MATERIALS
3	A3	WELDING MATERIAL SPECIFICATION AND CONTROL
4	A4	PROCEUDER FOR WELDER QUALIFICATION
5	A5	INSPECTION OF WELDING
6	A6	SAFE PRACTISES IN WELDING
7	B1	ERECTION WELDING PRACTISES FOR SA 335 P91/P92, SA182 F91/F92, SA217 C12A MATERIALS
8	B2	ERECTION WELDING PRACTISES FOR SA 213 T91/T92 MATERIALS
9	B3	ERECTION WELDING PRACTISES FOR SA 213 T23 MATERIALS

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

Table A2.1 - Pipes (ASME)

Table A2.2 - Tubes (ASME)

Table A2.3 - Forgings (ASME)

Table A2.4 - Castings (ASME)

Table A2.5 - Plates / Sheets (ASTM, ASME& IS)

Table A2.6 - Pipes (Other specifications)

Table A2.7 - Tubes (Other specifications)

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. o.	P. No. /Group No.	Material S e fi a on	Chemical Composition (%)								Mechanical Properties (Min.)		
			C	Mn	P	S	Si	Ni	Cr	Mo	. MPa	. MPa	% EMi n.
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	P15EI1	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	-	-	-	-0.01-0.1	450	345	17
			>40					0.15-0.40	-	-					
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			ERNiCr3	ERNiCr3	ERNiCr3	ERNiCr3	ERNiCrFe7A	ER347		
	SMAW			ENiCrFe3	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

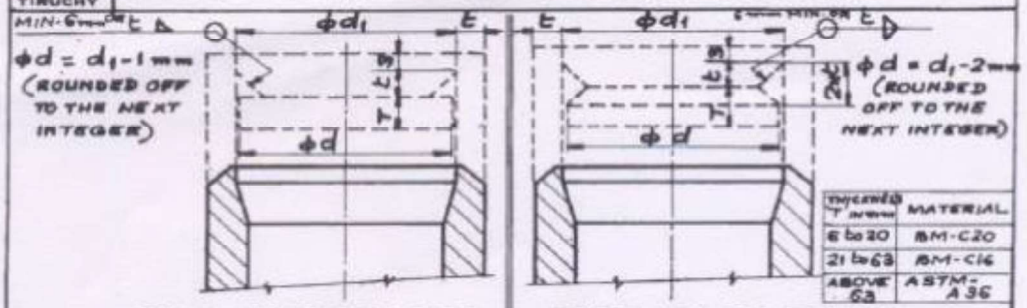
INDEX NO. 2-8

TIRUCHY

SELECTION CHART FOR DUMMY END COVERS FOR HYDRAULIC TEST

THICKNESS 'T' = 0.5 $d_1 \sqrt{\frac{P}{f}}$ (IS:0-REC. # 831/1968) f = 1900 kg/cm²

ROUNDED OFF TO THE NEXT NEAREST RATIONALISED PLATE SIZE.



THICKNESS 'T' IN 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' TEST PRESSURE kg/cm² / 'D' MAIN PIPE 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	56	56	56	56	56	56	63	63	63
350	25	32	32	36	40	56	56	56	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

MICROFILMED ON
ROLL D0037 FRAME 528

PREPARED BY

CHECKED BY

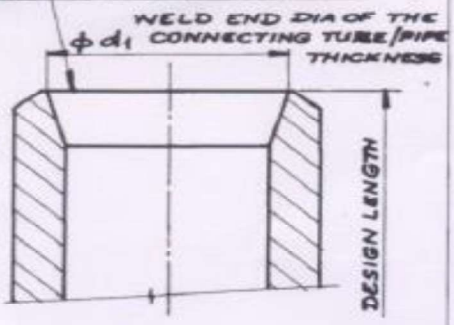
40-B-006, 2887

TIRUCHY

NIPPLES - FREE END DETAILS.

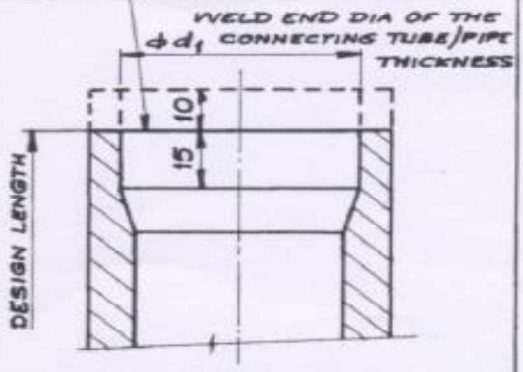
(FOR HEADERS ONLY.)

INDICATE STYLE NO 'D' - d_1 TO BPS NO 710004-74 (LAT. REV.)



STRAIGHT NIPPLES WHICH DO NOT REQUIRE ANY ALLO-WANCE. (NO SHOP HYD. TEST.)

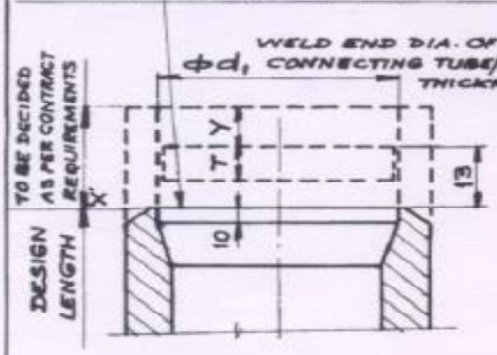
INDICATE STYLE NO 'C' - d_1 TO BPS NO 710004-74 (LAT. REV.)



STRAIGHT & BENT NIPPLES WHICH REQUIRE 10 mm ALLO-WANCE. (NO SHOP HYD. TEST.)

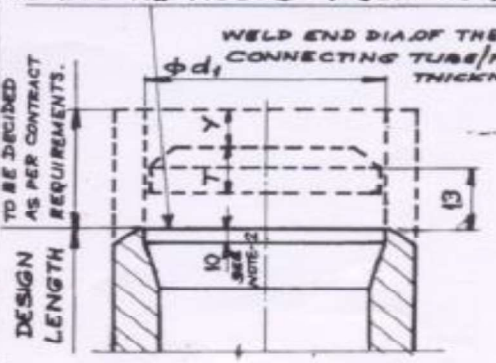
CASE WHEN $T \leq 20$

INDICATE STYLE NO 'C' - d_1 TO BPS NO 710004-74 (LAT. REV.)



CASE WHEN $T > 20$

INDICATE STYLE NO 'C' - d_1 TO BPS NO 710004-74 (LAT. REV.)



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 25 mm THE INSIDE HEIGHT OF MACHINING (WHICH IS NOW 10 mm) WILL BE INCREASED ACCORDINGLY.

PREPARED BY	CHECKED BY.

MICROFILMED ON
ROLL 20037 FRAME 513

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:

1. Qualification of Welder.
2. Table- A6.1 - Welder Qualification Requirements for non-IBR applications.
3. Figure-A6.1 - Structural Tack Weld Specimen.

   Figure- A6.2 - Break test.

   Figure- A6.3 - Weld Positions.

   Figure- A6.4 - 6G position

   Figure- A6.5 - Flat position

   Figure- A6.6 - Vertical position

   Figure- A6.7 - Horizontal position

   Figure- A6.8 - Overhead position

   Figure- A6.9- Plate Butt Weld Specimen.

   Figure- A6.10- Pipe Butt Weld Specimen.
4. Record of Welder Performance Qualification Tests.
5. Welder performance monitoring.

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 (E7018) F4	3F&4F 3F&4F	Fig. A6.1 A6.2 & A6.3	T-Unlimited T-Unlimited	All All	F2, F1 F4 & Below
2	Plate Welder (Structural)	- do -	t≥25mm t<25mm	F4 F4	3G & 4G 3G & 4G	Fig.A6.7 & A6.8	T≥3.0 mm* T>3.0 mm*≤2t	All All	F4 & Below F4 & Below
3	Plate Welder (Other than structural)	- do -	t≥13mm t<13mm	F4 F4	2G, 3G & 4G 2G, 3G & 4G	Fig.A6.6 , A6.7 & A6.8	T-Unlimited OD≥600mm T≤2t OD≥600mm	All All	F4 & Below F4 & Below
4	Pipe/Tube Welder	- do -	OD<25mm OD≥25mm &≤73mm OD>73mm t<13mm t≥13mm	F4 F4 F4 F4 F4	6G 6G 6G 6G 6G	Fig.A6.4	Test piece Dia.& above 25mm & above 73mm & above T≤2t T-Unlimited	All All All All All	F4 & Below F4 & Below F4 & Below F4 & Below 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.

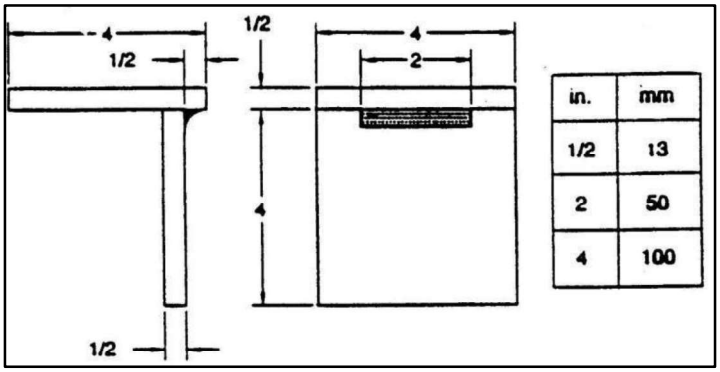


Figure A6.1 – Structural Tack Weld Specimen

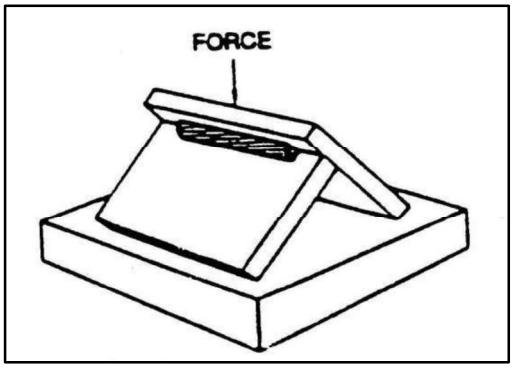


Figure A6.2 – Break Test

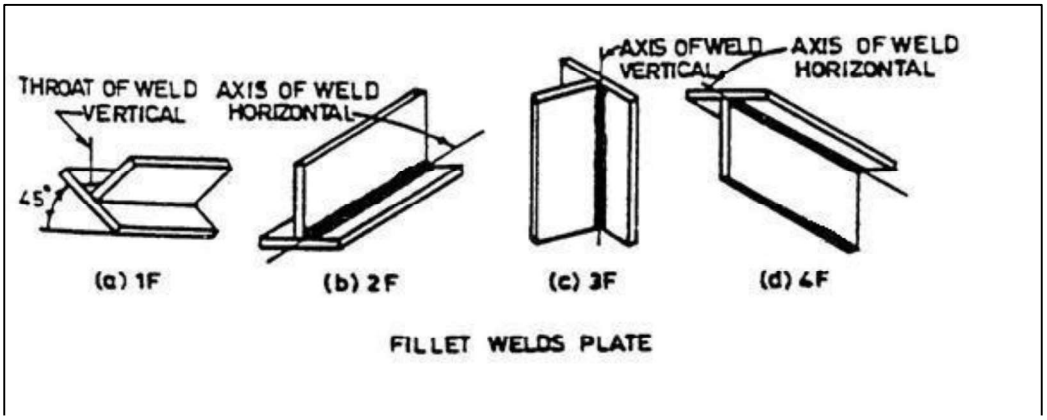


Figure A6.3 - WeldPositions

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.

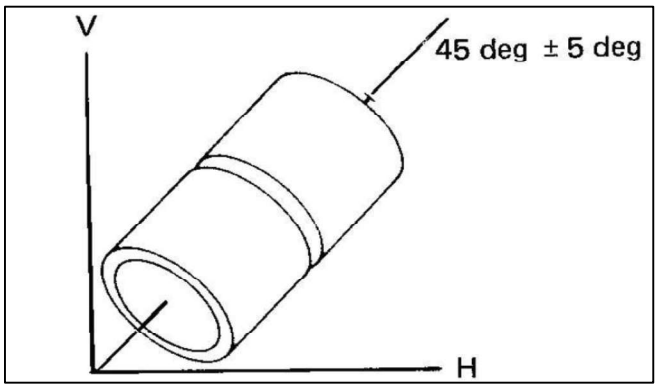


Figure A6.46G-Position

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.

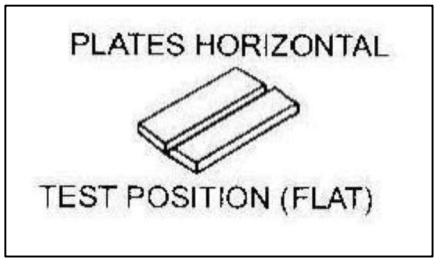


Figure A6.5Flat position

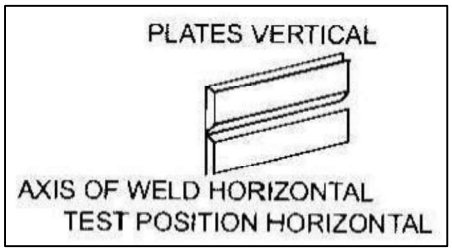


Figure A6.6Horizontal Position

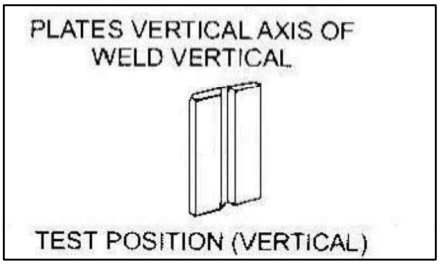


Figure A6.7Vertical Position

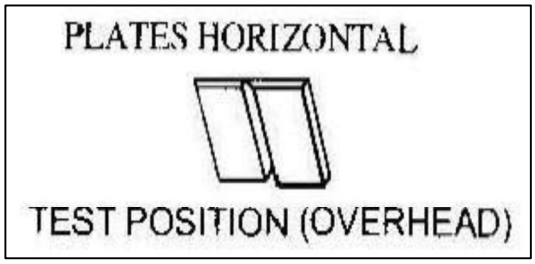


Figure A6.8Overhead Position

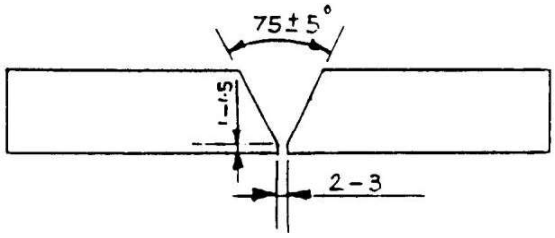
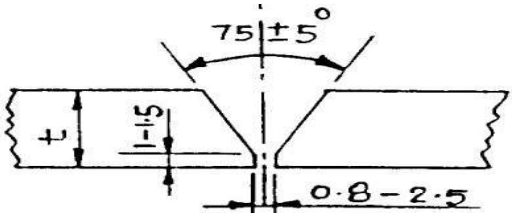
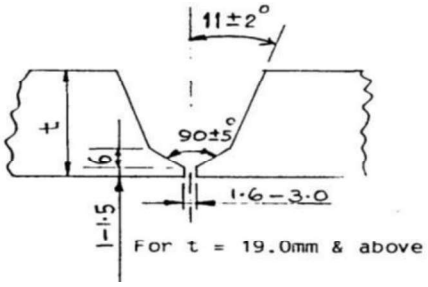


Figure A6.9- Plate butt weld specimen





(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

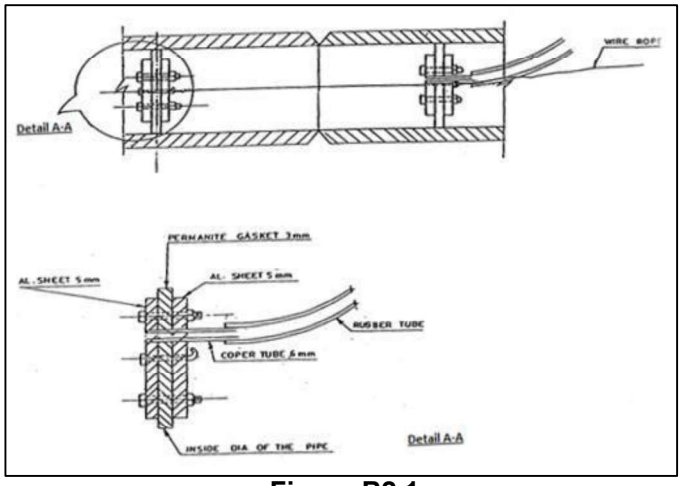


Figure B2.1

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).

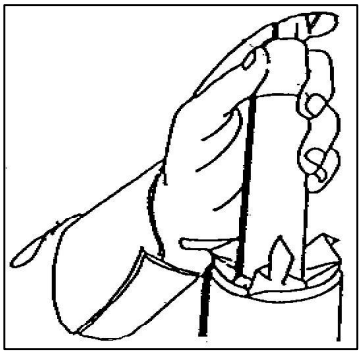


Figure B2.2

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).

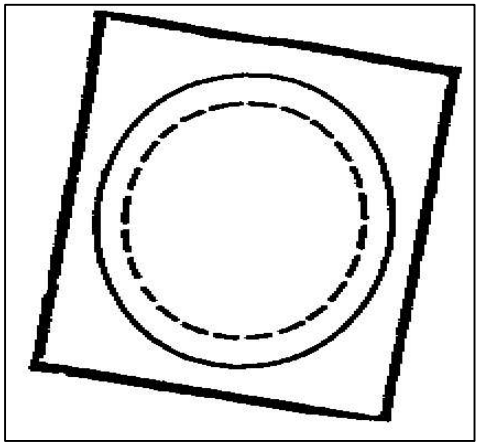


Figure B2.3

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).

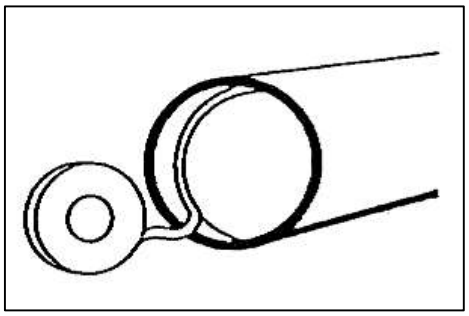


Figure B2.4

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.

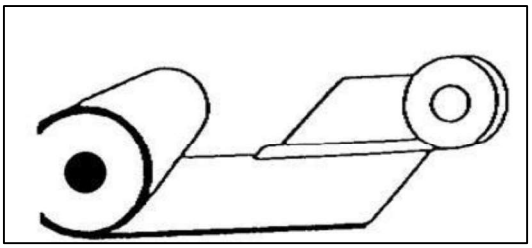


Figure B2.5

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 pattern' – showing the flaw-echo amplitude with respect to DAC, flaw depth, projection surface distance (probe position) and beam-path shall be attached to UT test report. This hard-copy of echo-trace with equipment calibration data 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

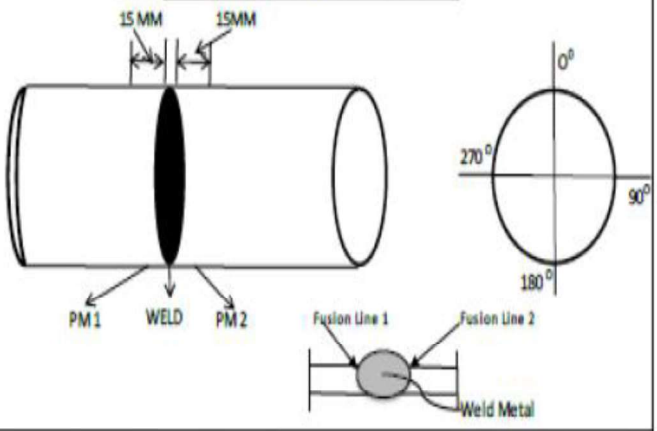
T91/T92/P91/P92/F91/F92/C12A HARDNESS TESTING PROTOCOL

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 <u>DO N' T' s</u>:

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.

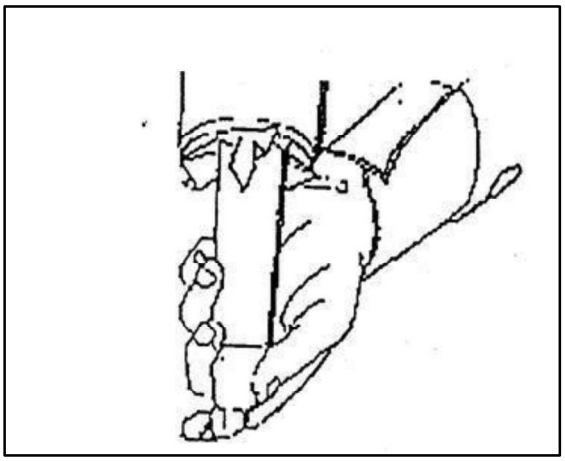


Figure B3.1: Insertion of Water Soluble Tissue paper

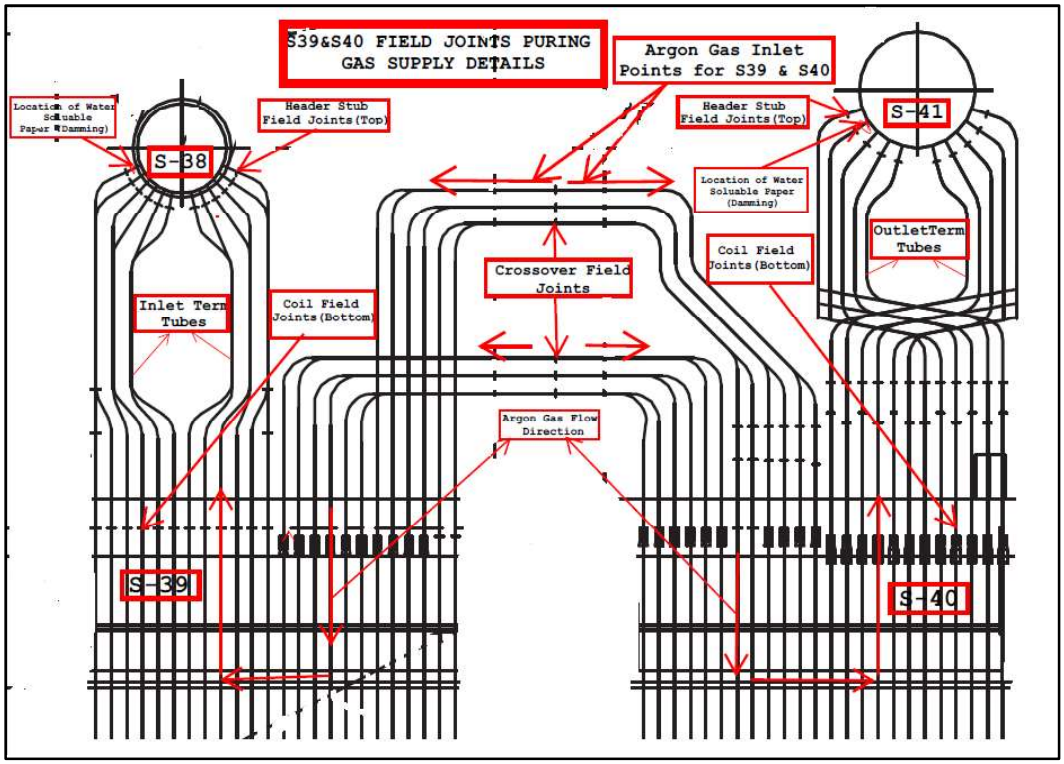


Figure B2.2: Purging Arrangement for SH Header Field Joints

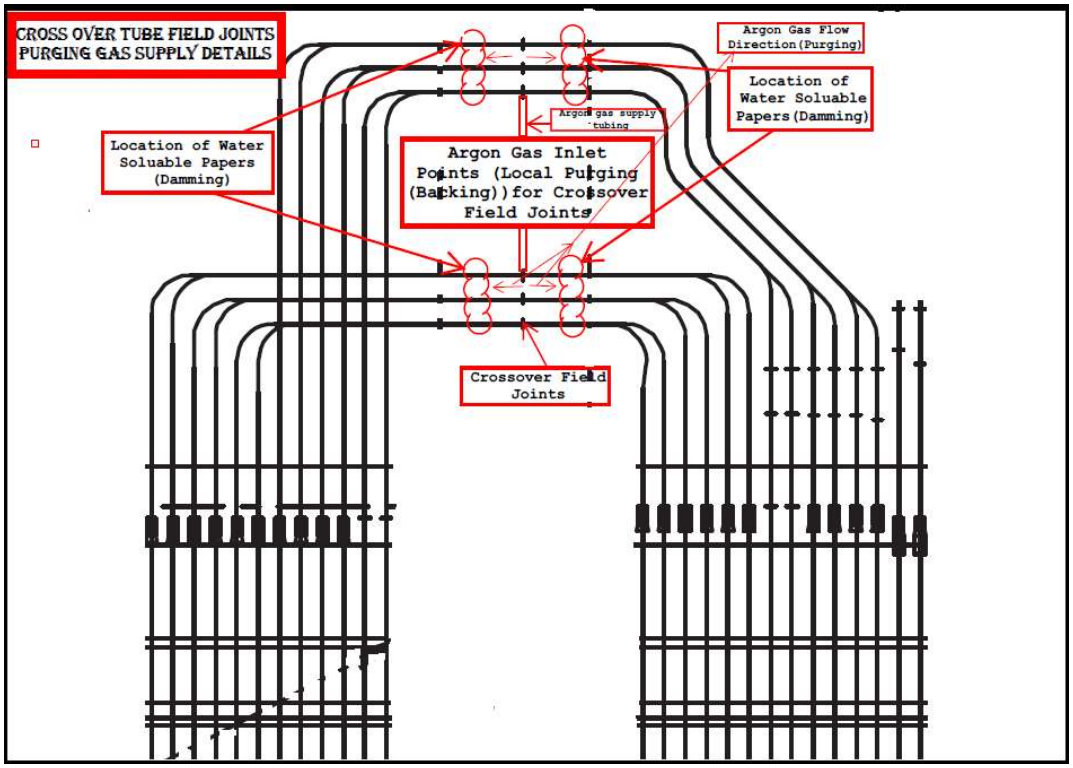


Figure B2.3: Purging Arrangement for Cross Over Tube Field Joints

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

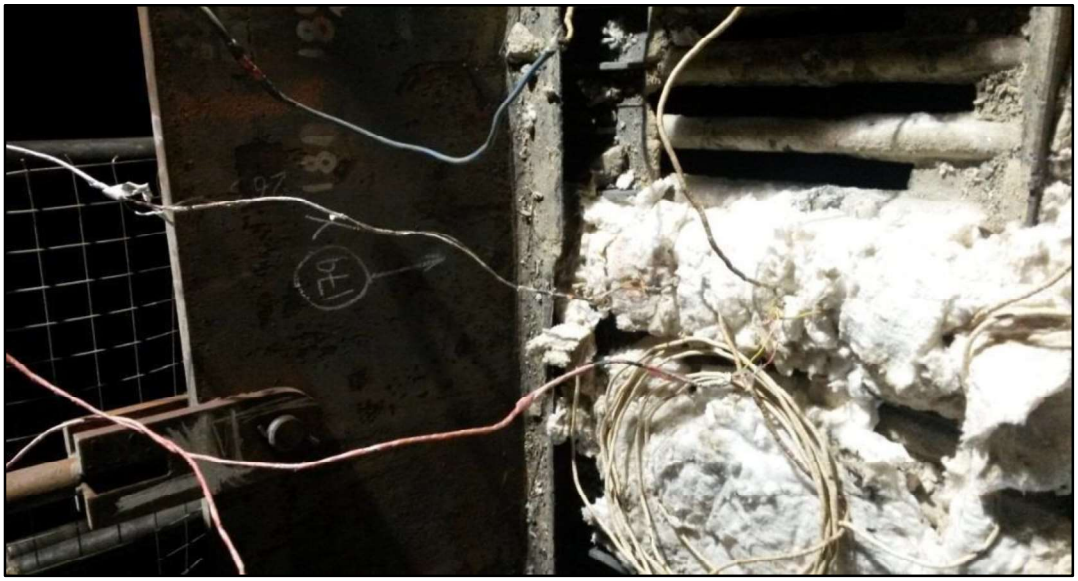


Figure B3.4: Post heating arrangement



Figure B3.5: Heating pads in place for PWHT



Figure B3.6: PWHT in progress

GUIDELINES FOR SELECTION OF NDE AND HEAT TREATMENT AGENCIES AT SITE

(to be deployed by BHEL's E&C Associates)

Bharat Heavy Electricals Limited

Power Sector Eastern Region

Kolkata - 700091

Doc. No. : PP-QLY-AA-DC-106/01-20

Rev. No. : 0

Title : Guidelines for Selection of NDE and Heat Treatment Agencies at Site
(to be deployed by BHEL's E&C Associates)

Prepared By Committee	Smarak Kumar Sahoo / Dy Engr. (Member)	
	Sontosh Pal / Addl. Engineer Gr.II (Co-opted)	
	Subhradip Joarder / Engineer (Co-opted)	
	Saurav Srivastava / Dy. Manager (Member)	
	Tathagata Dutta / Dy. Manager (Member)	
	Rajesh Das / Dy. Manager (Member)	On behalf of the committee
	Arup Ratan Paul / Engineer (Convener)	अरुप रतन पाल / Arup Ratan Paul अभियंता (गुणवत्ता) / Engineer (Quality) भा. ह. इ. लि.: पी.एस.ई.आर: मुख्यालय : BHEL : PSER : H.Q. डी जे - 9/1, सॉल्ट लेक : DJ-9/1, SALT LAKE कोलकाता-700 091 : KOLKATA-700 091 Digitally signed by ARUP RATAN PAUL DN: c=IN, o=BHARAT HEAVY ELECTRICALS LIMITED, ou=BHEL-PSER-HQ, postalCode=700091, st=West Bengal, 2.5.4.20=b6355c0e40c2ad6bdcd8874 ead57fc91a7d353fa88668896bf7406 a564865593, cn=ARUP RATAN PAUL Date: 2020.09.14 17:24:20 +05'30'
	Mridul Taisum / Sr. Manager (Chairman of the committee)	
Approved By	Head/ QLY & BE	Digitally signed by SUMANTA CHATTERJEE DN: c=IN, o=BHARAT HEAVY ELECTRICALS LIMITED, ou=BHEL-PSER-HQ, postalCode=700091, st=West Bengal, 2.5.4.20=b8585eb2e62f6511c82073907e19d5f8 fa875666724bfa32fed52c3c0d8bcded, cn=SUMANTA CHATTERJEE Date: 2020.09.14 17:25:36 +05'30'

ISSUE CONTROL:

DOCUMENT NO.	PP-QLY-AA-DC-106/01-20
ORIGINAL DATE OF ISSUE	14/09/2020
REVISION NO. & DATE	Rev. No. : 0, Date : 14/09/2020
COPY NO.	
ISSUED TO	
DATE OF ISSUE	
PURPOSE :	
ISSUED BY (SIGNATURE & DESIGNATION)	

STATUS OF REVISIONS

SL. NO.	REFERENCE OF SHEETS REVISED	REVISION NO. & DATE	REMARKS
01	All	0, Dtd.: 14/09/20	New guidelines developed. Valuable comments / guidelines from CQ&BE and QA-Trichy incorporated in the document.

1.0 Object

Object of the guidelines is to enable BHEL engineers to make informed decision regarding selection/acceptance of NDE & Heat Treatment agencies; those are deployed by BHEL's E&C associates at site and to evaluate the performance of the agencies.

2.0 General Guidelines

A. BHEL's E&C associates have to take prior permission/approval before deployment of NDE & Heat Treatment agencies at site. All relevant documents along with the filled-up format as per Annex-A & Annex-B to be submitted by BHEL's E&C associates.

B. The personnel, proposed by the agency for NDE, should have sufficient experience in testing of welds/castings/forgings/plates and should be capable to interpret the given procedure and carry out the test. Trained, experienced and certified personnel qualified as Level I / II / III (as required) as per SNT-TC-1A of ASNT or BSEN 473 of EN through ASNT / ISNT / CSWIP or its Accredited Agencies should only be deployed.

C. The personnel, proposed by the agency for Heat Treatment job, should have sufficient experience in heat treatment of welds/castings/forgings/plates and should be capable to interpret the given procedure and carry out the test.

D. On receipt of proposal along with all necessary supporting documents from E&C associates at site, concerned BHEL Erection engineer & BHEL FQA engineer shall jointly review the proposal and record the details of the accepted agencies as per Annex-C and share with the Construction manager and Head/ Quality & BE/ BHEL-PSER HQ.

E. The FQA engineer shall also take necessary clearance / acceptance from customer, if required, before acceptance of the proposed agency and maintain a record for that. If customer approval is not required, prior intimation shall be given to the customer through memo.

F. The NDE / Heat Treatment agency shall meet the requirements of this document plus any additional qualification requirements specified in latest revision of the BHEL NDE Manual (AA/CQ/GL/011 Part III-NDEM), as applicable.

G. Based on the feedback from BHEL FQA engineers, a controlled list (with revision number & date) of accepted NDE & Heat Treatment agencies with their BHEL-approved personnel shall be maintained by PSER-HQ Quality department and this list shall be uploaded in PSER intranet portal.

H. Monthly performance of the accepted agency/s shall be monitored by BHEL FQA Engineer and the evaluation report to be sent to Head/ Quality & BE/ BHEL-PSER HQ, in MSQR.

I. The agency may be disqualified/debarred on following grounds:
   i. if a re-inspection of material or a recheck of NDE / Heat Treatment data shows significant variation from the agency's report, as determined by BHEL FQA engineer
   ii. if a significant discrepancy or issue (*viz.* or malpractices like usage of modified/ manipulated Reports/ Charts, other fraudulent activity) is noted during the process audit / routine site inspection..
   iii. if any of the agency's BHEL-approved personnel has changed without taking prior approval from BHEL FQA In-charge.

iv. if the equipment mobilised by the agency no longer meets the requirements for approved usage.

v. if the Agency is not able to ensure re-qualification of his personnel/ equipment on expiry of certification or is not able to replace such personnel/ equipment in time with permission of the FQA.

J. The debarred / disqualified agency may apply for re-acceptance only after three months with a written clarification of its previous misconduct and corrective action taken to avoid occurrence of the same incidence. A standing committee of FQA Engineers shall be constituted by Head/Quality & BE/PSER, which shall scrutinise the documents

K. If, for any of the above reasons, the agency is debarred / disqualified, the same shall be immediately intimated by BHEL FQA engineer to Head/ Quality & BE/ BHEL-PSER Site CM and Main Sub-Contractor with intimation for immediate replacement.. The same shall be updated in controlled list of accepted agencies.

L. This guideline does not specifically provide any recommendation for safety measures to be taken during NDE & Heat Treatment work. Suitable safety analysis & hazard identification is to be done at site as per the project HSE manual & standard OCP.

3.0 Specific Guidelines for selection of NDE Agency for PAUT (Phase Array UT)

A. The NDE agency should have executed at least 30% of the proposed work quantity in a single job. In case, multiple agencies are proposed to be deployed, each agency should have executed at least 30% of proposed quantity in a single job. The necessary documents (*viz.* copy of Work Order, End User Performance Certificate, *etc.*) for above to be produced by agency.

B. The Agency to submit their organizational setup, supervision arrangement and list of resources to be deployed at site.

C. For PAUT, the agency shall be capable of mobilising the PAUT equipment & accessories and manpower as follows –

i. **PAUT equipment**: Omni scan MX/MX2/X3 or equivalent Phased Array equipment shall be used coupled with Scanner (16:68 or higher configuration), having

- Weld inspection features including setting up of weld profile.
- Multi grouping capability.
- Capability of using two PAUT probes simultaneously. Necessary adapter/splitter (if required) for attaching two probes for simultaneously working should be available for inspection.
- Operation with battery.
- A-scan, B-scan, C-scan, S-scan, Linear scan, Sectional scan
- Calibration: Velocity, Wedge delay, Sensitivity, TCG, DAC, Encoder calibration features.
- Data analysis and report building
- Encoder recognition.

- Probes: At least two numbers of low profile suitable PAUT probes for (MS and Alloy Steel) of 7.5 -10 Mhz frequency,16-32 element with more than 2 meters of cable length. The probes shall have couplant supply mechanism (passage of couplant) to test surface & required accessories for the same.
- Suitable probes for SS to be made available for inspection of SS joints.
- For Circumferential weld Inspection of Small-Diameter Pipes Advanced semi-automated scanning equipment/ Cobra scanner

ii. **Wedges:** Specially designed wedges to fit in the above probes and having reference angle of 50 to 60 Degree sheer wave in steel will be required. Wedges should have suitable contour to fit around required range of tubes OD (NORMALLY 25 TO 100mm).

iii. **Scanner:** A manual/automated scanner capable for scanning of required OD (normally 25 mm to 100 mm) tubes. The scanner should have encoder with it for precise data acquisition. The scanner should be able to hold two low profile phased array probes and wedges, as mentioned above for complete inspection of the weld in one rotation of the scanner. The design of scanner, probe & wedges shall allow complete inspection of circumferential weld on tube having gap more than 15 mm with any adjacent tubes, supports and structures etc.

iv. **Manpower**: The NDE agency shall deploy minimum two persons for performing non-destructive testing. They shall be qualified and certified in accordance with NDE written practice for Training, Examination, and Qualification & Certification of NDE Personnel as PAUT Level-II. The personnel who acquires the data, scan the job, does the calibration and analyse Phased Array data shall be trained on same specific technique and certified as PAUT level II. However, data evaluation and analysis shall be performed by a PAUT Level II or UT Level III. The necessary document/certificate for above to be produced by agency.

D. **Test Plan / Scan Plan:** The agency shall be capable of submitting the written inspection procedure for PAUT of weld complying with the requirement of latest BHEL NDE Manual (AA/CQ/GL/011 Part III-NDEM), duly approved by a UT Level-III person. The procedure / test plan shall be qualified at site as per latest BHEL NDE Manual (AA/CQ/GL/011 Part III-NDEM).

E. **Calibration:** Velocity, wedge delay, sensitivity, TCG, encoder calibration shall be performed by PAUT operator before inspection and as per frequency of code. Verification shall be done by BHEL FQA engineer regarding competency of the personnel deployed by the agencies, prior to start of job.

F. **Reference block:** Tubes with similar dia & wall thk (within 10% as per code) and circumferential notches/groves shall be used as reference block. The reference block should have length not less than 200 mm. It should have two circumferential grooves/notches (one each on ID & OD) having depth of 10% of wall thickness. 1 to 1.5 mm width & length between 25 to 50 mm. These two grooves should be located at opposite ends of the tube. The notches should be separated from adjacent tube edge by about 50 mm. These two grooves should be located at opposite ends of the tube. The notches should be separated from adjacent tube edge by about 50 mm. The length of reference block and

location of reflectors (notches/grooves) should comply the requirement of calibration for angle beams. Agency to take tube samples in advance so that Machine calibration work can be completed before start of work.

G. **Data Storage:** The calibration data and inspection data should be in the equipment and should be available for verification. Inspection data file to be stored by giving identifiable marking for reporting & interpretation. Agency must be capable to hand over data in suitable media (DVD / Flash Drive).

H. **Test Result:** The test result submitted by the agency for each tested tube should provide information on type of defects (like lack of penetration, porosity, lack of fusion etc), their location, length, height, depth etc. The final report with above information to be given in an excel sheet along with PAUT inspection data file & images for all the tested joints. Sample copy of test result of previous job to be submitted by the agency.

4.0 Specific Guidelines for selection of NDE Agency for RT (Radiography Test)

A. The NDE agency should have executed at least 30% of the proposed work quantity in a similar single job. In case, multiple agencies are proposed to be deployed, each agency should have executed at least 30% of proposed quantity in a similar single job. The necessary documents (*viz.* copy of Work Order, End User Performance Certificate, *etc.*) for above to be produced by agency.

B. Agency will submit their organizational setup, supervision arrangement and list of radiography sources to be deployed at site.

C. Agency to submit the documents of BARC / AERB Level- I & II personnel for doing RT & Interpretation of films, respectively. Personnel's skill & capability will be reviewed by FQA before engaging them in job.

D. The agency shall comply with all safety norms as per BARC/AERB & agency must submit source movement authorization for the subject site from BARC/AERB before start of work. The source movement within the site shall also be maintained by the agency in the log book. The agency shall fulfil all the safety precautions as per statutory requirements including Radiological safety at their own cost.

E. Manpower & Resources:

i. For a single unit, The agency shall deploy one BARC/AERB certified site in-charge and minimum of two numbers of BARC/AERB qualified Level-I radiographers for deployment of each number of source and one number of Trained, experienced and BARC/AERB qualified RT Level-II film interpreter. Personnel's skill & capability will be reviewed by FQA before engaging them in job.

ii. Agency shall mobilize one full time Radiation Safety Officer (RSO) and one site in-charge at site and maintained as per BARC and BHEL OCP guidelines.

iii. For a single unit, the NDE agency shall have permission from BARC/AERB for mobilizing a minimum of two radioactive sources (as per contractual guidelines) of sufficient strength all the time (minimum of 10 Curie). The source should be replaced immediately after decay to 10 Curie. Agency shall be capable to arrange additional source on emergency.

iv. The Agency has to submit the decay chart and all records regarding movement of the source.

v. The agency should be responsible for security of their source in the plant or during movement of camera at site.

vi. All employees of the agency to use TLD badges & pocket dosimeters while doing radiography testing at site. Also submit annual dose report of radiation workers.

vii. The agency to calculate cordon-off distance & provide 'Radiography warning sign boards & symbols' with cordon-off rope & warning alarm while carrying out the radiography.

viii. Radiography team to be available at site round the clock

ix. Equipment, Film and other consumables used shall be BHEL approved brands.

F. Agency has to demonstrate and establish various parameters for the quality of radiograph (*e.g.* Image density, sensitivity, source size, source to film distance, geometric unsharpness etc.,) to the satisfaction of BHEL.

5.0 Specific Guidelines for selection of NDE Agency for UT & MPI

A. The NDE agency should have executed at least 30% of the proposed work quantity in a similar single job. In case, multiple agencies are proposed to be deployed, each agency should have executed at least 30% of proposed quantity in a similar single job. The necessary documents (viz. copy of Work Order, End User Performance Certificate, etc.) for above to be produced by agency.

B. Agency will submit their organizational setup, supervision arrangement and list of resources to be deployed at site.

C. For a single unit, the NDE agency shall deploy a minimum of two number Digital type Pulse Echo A Scan UT equipment (preferably of OLYMPUS, EINSTEIN-II & Krautkramer) along with required calibration block at site.

D. For a single unit, the NDE agency shall deploy a minimum of two numbers of Trained, experienced and certified Level-I UT technicians and one number of Trained, experienced and certified Level-II Interpreter in UT.

E. For a single unit in MPI work, the NDE agency shall deploy a minimum of two sets of magnetic yokes, pie indicators, iron oxide particles, colour contrast, etc. Should have portable AC/HWAC equipment delivering current of minimum of 1000 amps and portable AC/DC electromagnetic yokes. Calibrated Equipment/ Ammeters shall be used for testing. The equipment should be capable of testing with visual and fluorescent magnetic particles.

F. The agency shall deploy a minimum of two numbers of Trained, experienced and certified Level-I technician in MPI and one number of Trained, experienced and certified Level-II Interpreter in MPI.

6.0 Specific Guidelines for selection of Heat Treatment Agency

A. The NDE agency should have executed at least 30% of the proposed work quantity in a similar single job. In case, multiple agencies are proposed to be deployed, each agency should have executed at least 30% of proposed quantity in a similar single job. The necessary documents (viz. copy of Work Order, End User Performance Certificate, etc.) for above to be produced by agency.

B. Agency will submit their organizational setup, supervision arrangement and list of resources to be deployed at site. This must coresponf to the requirement mentioned in Sl. No. F

C. The T & P's for Resistance Heating being deployed by Heat Treatment agency at site *viz.* PID Control Heating panels, Thermocouples, heating elements, Recorders shall be of renowned make/ branded having provision for digital display (*e.g.* temperature, Amp/ Voltage *etc.*), calibrated and in good working condition. Also to be noted that insulation being used should be in workable condition.

D. The T & P's for Induction Heating being deployed by Heat Treatment agency at site *viz.* Induction Heating equipment, induction cables, Thermocouples, auto-recorders shall be of renowned make/ branded having provision for digital display (e.g. temperature, Amp/ Voltage etc.),calibrated and in good working condition. The Induction heating equipment should be inverter type (IGBT H Bridge) and output frequency should be 7.5-10 KHz. Also, to be noted that insulation being used should be in workable condition.

E. Guidelines of BHEL Heat Treatment manuals shall also be referred.

F. The agency shall be capable of mobilising required number of machines and against each machine one experienced operator & one technician-cum-electrician must be deployed. One experienced supervision staff must be engaged by the agency exclusively for HT job. Qualification of the supervision staff shall be minimum Diploma in Mechanical/ Metallurgical engineering. The competency of operator & condition of equipment must be verified at site, as elaborated in Sl. No. H.

G. The agency should have capability of mobilising flexible ceramic pads as & when advised by BHEL.

H. One trial Heat Treatment must be conducted by BHEL engineers before acceptance of the HT equipment and the manpower, to assess the competency of the deployed persons and the condition of the machinery. The thickness & material to be selected based on the maximum thickness & material to be heat treated at site. All results to be recorded by BHEL engineer for future reference. The following are to be monitored and assessed -

1) For resistance heating process:
   i. Equipment's condition and calibration documents
   ii. Competency of the operator to follow SR job card instruction/ WPS instruction
   iii. Competency of the operator for selection of Resistance coil gauge
   iv. Wrapping skill of the operator for single tube/pipe
   v. Wrapping skill of the operator for bunching of tubes
   vi. Insulating skill of the operator
   vii. Competency of the operator for Thermocouple fixing skill
   viii. Competency of the operator for Programming of PID controller
   ix. Competency of the operator for selection of ROH/ROC
   x. Performance after completion of PWHT

2) For Induction heating process:
   i. Equipment's condition and calibration documents
   ii. Competency of the operator to follow SR job card instruction/ WPS instruction
   iii. Competency of the operator for Induction coil/ annealing cable rotation

iv. Wrapping skill of the operator for single tube/pipe
v. Insulating skill of the operator
vi. Competency of the operator for Thermocouple fixing skill
vii. Competency of the operator for programming in auto controller of IHE
viii. Competency of the operator for selection of ROH/ROC
ix. Performance after completion of PWHT
x. Competency of the operator to download PWHT graph from auto controller recorder

One mock power failure shall be staged during the trial process to verify readiness of the agency & BHEL's E&C associate for contingency. Acceptability shall depend on the hardness achieved (as measured by UCI machine)

7.0 Revision of this Guidelines

A. Revision in this Guideline, as may be felt from time to time, shall be decided by the standing committee of FQA Engineers constituted by Head/Quality & BE/BHEL-PSER.

******

Annex-A

Application for approval of NDE / Heat Treatment Agency at ……..

(Name of Project)

Name of the NDE / Heat Treatment Agency : ……

Address : ……

Name of the Proprietor : ……

PAN / TIN of agency : ……

Contact No. : ……

Email address : ……

1. Details of Qualified / Certified NDT Personnel (ASNT / ISNT)
   (*Including BARC certified Radio grapher-RT-1, Site In-charge-RT-2, RSO*)

Sl. No.	Name	NDT Method	Level	Date of first Certification	Certificate Valid upto	Certifying Authority

2. Details of Heat Treatment Personnel

Sl. No.	Name	Qualification	Previous Experience

3. Details of NDE / HT Equipment proposed to be mobilised

Sl. No.	Equipment (Make/Model)	Type (RT/ UT/ MPI/ PAUT/ HT)	Quantity	Specification / Rating	Calibration Status	Capacity of the Equipment

4. Details of Previous work done (in past 3 years):

Sl. No.	Project Name & Customer	Type of Job (RT/ UT/ MPI/ PAUT/ HT)	Number Tube Joints completed	Number of Pipe Joints Completed

…… ……

Signature of the Owner of the Agency & seal Signature of BHEL's E&C Associate & seal

Note : Applicant shall submit supporting documents along with this application and fill the Annex-B

SAMPLE FORMAT

Annex-B

Check list for Annex-A

Note : Applicant shall fill the following details and no column shall be left blank		
Sl. No.	***Description***	
A.	Name of the Proposed Agency	
B.	Quantum of job being proposed for the agency	
C.	Copy of agencies Govt. Registration	Page no.
D.	Duly filled in Annex-A	Page no.
E.	Certificates for Individuals as mentioned in Sl. No. 1 of Annex-A (Not applicable for HT agency)	Page no. from ….. to …..
F.	AERB approval certificate (for RT agency Only)	Page no. from ….. to …..
G.	Supporting documents for previous work Experience as mentioned in Sl. No. 2 of Annex-A	Page no. from ….. to …..
H.	Supporting documents for previous work Experience as mentioned in Sl. No. 3 of Annex-A	Page no. from ….. to …..

SAMPLE FORMAT

…….

Signature of BHEL's E&C Associate & seal

Annex-C

Agencies Authorised for conducting NDE / Heat Treatment at ……

(Name of Project)

Date : ……

Proposed By (Name of BHEL E&C Associate) : ……..

SL. No	Name & Address of Agency	Type of Job (RT/ UT/ MPI/ PAUT/ HT)	Name of the Persons	Method	Level	Certificate Valid upto	Contact Person, Contact number

SAMPLE FORMAT

Tick (√) applicable

1. Credentials of the above agencies have been reviewed as per Guideline and found acceptable.
2. Trial Heat Treatment has been performed by the HT agency and found to be satisfactory
3. The agencies' personnel have been interviewed and found to possess knowledge of the process & equipment

…… ……

(BHEL Erection Engineer) (BHEL FQA Engineer)

Distribution:

1. Construction Manager / BHEL Site
2. Head / Quality & BE, BHEL-PSER

Annexure

C1

DATE:31/08/2021

REVISED RATES OF T&P HIRE CHARGES FOR CRANES & TRAILERS ETC. FOR
SUB-CONTRACTORS WORKING FOR BHEL FOR DOING BHEL JOBS

SL NO.	ITEM DESCRIPTION	USEFUL LIFE (IN YRS)	Revised rates (Rs./Hour) valid from 01/09/2021 to 31/8/2023 (WITHIN USEFUL LIFE)	Revised rates (Rs./Hour) valid from 01/09/2021 to 31/8/2023 (BEYOND USEFUL LIFE)
I.	CRANES:-			
1	Portal Gantry Crane 500T	15	24500.00	24500.00
2	100MT Crawler Crane ZOOMLION CRANE-QUY-100	10	11370.00	10940.00
3	Heavy Lift Crawler Crane 600MT Class DEMAG Model CC2800	15	56290.00	53560.00
4	PORTAL CRANE, 360T	15	14070.00	13390.00
5	600MT Class Crawler Crane- Manitowoc Model 18000-UPGRADED	15	55460.00	52770.00
6	600MT Class Crawler Crane- Liebherr Model LR1600-2 (Upgraded [illegible])	15	68610.00	65280.00
7	CRAWLER CRANE FMC/LINKBELT 718, 250T (WITH RINGER)	15	33510.00	31880.00
8	CRAWLER CRANE FMC/LINKBELT 718, 250T (WITH-OUT RINGER)	15	20940.00	19920.00
9	MANITOWOC M-250T TRUCK CRANE	15	30160.00	28690.00
10	270 MT Class Crawler Crane- Manitowoc Model 2250	15	31660.00	30130.00
11	300MT Crane Crawler Crane LIEBHERR Model LR-1350/1	15	26390.00	25110.00
11.A	300MT Crane Crawler Crane LIEBHERR Model LR-1350/1 (UPGRADED)	15	36110.00	34580.00
12	250MT Class Mid range Crawler Crane- Kobelco Model CKE2500-2	15	15130.00	14390.00
12.A	250MT Class Mid range Crawler Crane- Kobelco Model CKE2500-2 (UPGRADED)	15	18850.00	18050.00
13	LINKBELT LS- 248H CRAWLER CRANE (180T)	15	16750.00	15940.00
14	MANITOWAC MODEL 888 CRAWLER CRANE (200 MT)	15	21780.00	20720.00
15	CRAWLER CRANE SUMITOMO, 150T	15	10890.00	10360.00
16	All Terrain Crane, 150MT- Liebherr Model LTM1150	15	13400.00	12750.00
17	CRAWLER CRANE, 120 T Fushun Model QUY120	10	10830.00	10420.00
18.A	CRAWLER CRANE 135MT Kobelco Model CK1350- 1F	15	10720.00	10200.00
18.B	CRAWLER CRANE 135MT Kobelco Model CK1350	15	8880.00	8440.00
19	CRAWLER CRANE 120MT - Tata-Sumitomo Model SCX1200-2	15	10050.00	9560.00
20	CRAWLER CRANE 100 T (KH 500)	15	10050.00	9560.00
21	Hydraulic Crawler Crane 80MT, Fushun Model QUY 80B	10	5410.00	5210.00
22	ROUGH TERRAIN CRANE 75T (RT880)	12	6140.00	5880.00
23	CRAWLER CRANE, 75T -Tata Model 955ALC/TFC280	12	5370.00	5150.00
24	Mobile Crane, 55MT (TIL)	12	4410.00	4230.00
25	CRAWLER CRANE, 25T -Tata Model TFC75	10	3030.00	2910.00
26	MOBILE CRANE, 20MT (TIL)	10	2270.00	2180.00
27	MOBILE CRANE, 20MT (ESCORTS)	10	2270.00	2180.00
28	MOBILE CRANE ESCORTS- 14MT	10	710.00	680.00
29	HYDAULIC PICK & CARRY CRANE, 8/9/10/11/12 MT	10	390.00	370.00

Annexure

C1

DATE:31/08/2021

REVISED RATES OF T&P HIRE CHARGES FOR CRANES & TRAILERS ETC. FOR
SUB-CONTRACTORS WORKING FOR BHEL FOR DOING BHEL JOBS

SL NO.	ITEM DESCRIPTION	USEFUL LIFE (IN YRS)	Revised rates (Rs./Hour) valid from 01/09/2021 to 31/8/2023 (WITHIN USEFUL LIFE)	Revised rates (Rs./Hour) valid from 01/09/2021 to 31/8/2023 (BEYOND USEFUL LIFE)
30	FORK LIFT 5T	5	650.00	640.00
31	FORK LIFT 3T	5	540.00	530.00

Annexure C2 DATE:31/08/202

REVISED RATES OF T&P HIRE CHARGES FOR CRANES & TRAILERS ETC. FOR OUTSIDE AGENCIES

SL NO.	ITEM DESCRIPTION	USEFUL LIFE (IN YRS)	Revised rates (Rs./Hour) valid from 01/09/2021 to 31/8/2023 (WITHIN USEFUL LIFE)	Revised rates (Rs./Hour) valid from 01/09/2019 to 31/8/2021 (BEYOND USEFUL LIFE)
I.	CRANES:-			
1	Portal Gantry Crane 500T	15	27230.00	27230.00
2	100MT Crawler Crane ZOOMLION CRANE-QUY-100	10	12630.00	12160.00
3	Heavy Lift Crawler Crane 600MT Class DEMAG Model CC2800	15	62550.00	59520.00
4	PORTAL CRANE, 360T	15	15630.00	14880.00
5	600MT Class Crawler Crane- Manitowoc Model 18000-UPGRADED	15	61620.00	58630.00
6	600MT Class Crawler Crane- Liebherr Model LR1600-2 (Upgraded version)	15	76230.00	72540.00
7	CRAWLER CRANE FMC/LINKBELT 718, 250T (WITH RINGER)	15	37230.00	35420.00
8	CRAWLER CRANE FMC/LINKBELT 718, 250T (WITH-OUT RINGER)	15	23270.00	22140.00
9	MANITOWOC M-250T TRUCK CRANE	15	33510.00	31880.00
10	270 MT Class Crawler Crane- Manitowoc Model 2250	15	35180.00	33480.00
11	300MT Crane Crawler Crane LIEBHERR Model LR-1350/1	15	29320.00	27900.00
11.A	300MT Crane Crawler Crane LIEBHERR Model LR-1350/1 (UPGRADED)	15	40120.00	38420.00
12	250MT Class Mid range Crawler Crane- Kobelco Model CKE2500-2	15	16810.00	15990.00
12.A	250MT Class Mid range Crawler Crane- Kobelco Model CKE2500-2 (UPGRADED)	15	20950.00	20060.00
13	LINKBELT LS- 248H CRAWLER CRANE (180T)	15	18610.00	17710.00
14	MANITOWAC MODEL 888 CRAWLER CRANE (200 MT)	15	24200.00	23020.00
15	CRAWLER CRANE SUMITOMO, 150T	15	12100.00	11510.00
16	All Terrain Crane, 150MT- Liebherr Model LTM1150	15	14890.00	14170.00
17	CRAWLER CRANE, 120 T Fushun Model QUY120	10	12030.00	11580.00
18.A	CRAWLER CRANE 135MT Kobelco Model CK1350- 1F	15	11910.00	11330.00
18.B	CRAWLER CRANE 135MT Kobelco Model CK1350	15	9860.00	9380.00
19	CRAWLER CRANE 120MT - Tata-Sumitomo Model SCX1200-2	15	11170.00	10620.00
20	CRAWLER CRANE 100 T (KH 500)	15	11170.00	10620.00
21	Hydraulic Crawler Crane 80MT, Fushun Model QUY 80B	10	6010.00	5790.00
22	ROUGH TERRAIN CRANE 75T (RT880)	12	6830.00	6540.00
23	CRAWLER CRANE, 75T -Tata Model 955ALC/TFC280	12	5970.00	5720.00
24	Mobile Crane, 55MT (TIL)	12	4900.00	4700.00
25	CRAWLER CRANE, 25T -Tata Model TFC75	10	3370.00	3240.00
26	MOBILE CRANE, 20MT (TIL)	10	2520.00	2430.00
27	MOBILE CRANE, 20MT (ESCORTS)	10	2520.00	2430.00
28	MOBILE CRANE ESCORTS- 14MT	10	790.00	760.00
29	HYDAULIC PICK & CARRY CRANE, 8/9/10/11/12 MT	10	430.00	410.00

Annexure C2 DATE:31/08/202

REVISED RATES OF T&P HIRE CHARGES FOR CRANES & TRAILERS ETC. FOR OUTSIDE AGENCIES

SL NO.	ITEM DESCRIPTION	USEFUL LIFE (IN YRS)	Revised rates (Rs./Hour) valid from 01/09/2021 to 31/8/2023 (WITHIN USEFUL LIFE)	Revised rates (Rs./Hour) valid from 01/09/2019 to 31/8/2021 (BEYOND USEFUL LIFE)
30	FORK LIFT 5T	5	720.00	710.00
31	FORK LIFT 3T	5	600.00	590.00

Annexure I

RATES FOR INTER REGIONAL HIRE CHARGES FOR CRANES OF CAPACITY 75 TON OR MORE FOR PERIOD 01-09-2021 TO 31-08-2023

Dt : 31/08/2021

SL NO.	ITEM DESCRIPTION	Rates (Rs./MONTH) valid from 01/09/2021 to 31/8/2023
I.	CRANES : –	
1	Portal Gantry Crane 500T	1243192
2	100MT Crawler Crane ZOOMLION CRANE-QUY-100	631183
3	Heavy Lift Crawler Crane 600MT Class DEMAG Model CC2800	2717358
4	PORTAL CRANE, 360T	679333
5	600MT Class Crawler Crane- Manitowoc Model 18000-UPGRADED	2676917
6	600MT Class Crawler Crane- Liebherr Model LR1600-2 (Upgraded version)	3311783
7	CRAWLER CRANE FMC/LINKBELT 718, 250T (WITH RINGER)	1617475
8	CRAWLER CRANE FMC/LINKBELT 718, 250T (WITH-OUT RINGER)	1010917
9	MANITOWOC M-250T TRUCK CRANE	1455725
10	270 MT Class Crawler Crane- Manitowoc Model 2250	1528508
11	300MT Crane Crawler Crane LIEBHERR Model LR-1350/1	1273758
11.A	300MT Crane Crawler Crane LIEBHERR Model LR-1350/1 (UPGRADED)	1754150
12	250MT Class Mid range Crawler Crane- Kobelco Model CKE2500-2	730283
12.A	250MT Class Mid range Crawler Crane- Kobelco Model CKE2500-2 (UPGRADED)	915892
13	LINKBELT LS- 248H CRAWLER CRANE (180T)	808733
14	MANITOWAC MODEL 888 CRAWLER CRANE (200 MT)	1051358
15	CRAWLER CRANE SUMITOMO, 150T	525675
16	All Terrain Crane, 150MT- Liebherr Model LTM1150	646983
17	CRAWLER CRANE, 120 T Fushun Model QUY120	601125
18.A	CRAWLER CRANE 135MT Kobelco Model CK1350- 1F	517592
18.B	CRAWLER CRANE 135MT Kobelco Model CK1350	428625
19	CRAWLER CRANE 120MT - Tata-Sumitomo Model SCX1200-2	485242
20	CRAWLER CRANE 100 T (KH 500)	485242
21	Hydraulic Crawler Crane 80MT, Fushun Model QUY 80B	300558
22	ROUGH TERRAIN CRANE 75T (RT880)	321758
23	CRAWLER CRANE, 75T -Tata Model 955ALC/TFC280	281533

ANNEXURE-T I
DT: 31/08/2021

RATES OF T&P HIRE CHARGES FOR ITEMS OTHER THAN CRANES & TRAILERS ETC. FOR SUB-CONTRACTORS WORKING FOR BHEL FOR DOING BHEL JOBS

SL NO.	ITEM DESCRIPTION	Revised rates (Rs./Day) valid from 01/09/2021 to 31/8/2023
I.	LIFTING EQUIPMENTS	
1	Strand Jack System for Boiler Drum Lifting	20930
2	MULTI SHEAVE PULLEY BLOCK 40/50T/60T	310
3	MULTI SHEAVE PULLEY BLOCK 100T	630
4	MULTI SHEAVE PULLEY BLOCK 150T	1260
5	ELCTRIC WINCH 5T	1270
6	ELCTRIC WINCH 10T	2360
7	ELECTRIC WINCH 15 T	2150
8	PASSENGER CUM GOODS HOIST 1T	2270
9	FURNACE MAINTENANCE PLATFORM	5040
10	Gang Operated Hydraulic Jack (Set of 4 Jacks - 175 MT each)	2100
II	WELDING & HEAT TREATMENT EQUIPMENT	
1	125KW, 3KHZ, AIR-COOLED INDUCTION HEATING EQUIPMENT	16380
2	75KW, 10 KHZ, COMPACT INDUCTION HEATING EQUIPMENT	8190
3	WELDING GENERATOR 320/300 A	300
4	WELDING RECTIFIER 400A/300A	300
5	WELDING RECTIFIER 600A	400
6	DIESEL WELDING GENERATOR 400A/300A	400
7	TRANSFORMER,600A	300
8	TRANSFORMER 300/400A	200
III	SERVICE PLANTS & ALLIED EQUIPT.	0
1	500KVA DIESEL GENERATOR	3800
2	TRANSFORMER OIL FILTERATION EQUIPMENT 6000LPH CAPACITY WITHOUT STORAGE TANK	6370
3	-DO- , WITH STORAGE TANK	7280
4	OIL FILTERATION M/C, 250/500 LPH (OTHER THAN SILICON OIL)	910
5	OIL FILTERATION M/C, 250GPH/1000LPH (OTHER THAN SILICON OIL)	1360
6	OIL FILTERATION M/C, 500GPH/2500LPH (OTHER THAN SILICON OIL)	1820
7	OIL FILTERATION M/C, 1000GPH/5000LPH (OTHER THAN SILICON OIL)	3640
8	Portable Lube Oil Purification Unit (Centrifuge M/c) Capacity: 750 LPH	1270
9	Low Vacuum de-hydration unit	630
10	DIESEL GENERATING SET,250 KVA	1770
11	DIESEL GENERATING SET,25 KVA	500

ANNEXURE-T I
DT: 31/08/2021

RATES OF T&P HIRE CHARGES FOR ITEMS OTHER THAN CRANES & TRAILERS ETC. FOR SUB-CONTRACTORS WORKING FOR BHEL FOR DOING BHEL JOBS

SL NO.	ITEM DESCRIPTION	Revised rates (Rs./Day) valid from 01/09/2021 to 31/8/2023
12	VACUUM PUMP(ABSOLUTE V.C.)	540
13	ACID CIRCULATING PUMP WITH MOTOR 120M HEAD, 150T/HR	1090
14	ACID TRANSFER PUMP 20/50 T/HR	540
15	DEWATERING PUMP (Kirloskar make,11KW/15HP)	80
16	HP Air compressor (32 Kg/Sq. Cm, 150 CFM)	4240
17	AIR COMPRESSORS 250/300/330/360/350 CFM	2730
18	AIR COMPRESSORS 140/150/190/210 CFM	910
19	ACID CIRCULATING PUMP WITH MOTOR & STARTER, 200T/HR, 150M, 220 HP	1820
20	Industrial Blower 2000CFM	1270
21	Air Leak Test Blower (Flow: 40000 m^3/Hr)	1160
22	Air Blower (Flow: 20000 m^3/Hr)	940
IV	METAL FORMING /CUTTING EQUIPMENT	
1	TUBE EXPANDING M/C PNEUMATIC 60-100 MM	630
2	ELECTRO HYDRAULIC PIPE BENDING M/C 4"	1630
3	BOLTING MACHINE (ALCOA/AVLOCK/ HUCK)	1800
4	-do- Gun with nose Assembly only	540
V	TESTING/INSPECTION EQUIPMENT	
1	DATA LOGGER for PG TESTING	36980
2	MOTORISED HYDRAULIC TEST PUMP 250kg/cmsq	800
3	MOTORISED HYDRAULIC TEST PUMP 400-450kg/cmsq	1090
4	MOTORISED HYDRAULIC TEST PUMP 600 KG/CMSQ	1270
5	HYDRAULIC TEST PUMP 800 KG/CMSQ	1330
6	HYDRAULIC TEST PUMP 1000 KG/CMSQ	2230
7	BOLT STRETCHING DEVICE	910
8	BOROSCOPE/FIBROSCOPE FLEXIBLE TYPE (FLEXUX) IMPORTED	3640
9	ULTRASONIC FLAW DETECTOR	2730
10	MPI TEST KIT	360
11	GAS LEAK DETECTOR	270
12	VIBRATION/SOUND LEVEL METER IRD-306	360
13	VIBRATION/SOUND LEVEL METER IRD-308	360
14	VIBRATION ANALYSER/DYNAMIC BALANCING M/C IRD 350	1450
15	VIBRATION ANALYSER/DYNAMIC BALANCING M/C IRD 360	2540
16	SHOCK PULSE METER	630
17	HV.DC TEST KIT UPTO 50 KV	540
18	HV.DC TEST KIT ABOVE 50 KV	1000
19	HV.AC TEST KIT UPTO 50KV	810
20	HV.AC TEST KIT ABOVE 50KV	2910
21	MOTORISED MEGGER 2.5KV	400
22	MOTORISED MEGGAR 5KV	450
23	OSCILLOSCOPE-DUAL BEAM INDIGENOUS	450
24	OSCILLOSCOPE-DUAL BEAM IMPORTED	1090
25	WAVEFORM ANALYSER	910
26	OSCILLOGRAPH/UV RECORDER 24 CHANNEL	1630
27	OSCILLOGRAPH/UV RECORDER 12 CHANNEL	1090
28	OSCILLOGRAPH/UV RECORDER 6 CHANNEL	910

RATES OF T&P HIRE CHARGES FOR ITEMS OTHER THAN CRANES & TRAILERS ETC. FOR SUB-CONTRACTORS WORKING FOR BHEL FOR DOING BHEL JOBS

SL NO.	ITEM DESCRIPTION	Revised rates (Rs./Day) valid from 01/09/2021 to 31/8/2023
29	DIGITAL LOW RESISTANCE METER	630
30	DC POTENTIOMETER	180
31	PRECISION DEAD WEIGHT TESTER	1000
32	OPTICAL ALIGNMENT KIT	1360
33	BOROSCOPE/FIBROSCOPE(NON FLEXIBLE)	1200
34	VERNIER THEODOLITE,PRECISION	1200
35	VERNIER THEODOLITE,ORDINARY	200
36	ENGINEERS PRECISION LEVEL/DUMPY LEVEL	120
37	ISKAMATIC 'A'	3200
38	CALIBRATOR '03'	1000
39	48 POLE EXTENDER CARD	200
40	MULTIJET NPM	400
41	OSCILLOMETER	10190
42	VOC EQUIPMENT	1400
43	BINARY SIGNAL GENERATOR	290
44	ELECTRIC COUNTER	690
45	FREQUENCY GENERATOR	1000
46	DBF 3 VIBRATION RECORDER/ANALYSER	3270
47	L&T GOULD OSCILLOGRAPH 2-CHANNEL	490
48	L&T GOULD OSCILLOGRAPH 6-CHANNEL	1180
49	VIBROPORT 41/FFT ANALYSER	5460
50	ELCID kit	10010
51	UNIVERSAL CALIBRATION SYSTEM	2730
52	NATURAL FREQUENCY TESTER	2910
53	DIGITAL HARDNESS TESTER	360
54	ADRE 208 VIBRATION ANALYSER	7280
55	PCB DIAGONISTIC REPAIR KIT	2000
56	SECONDARY INJECTION RELAY TEST KIT	5270
57	MICRO OHM METER	1450
58	DIGITAL MICRO OHM METER MEASURING RANGE: 200 μΩ TO 20KΩ	3230
59	PMI Machine OLYMPUS make	3350
60	Mobile Lighting Mast - 9 metres (4X400 W)	860
61	10KVA RESISTANCE BRAZING MACHINE	140
62	RECURRENT SURGE OSCILLOGRAPH (RSO) TEST KIT WITH PORTABLE HANDHELD OSCILLOSCOPE.	460
63	HYDROGEN GAS LEAK DETECTOR	50
64	STATOR WEDGE ANALYZER KIT WITH COMPLETE ACCESSORIES	4980
65	WEDGE DEFLECTION KIT	80
66	TILE PRESSING MACHINE FOR GAS TURBINE	270
67	INDUCTION BRAZING MACHINE	4870
68	MAGNETIC COHESIVE FORCE (MCF) EQUIPMENT	3640
69	ULTRASONIC FLOW METER	180
70	PORTABLE VIBRATION ANALYSER (MODEL 811T)	40
71	CENTRIFUGAL PUMP SET FOR ACID CLEANING (WITH MOTOR AND PANEL) : PRESSURE -14KG/SQ CM. ; FLOW 60 M3/HR	470
72	CENTRIFUGAL PUMP SET FOR ACID CLEANING (WITH MOTOR AND PANEL) : PRESSURE -30KG/SQ CM. ; FLOW 15 M3/HR	430

ANNEXURE-T I
DT: 31/08/2021

RATES OF T&P HIRE CHARGES FOR ITEMS OTHER THAN CRANES & TRAILERS ETC. FOR SUB-CONTRACTORS WORKING FOR BHEL FOR DOING BHEL JOBS

SL NO.	ITEM DESCRIPTION	Revised rates (Rs./Day) valid from 01/09/2021 to 31/8/2023
73	HI SPEED MEMORY RECORDER, MAKE -YOKOGAWA, MODEL DL850E-Q-HE/B5/HD1	1810
74	TROLLEY MOUNTED HYDRAULIC JACK (100 MT)	1260
75	5KV Insulation Tester	450
76	4 Channel Digital Oscilloscope /Fast Recorder	1710
77	4 Channel Oscillographic Recorder	580
78	Sound Level Meter	230
79	Thermal Imaging Camera	770
80	Videoscope (Video Boroscope)	1510
81	DO (Dissolve Oxygen) Meter (0 to 1500 ppb)	1310
82	Conductivity Meter	80
83	Core Flux Test Kit	7280
84	Primary Current Injection Kit (2000A)	870
85	3 Phase Secondary Injection Kit (Relay Test)	3760
86	FRF Filtration Kit	1330
87	FFT Analyser	2290
88	Flue Gas Analyser	1030
89	Oil Test Kit (Mineral Oil)-Transformer	1010
90	Winding Resistance kit (R L C Load)	880
91	SFRA test Kit	1190
92	Tan Delta test Kit	4060
93	PF Meter	330
94	Ultrasonic Flow Meter	830
95	Oil Particle Counter	360
96	Plasma Cutting Machine (With complete accessories)	310
97	JCB make DG Set 80 KVA	670
98	Diesel Generating Set 82.5 KVA	610
99	Portable Jacking Oil Pump	1080
100	Alloy Analyser	1770

ANNEXURE-T II
DT: 31/08/2021

RATES OF T & P HIRE CHARGES FOR ITEMS OTHER THAN CRANES & TRAILLERS ETC. FOR OUTSIDE AGENCIES

SL NO.	ITEM DESCRIPTION	Revised rates (Rs./Day) valid from 01/09/2021 to 31/8/2023
I.	LIFTING EQUIPMENTS	
1	Strand Jack System for Boiler Drum Lifting	23250
2	MULTI SHEAVE PULLEY BLOCK 40/50T/60T	350
3	MULTI SHEAVE PULLEY BLOCK 100T	700
4	MULTI SHEAVE PULLEY BLOCK 150T	1400
5	ELCTRIC WINCH 5T	1410
6	ELCTRIC WINCH 10T	2620
7	ELECTRIC WINCH 15 T	2390
8	PASSENGER CUM GOODS HOIST 1T	2520
9	FURNACE MAINTENANCE PLATFORM	5600
10	Gang Operated Hydraulic Jack (Set of 4 Jacks - 175 MT each)	2330
II	WELDING & HEAT TREATMENT EQUIPMENT	
1	125KW, 3KHZ, AIR-COOLED INDUCTION HEATING EQUIPMENT	18190
2	75KW, 10 KHZ, COMPACT INDUCTION HEATING EQUIPMENT	9090
3	WELDING GENERATOR 320/300 A	330
4	WELDING RECTIFIER 400A/300A	330
5	WELDING RECTIFIER 600A	440
6	DIESEL WELDING GENERATOR 400A/300A	440
7	TRANSFORMER,600A	330
8	TRANSFORMER 300/400A	220
III	SERVICE PLANTS & ALLIED EQUIPT.	
1	500KVA DIESEL GENERATOR	4220
2	TRANSFORMER OIL FILTERATION EQUIPMENT 6000LPH CAPACITY WITHOUT STORAGE TANK	7070
3	-DO- , WITH STORAGE TANK	8080
4	OIL FILTERATION M/C, 250/500 LPH (OTHER THAN SILICON OIL)	1010
5	OIL FILTERATION M/C, 250GPH/1000LPH (OTHER THAN SILICON OIL)	1510
6	OIL FILTERATION M/C, 500GPH/2500LPH (OTHER THAN SILICON OIL)	2020
7	OIL FILTERATION M/C, 1000GPH/5000LPH (OTHER THAN SILICON OIL)	4040
8	Portable Lube Oil Purification Unit (Centrifuge M/c) Capacity: 750 LPH	1410
9	Low Vacuum de-hydration unit	700
10	DIESEL GENERATING SET,250 KVA	1970
11	DIESEL GENERATING SET,25 KVA	560
12	VACUUM PUMP(ABSOLUTE V.C.)	600
13	ACID CIRCULATING PUMP WITH MOTOR 120M HEAD, 150T/HR	1210
14	ACID TRANSFER PUMP 20/50 T/HR	600
15	DEWATERING PUMP (Kirloskar make,11KW/15HP)	90
16	HP Air compressor (32 Kg/Sq. Cm, 150 CFM)	4710
17	AIR COMPRESSORS 250/300/330/360/350 CFM	3030
18	AIR COMPRESSORS 140/150/190/210 CFM	1010

ANNEXURE-T II
DT: 31/08/2021

RATES OF T & P HIRE CHARGES FOR ITEMS OTHER THAN CRANES & TRAILLERS ETC. FOR OUTSIDE AGENCIES

SL NO.	ITEM DESCRIPTION	Revised rates (Rs./Day) valid from 01/09/2021 to 31/8/2023
19	ACID CIRCULATING PUMP WITH MOTOR & STARTER, 200T/HR, 150M, 220 HP	2020
20	Industrial Blower 2000CFM	1410
21	Air Leak Test Blower (Flow: 40000 m^3/Hr)	1290
22	Air Blower (Flow: 20000 m^3/Hr)	1040
IV	METAL FORMING /CUTTING EQUIPMENT	
1	TUBE EXPANDING M/C PNEUMATIC 60-100 MM	700
2	ELECTRO HYDRAULIC PIPE BENDING M/C 4"	1810
3	BOLTING MACHINE (ALCOA/AVLOCK/ HUCK)	2000
4	-do- Gun with nose Assembly only	600
V	TESTING/INSPECTION EQUIPMENT	
1	DATA LOGGER for PG TESTING	41090
2	MOTORISED HYDRAULIC TEST PUMP 250kg/cmsq	880
3	MOTORISED HYDRAULIC TEST PUMP 400-450kg/cmsq	1210
4	MOTORISED HYDRAULIC TEST PUMP 600 KG/CMSQ	1410
5	HYDRAULIC TEST PUMP 800 KG/CMSQ	1480
6	HYDRAULIC TEST PUMP 1000 KG/CMSQ	2480
7	BOLT STRETCHING DEVICE	1010
8	BOROSCOPE/FIBROSCOPE FLEXIBLE TYPE (FLEXUX) IMPORTED	4040
9	ULTRASONIC FLAW DETECTOR	3030
10	MPI TEST KIT	400
11	GAS LEAK DETECTOR	300
12	VIBRATION/SOUND LEVEL METER IRD-306	400
13	VIBRATION/SOUND LEVEL METER IRD-308	400
14	VIBRATION ANALYSER/DYNAMIC BALANCING M/C IRD 350	1610
15	VIBRATION ANALYSER/DYNAMIC BALANCING M/C IRD 360	2830
16	SHOCK PULSE METER	700
17	HV.DC TEST KIT UPTO 50 KV	600
18	HV.DC TEST KIT ABOVE 50 KV	1110
19	HV.AC TEST KIT UPTO 50KV	900
20	HV.AC TEST KIT ABOVE 50KV	3230
21	MOTORISED MEGGER 2.5KV	440
22	MOTORISED MEGGAR 5KV	500
23	OSCILLOSCOPE-DUAL BEAM INDIGENOUS	500
24	OSCILLOSCOPE-DUAL BEAM IMPORTED	1210
25	WAVEFORM ANALYSER	1010
26	OSCILLOGRAPH/UV RECORDER 24 CHANNEL	1810
27	OSCILLOGRAPH/UV RECORDER 12 CHANNEL	1210
28	OSCILLOGRAPH/UV RECORDER 6 CHANNEL	1010
29	DIGITAL LOW RESISTANCE METER	700
30	DC POTENTIOMETER	200
31	PRECISION DEAD WEIGHT TESTER	1110
32	OPTICAL ALIGNMENT KIT	1510
33	BOROSCOPE/FIBROSCOPE(NON FLEXIBLE)	1330
34	VERNIER THEODOLITE,PRECISION	1330
35	VERNIER THEODOLITE,ORDINARY	220

ANNEXURE-T II
DT: 31/08/2021

RATES OF T & P HIRE CHARGES FOR ITEMS OTHER THAN CRANES & TRAILLERS ETC. FOR OUTSIDE AGENCIES

SL NO.	ITEM DESCRIPTION	Revised rates (Rs./Day) valid from 01/09/2021 to 31/8/2023
36	ENGINEERS PRECISION LEVEL/DUMPY LEVEL	130
37	ISKAMATIC 'A'	3550
38	CALIBRATOR '03'	1110
39	48 POLE EXTENDER CARD	220
40	MULTIJET NPM	440
41	OSCILLOMETER	11320
42	VOC EQUIPMENT	1550
43	BINARY SIGNAL GENERATOR	320
44	ELECTRIC COUNTER	760
45	FREQUENCY GENERATOR	1110
46	DBF 3 VIBRATION RECORDER/ANALYSER	3630
47	L&T GOULD OSCILLOGRAPH 2-CHANNEL	540
48	L&T GOULD OSCILLOGRAPH 6-CHANNEL	1310
49	VIBROPORT 41/FFT ANALYSER	6060
50	ELCID kit	11120
51	UNIVERSAL CALIBRATION SYSTEM	3030
52	NATURAL FREQUENCY TESTER	3230
53	DIGITAL HARDNESS TESTER	400
54	ADRE 208 VIBRATION ANALYSER	8080
55	PCB DIAGONISTIC REPAIR KIT	2220
56	SECONDARY INJECTION RELAY TEST KIT	5860
57	MICRO OHM METER	1610
58	DIGITAL MICRO OHM METER MEASURING RANGE: 200 μΩ TO 20KΩ	3590
59	PMI Machine OLYMPUS make	3730
60	Mobile Lighting Mast - 9 metres (4X400 W)	960
61	10KVA RESISTANCE BRAZING MACHINE	160
62	RECURRENT SURGE OSCILLOGRAPH (RSO) TEST KIT WITH PORTABLE HANDHELD OSCILLOSCOPE.	510
63	HYDROGEN GAS LEAK DETECTOR	60
64	STATOR WEDGE ANALYZER KIT WITH COMPLETE ACCESSORIES	5530
65	WEDGE DEFLECTION KIT	90
66	TILE PRESSING MACHINE FOR GAS TURBINE	300
67	INDUCTION BRAZING MACHINE	5410
68	MAGNETIC COHESIVE FORCE (MCF) EQUIPMENT	4040
69	ULTRASONIC FLOW METER	200
70	PORTABLE VIBRATION ANALYSER (MODEL 811T)	50
71	CENTRIFUGAL PUMP SET FOR ACID CLEANING (WITH MOTOR AND PANEL) : PRESSURE -14KG/SQ CM. ; FLOW 60 M3/HR	520
72	CENTRIFUGAL PUMP SET FOR ACID CLEANING (WITH MOTOR AND PANEL) : PRESSURE -30KG/SQ CM. ; FLOW 15 M3/HR	480
73	HI SPEED MEMORY RECORDER, MAKE -YOKOGAWA, MODEL DL850E-Q-HE/B5/HD1	2010
74	TROLLEY MOUNTED HYDRAULIC JACK (100 MT)	1400
75	5KV Insulation Tester	500

ANNEXURE-T II
DT: 31/08/2021

RATES OF T & P HIRE CHARGES FOR ITEMS OTHER THAN CRANES & TRAILLERS ETC. FOR OUTSIDE AGENCIES

SL NO.	ITEM DESCRIPTION	Revised rates (Rs./Day) valid from 01/09/2021 to 31/8/2023
76	4 Channel Digital Oscilloscope /Fast Recorder	1900
77	4 Channel Oscillographic Recorder	650
78	Sound Level Meter	260
79	Thermal Imaging Camera	860
80	Videoscope (Video Boroscope)	1680
81	DO (Dissolve Oxygen) Meter (0 to 1500 ppb)	1460
82	Conductivity Meter	90
83	Core Flux Test Kit	8090
84	Primary Current Injection Kit (2000A)	960
85	3 Phase Secondary Injection Kit (Relay Test)	4180
86	FRF Filtration Kit	1480
87	FFT Analyser	2550
88	Flue Gas Analyser	1140
89	Oil Test Kit (Mineral Oil)-Transformer	1120
90	Winding Resistance kit (R L C Load)	970
91	SFRA test Kit	1320
92	Tan Delta test Kit	4510
93	PF Meter	360
94	Ultrasonic Flow Meter	920
95	Oil Particle Counter	400
96	Plasma Cutting Machine (With complete accessories)	340
97	JCB make DG Set 80 KVA	740
98	Diesel Generating Set 82.5 KVA	680
99	Portable Jacking Oil Pump	1200
100	Alloy Analyser	1970



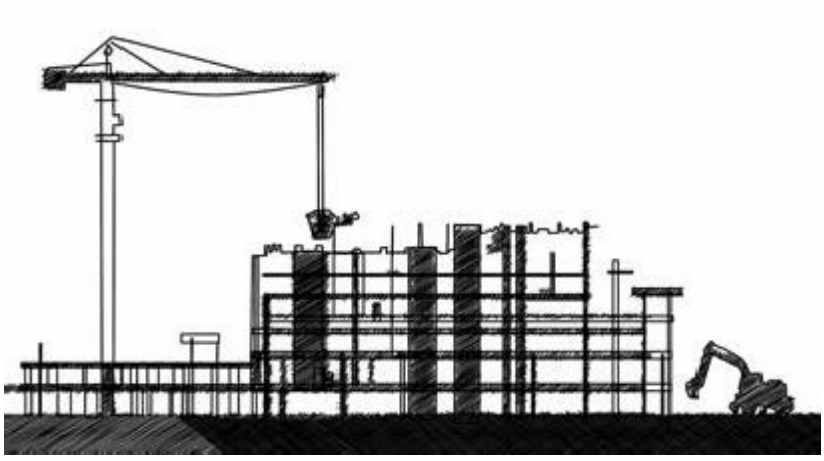
HEALTH, SAFETY and ENVIRONMENT PLAN

for

SITE OPERATIONS

by

SUB-CONTRACTORS



POWER SECTOR

HSE PLAN FOR SITE OPRATIONS BY BHEL'S SUBCONTRACTORS

AT A GLANCE

BEFORE START

SIGNING OF MOU	
Agree to comply to HSE requirement- Statutory and BHEL's	Agree to accept BHEL's decision on release of 1.5% (as specified in the contract) of Gross bill amount or part thereof or otherwise(non-release), based on our HSE performance as evaluated by BHEL during the execution period

PLAN

HSE ORGANISATION	
Manpower • 1 (one) safety officer for every 500 workers or part thereof • 1(one) safety-steward/ supervisor for every 100 workers **Qualification** As per Cl. 7.1	**HSE Roles and responsibilities** • Site In-charge- As per clause 7.2.1 • Safety officer- As per clause 7.2.2

HSE Planning
for Man, Machinery/Equipment/Tools & Tackles

PROVIDE

HSE INFRASTUCTURE	
• PPEs • Drinking Water • Washing Facilities • Latrines and Urinals • Provision of shelter for rest • Medical facilities	• Canteen facilities • Labour Colony • Emergency Vehicle • Pest Control • Scrapyard • Illumination

TRAIN

HSE TRAINING , AWARENESS & PROMOTION	
Training • Induction training • Height work and other critical areas • Tool Box talk & Pep Talk	**Awareness & Promotion** • Signage • Poster • Banner • Competition • Awards

COMMUNICATE

HSE COMMUNICATION	
Incident Reporting • Accident- Fatal & Major • Property damage • Near Miss	**Event Reporting** • Celebrations • Training • Medical camp

EXECUTE SAFELY

OPERATIONAL CONTROL PROCEDURES

PERMIT TO WORK

Height work (above 2 metres), Hot Work, Heavy Lifting, Confined Space, Radiography, excavation (More than 4 metres)

SAFETY DURING WORK EXECUTION	
• Welding • Rigging • Cylinder- storage & Movement • Demolition work • T&Ps • Chemical Handling • Electrical works	• Fire • Scaffolding • Height work • Working Platform • Excavation • Ladder • Lifting • Hoisting appliance
HOUSE KEEPING	
WASTE MANGEMENT	
TRAFFIC MANAGEMENT	
ENVIRONMENTAL CONTROL	
EMERGENCY PREPAREDNESS AND RESPONSE PLAN	

CHECKS

HSE AUDITS & INSPECTION	
• Daily Checks • Inspection of PPEs • Inspection of T& Ps • Inspection of Cranes & Winches	• Inspection of Height work • Inspection of Welding and Gas cutting • Inspection of elevators etc.

HSE PERFORMANCE EVALUATION PARAMETERS

NON CONFORMANCE

PENALTY for NON CONFORMANCE

Refer Clause 16

Incremental penalty

For repeated violation by the same person, the penalty would be double of the previous penalty

For repeated fatal incident in the same Unit incremental penalty to be imposed. The subcontractor will pay 2 times the penalty compared to previously paid in case there are repeated cases of fatal incidents under the same subcontractor for the same package in the same unit.

Sr. No.	Description	Page No.
1.0	PURPOSE	4
2.0	SCOPE	4
3.0	OBJECTIVES AND TARGETS	4
4.0	HEALTH, SAFETY & ENVIRONMENT POLICY	5
5.0	MEMORANDUM OF UNDERSTANDING	6
6.0	TERMS & DEFINITIONS	7
7.0	HSE ORGANIZATION	8
7.1	QUALIFICATION FOR HSE PERSONNEL	8
7.2	RESPONSIBILITIES	9
8.0	PLANNING BY SUBCONTRACTOR	11
8.1	MOBILISATION OF MACHINERY/EQUIPMENT/TOOLS	11
8.2	MOBILISATION OF MANPOWER BY SUBCONTRACTOR	11
8.3	PROVISION OF PPEs	12
8.4	ARRANGEMENT OF INFRASTRUCTURE	13
9.0	HSE TRAINING & AWARENESS	16
9.1	HSE INDUCTION TRAINING	16
9.2	HSE TOOLBOX TALK	17
9.3	TRAINING ON HEIGHT WORK	17
9.4	HSE TRAINING DURING PROJECT EXECUTION	17

9.5	HSE PROMOTION-SIGNAGE, POSTERS, COMPETITION, AWARDS ETC	18
10.0	HSE COMMUNICATION	18
10.1	INCIDENT REPORTING	18
10.2	HSE EVENT REPORTING	18
11.0	OPERATIONAL CONTROL	19
11.1	HSE ACTIVITIES	19
11.2	WORK PERMIT SYSTEM	20
11.3	SAFETY DURING WORK EXECUTION	20
11.4	ENVIRONMENTAL CONTROL	24
11.5	HOUSEKEEPING	24
11.6	WASTE MANAGEMENT	25
11.7	TRAFFIC MANAGEMENT SYSTEM	26
11.8	EMERGENCY PREPAREDNESS AND RESPONSE	28
12.0	HSE INSPECTION	29
12.1	DAILY HSE CHECKS	29
12.2	INSPECTION OF PPE	29
12.3	INSPECTION OF T&Ps	30
12.4	INSPECTION OF CRANES AND WINCHES	30
12.5	INSPECTION ON HEIGHT WORKING	30
12.6	INSPECTION ON WELDING AND GAS CUTTING OPERATION	30

12.7	INSPECTION ON ELECTRICAL INSTALLATION / APPLIANCES	31
12.8	INSPECTION OF ELEVATOR	31
12.9	INSPECTION OF EXCAVATION ACTIVITIES	31
13.0	HSE PERFORMANCE	31
14.0	HSE PENALTIES	32
15.0	OTHER REQUIREMENTS	32
16.0	NON COMPLIANCE	33
17.0	HSE AUDIT/INSPECTION	34
18.0	MONTHLY HSE REVIEW MEETING	34
19.0	FORMATS USED	34
20.0	Annexures	36
	Revision History Sheet	

1.0 PURPOSE

1.1 The purpose of this HSE Plan is to provide for the systematic identification, evaluation, prevention and control of general workplace hazards, specific job hazards, potential hazards and environmental impacts that may arise from foreseeable conditions during installation and servicing of industrial projects and power plants.

1.2 This document shall be followed by BHEL's subcontractors at all installation and servicing sites. In case customer specific documents are to be implemented, this document will be followed in conjunction with customer specific documents.

1.3 Although every effort has been made to make the procedures and guidelines in line with statutory requirements, in case of any discrepancy relevant statutory guidelines must be followed.

1.4 In case the customer has any specific requirement, the same is to befulfilled.

2.0 SCOPE

The document is applicable for BHEL's Subcontractors at all installation / servicing activities of BHEL Power Sector as per the relevant contractual obligations.

3.0 OBJECTIVES AND TARGETS

The HSE Plan reflects that BHEL places high priority upon the Occupational Health, Safety and Environment at workplaces.

- Ensure the Health and Safety of all persons at work site is not adversely affected by the work.
- Ensure protection of environment of the work site.
- Comply at all times with the relevant statutory and contractual HSE requirements.
- Provide trained, experienced and competent personnel. Ensure medically fit personnel only are engaged at work.
- Provide and maintain plant, places and systems of work that are safe and without risk to health and the environment.
- Provide all personnel with adequate information, instruction, training and supervision on the safety aspect of their work.
- Effectively control, co-ordinate and monitor the activities of all personnel on the Project sites including subcontractors in respects of HSE.
- Establish effective communication on HSE matters with all relevant parties involved in the Project works.
- Ensure that all work planning takes into account all persons that may be affected by the work.
- Ensure fitness testing of all T&Ps/Lifting appliances like cranes, chain pulley blocks etc. are to be certified by competent person.
- Ensure timely provision of resources to facilitate effective implementation of HSE requirements.
- Ensure continual improvements in HSE performance
- Ensure conservation of resources and reduction of wastage.
- Capture the data of all incidents including near misses, process deviation etc. Investigate and analyze the same to find out the root cause.
- Ensure timely implementation of correction, corrective action and preventive action.

HSE TARGETS

EXPLOSION	**ZERO**
FATALITY	**ZERO**
LOST TIME INJURY	**ZERO**
FIRE	**ZERO**
VEHICLE INCIDENTS	**ZERO**
ENVIRONMENTAL INCIDENTS	**ZERO**

4.0 BHEL POWER SECTOR HEALTH, SAFETY & ENVIRONMENT POLICY

Power Sector HSE Policy

We, at BHEL Power Sector, reaffirm our belief that the Health and Safety of our stakeholders and conservation of Environment is of utmost importance and takes precedence in all our business decisions. In pursuit of this belief and commitment, we strive to:

- ✓ **Ensure total compliance with applicable legislation, regulations and other requirements concerning Occupational Health, Safety and Environment.**
- ✓ **Ensure continual improvement in the Occupational Health, Safety and Environment Management System performance.**
- ✓ **Enhance Occupational Health, Safety and Environment awareness amongst employees, customers and suppliers by proactive communication and training.**
- ✓ **Review periodically and improve Occupational Health, Safety and Environment Management System to ensure its continuing suitability, adequacy and effectiveness in a continuously changing business environment.**
- ✓ **Develop a culture of safety through active leadership and provide appropriate training at all levels to enable employees to fulfill their Health, Safety and Environmental obligations.**
- ✓ **Incorporate appropriate Occupational Health, Safety and Environmental criteria into business decisions for selection of plant, technology and services as well as appointment of key personnel.**
- ✓ **Ensure availability at all times of appropriate resources to fully implement the Occupational Health, Safety and Environmental policy of the company.**

This policy will be communicated to all employees and made available to interested parties.

` Sd/-

Date: 01.05.2013 **Director (Power)**

5.0 MEMORANDUM OF UNDERSTANDING:

After award of work, subcontractors are required to enter into a memorandum of understanding as given below:

Memorandum of Understanding

BHEL, Power Sector_____Region is committed to Health, Safety and Environment Policy (HSE Policy).

M/s_____do hereby also commit to comply with the same HSE Policy while executing the Contract Number _____

M/s_____shall ensure that safe work practices as per the HSE plan. Spirit and content therein shall be reached to all workers and supervisors for compliance.

In addition to this, M/S_____shall comply to all applicable statutory and regulatory requirements which are in force in the place of project and any special requirement specified in the contract document of the principal customer.

M/s_____shall co-operate in HSE audits/inspections conducted by BHEL /customer/ third party and ensure to close any non-conformity observed/reported within prescribed time limit.

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

Name :

Place & Date:

6.0 TERMS AND DEFINITIONS

6.1 DEFINITIONS

6.1.1 INCIDENT

Work- related or natural event(s) in which an injury, or ill health (regardless of severity), damage to property or fatality occurred, or could have occurred.

6.1.2 NEAR MISS

An incident where no ill health, injury, damage or other loss occurs, but it had a potential to cause, is referred to as "Near-Miss".

6.1.3 MAN-HOURS WORKED

The total number of man hours worked by all employees including subcontractors working in the premises. It includes managerial, supervisory, professional, technical, clerical and other workers including contract labours. Man-hours worked shall be calculated from the payroll or time clock recorded including overtime. When this is not feasible, the same shall be estimated by multiplying the total man-days worked for the period covered by the number of hours worked per day. The total number of workdays for a period is the sum of the number of men at work on each day of period. If the daily hours vary from department to department separate estimate shall be made for each department and the result added together.

6.1.4 FIRST AID CASES

First aids are not essentially all reportable cases, where the injured person is given medical treatment and discharged immediately for reporting on duty, without counting any lost time.

6.1.5 LOST TIME INJURY

Any work injury which renders the injured person unable to perform his regular job or an alternative restricted work assignment on the next scheduled work day after the day on which the injury occurred.

6.1.6 MEDICAL CASES

Medical cases come under non-reportable cases, where owing to illness or other reason the employee was absent from work and seeks Medical treatment.

6.1.7 TYPE OF INCIDENTS & THEIR REPORTING:

The three categories of Incident are as follows:

Non-Reportable Cases:
An incident, where the injured person is given medical help and discharged for work without counting any lost time.

Reportable Cases:
In this case the injured person is disable for 48 hours or more and is not able to perform his duty.

Injury Cases:
These are covered under the heading of non-reportable cases. In these cases the incident caused injury to the person, but he still continues his duty.

6.1.8 TOTAL REPORTABLE FREQUENCY RATE

Frequency rate is the number of Reportable Lost Time Injury (LTI) per one Million Man hours worked. Mathematically, the formula read as:

$$\frac{\text{Number of Reportable LTI}}{\text{Total Man Hours Worked}} \times 1{,}000{,}000$$

6.1.9 SEVERITY RATE

Severity rate is the Number of days lost due to Lost Time Injury (LTI) per one Million Man hours worked. Mathematically, the formula reads as:

$$\frac{\text{Days lost due to LTI}}{\text{Total Man Hours Worked}} \times 1{,}000{,}000$$

6.1.10 INCIDENCE RATE

Incidence Rate is the Number of LTI per one thousand manpower deployed. Mathematically, the formula reads as:

$$\frac{\text{Number of LTI} \times 1000}{\text{Average number of manpower deployed}}$$

7.0 HSE ORGANISATION

Number of safety officers:
The subcontractor must deploy one safety officer for every 500 workers or part thereof in each package. In addition, there must be one safety-steward/safety-supervisor for every 100 workers.

Deployment: The subcontractor should deploy sufficient safety officers and safety-steward/Safety-supervisor, as per requirement given above, since initial stage and add more in proportion to the added strength in work force. Any delay in deployment will attract a penalty of Rs.30,000/- per man month for the delayed period.

7.1 QUALIFICATION FOR HSE PERSONNEL

Sl.no	Designation	Qualification	Experience
1	Safety officer (Construction Agency)	Degree or Diploma in Engineering with full time diploma in Industrial Safety with construction safety as one of the subjects	Minimum two years for degree holder and five years for diploma holder in the field of Construction of power plant/ major industries

2	Safety-Steward/ Safety-Supervisor	Degree or diploma in any discipline with full time diploma in Industrial Safety with construction safety as one of the subjects	Minimum two years

7.2 RESPONSIBILITIES

7.2.1 SITE IN -CHARGE OF SUBCONTRACTOR

- Shall sign Memorandum of Understanding (MoU) for compliance to BHEL's HSE Plan for Site Operations as per clause 5.0
- Shall engage qualified safety officer(s) and steward (s) as per clause 7.0
- Shall adhere to the rules and regulations mentioned in this code, practice very strictly in his area of work in consultation with his concerned engineer and the safety coordinator.
- Shall screen all workmen for health and competence requirement before engaging for the job and periodically thereafter as required.
- Shall not engage any employee below 18 years.
- Shall arrange for all necessary PPEs like safety helmets, belts, full body harness, shoes, face shield, hand gloves etc. before starting the job. Shall ensure that no working men/women carry excessive weight more than stipulated in Factory Rule Regulation R57.
- Shall ensure that all T&Ps engaged are tested for fitness and have valid certificates from competent person.
- Shall ensure that provisions stipulated in contract Labour Regulation Act 1970, Chapter V C.9, canteen, rest rooms/washing facilities to contracted employees at site.
- Shall adhere to the instructions laid down in Operation Control Procedures (OCPs) available with the site management.
- Shall ensure that person working above 2.0 meter should use Safety Harness tied to a life line/stable structure.
- Shall ensure that materials are not thrown from height. Cautions to be exercised to prevent fall of material from height.
- Shall report all incidents (Fatal/Major/Minor/Near Miss) to the Site engineer /HSE officer of BHEL.
- Shall ensure that Horseplay is strictly forbidden.
- Shall ensure that adequate illumination is arranged during night work.
- Shall ensure that all personnel working under subcontractor are working safely and do not create any Hazard to self and to others.
- Shall ensure display of adequate signage/posters on HSE.
- Shall ensure that mobile phone is not used by workers while working.
- Shall ensure conductance of HSE audit, mockdrill, medical camps, induction training and training on HSE at site.
- Shall ensure full co-operation during HQ/External /Customer HSE audits.

- Shall ensure submission of look-ahead plan for procurement of HSE equipment's and PPEs as per work schedule.
- Shall ensure good housekeeping.
- Shall ensure adequate valid fire extinguishers are provided at the work site.
- Shall ensure availability of sufficient number of toilets /restrooms and adequate drinking water at work site and labour colony.
- Shall ensure adequate emergency preparedness.
- Shall be member of site HSE committee and attend all meetings of the committee
- Power source for hand lamps shall be maximum of 24 v.
- Temporary fencing should be done for open edges if Hand – railings and Toe-guards are not available.

7.2.2 HEALTH, SAFETY AND ENVIRONMENT OFFICER OF SUBCONTRACTOR

- Carry out safety inspection of Work Area, Work Method, Men, Machine & Material, P&M and other tools and tackles.
- Facilitate inclusion of safety elements into Work Method Statement.
- Highlight the requirements of safety through Tool-box / other meetings.
- Help concerned HOS to prepare Job Specific instructions for critical jobs.
- Conduct investigation of all incident/dangerous occurrences & recommend appropriate safety measures.
- Advice & co-ordinate for implementation of HSE permit systems, OCPs & MPs.
- Convene HSE meeting & minute the proceeding for circulation & follow-up action.
- Plan procurement of PPE & Safety devices and inspect their healthiness.
- Report to PS Region/HQ on all matters pertaining to status of safety and promotional program at site level.
- Facilitate administration of First Aid
- Facilitate screening of workmen and safety induction.
- Conduct fire Drill and facilitate emergency preparedness
- Design campaigns, competitions & other special emphasis programs to promote safety in the workplace.
- Apprise PS– Region on safety related problems.
- Notify site personnel non-conformance to safety norms observed during site visits / site inspections.
- Recommend to Site In charge, immediate discontinuance of work until rectification, of such situations warranting immediate action in view of imminent danger to life or property or environment.
- To decline acceptance of such PPE / safety equipment that do not conform to specified requirements.
- Encourage raising Near Miss Report on safety along with, improvement initiatives on safety.
- Shall work as interface between various agencies such customer, package-in-charges, subcontractors on HSE matters

8.0 PLANNING BY SUBCONTRACTOR

Monthly planning and review of HSE activities shall be carried out by subcontractor as per format No. HSEP:14-F30 jointly along with BHEL.

8.1 MOBILISATION OF MACHINERY/EQUIPMENT/TOOLS BY SUBCONTRACTOR

- As a measure to ensure that machinery, equipment and tools being mobilized to the construction site are fit for purpose and are maintained in safe operating condition and complies with legislative and owner requirement, inspection shall be arranged by in-house competent authority for acceptance as applicable.

- The machinery and equipment to be embraced for this purpose shall include but not limited to the following:

    - Mobile cranes.
    - Side Booms.
    - Forklifts.
    - Grinding machine.
    - Drilling machine.
    - Air compressors.
    - Welding machine.
    - Generator sets.
    - Dump Trucks.
    - Excavators.
    - Dozers
    - Grit Blasting Equipment.
    - Hand tools.

- Subcontractor shall notify the engineer, of his intention to bring on to site any equipment or any container, with liquid or gaseous fuel or other substance which may create a hazard. The Engineer shall have the right to prescribe the condition under which such equipment or container may be handled and used during the performance of the works and the subcontractor shall strictly adhere to such instructions. The Engineer shall have the right to inspect any construction tool and to forbid its use, if in his opinion it is unsafe. No claim due to such prohibition will be entertained.

8.2 MOBILISATION OF MANPOWER BY SUBCONTRACTOR

- The subcontractor shall arrange induction and regular health check of their employees as per schedule VII of BOCW rules by a registered medical practitioner.
- The subcontractor shall take special care of the employees affected with occupational diseases under rule 230 and schedule II of BOCW Rules. The employees not meeting the fitness requirement should not be engaged for such job.
- Ensure that the regulatory requirements of excessive weight limit (to carry/lift/ move weights beyond prescribed limits) for male and female workers are complied with.
- Appropriate accommodation to be arranged for all workmen in hygienic condition.

8.3 PROVISION OF PPEs

- Personnel Protective Equipment (PPEs), in adequate numbers, will be made available at site & their regular use by all concerned will be ensured
- The following matrix recommends usage of minimum PPEs against the respective job.

Sl. No	Type of work	PPEs
1	Concrete and asphalt mixing	Nose mask, hand glove, apron and gum boot
2	Welders/Grinders/ Gas cutters	Welding/face screen, apron, hand gloves, nose mask and ear muffs if noise level exceeds 90dB. Helmet fitted with welding shield is preferred for welders
3	Stone/ concrete breakers	Ear muffs, safety goggles, hand gloves
4	Electrical Work	Rubber hand glove, Electrical Resistance shoes
5	Insulation Work	Respiratory mask, Hand gloves, safety goggles
6	Work at height	Double lanyard full body harness, Fall arrestor (specific cases)
7	Grit/Sand blasting	Blast suit, blast helmet, respirator, leather gloves
8	Painting	Plastic gloves, Respirators (particularly for spray painting)
9	Radiography	As per BARC guidelines

- The PPEs shall conform to the relevant standards as below and bear ISI mark.

Relevant is-codes for personal protection

IS: 2925 – 1984	Industrial Safety Helmets.
IS: 4770 – 1968	Rubber gloves for electrical purposes.
IS: 6994 – 1973 (Part-I)	Industrial Safety Gloves (Leather &Cotton Gloves).
IS: 1989 – 1986 (Part-I-II)	Leather safety boots and shoes.
IS: 5557 – 1969	Industrial and Safety rubber knee boots.
IS: 6519 – 1971	Code of practice for selections care and repair of Safety footwear.
IS: 11226 – 1985	Leather Safety footwear having direct molding sole.
IS: 5983 – 1978	Eye protectors.
IS: 9167 – 1979	Ear protectors.
IS: 1179-1967	Eye & Face protection during welding
IS: 3521 – 1983	Industrial Safety Belts and Harness
IS:8519 -1977	Guide for selection of industrial Safety equipment for body protection
IS:9473-2002,14166-1994,14746-1999	Respiratory Protective Devices

The list is not exhaustive. The safety officer may demand additional PPEs based on specific requirement.

- Where workers are employed in sewers and manholes, which are in use, the subcontractor shall ensure that the manhole covers are opened and ventilated at least for an hour before the workers are allowed to get into manhole, and the manholes so opened shall be cordoned off with suitable railing and provided with warning signals or boards to prevent incident to the public
- Besides the PPEs mentioned above, the persons shall use helmet and safety shoe. The visitors shall use Helmet and any other PPEs as deemed appropriate for the area of work.

Colour scheme for Helmets:

1. Workmen: Yellow
2. Safety staff: Green or white with green band
3. Electrician: Red
4. Others including visitors: White

- All the PPEs shall be checked for its quality before issue and the same shall be periodically checked. The users shall be advised to check the PPEs themselves for any defect before putting on. The defective ones shall be repaired/ replaced.
- The issuing agency shall maintain register for issue and receipt of PPEs.
- The Helmets shall have logo or name (abbreviation of agency name permitted) affixed or printed on the front.
- The body harnesses shall be serial numbered.

8.4 ARRANGEMENT OF INFRASTRUCTURE

8.4.1 DRINKING WATER

- Drinking water shall be provided and maintained at suitable places at different elevations.
- Container should be labeled as " Drinking Water"
- Cleaning of the storage tank shall be ensured atleast once in 3 months indicating date of cleaning and next due date.
- Potability of water should be tested as per IS10500 at least once in a year.

8.4.2 WASHING FACILITIES

- In every workplace, adequate and suitable facilities for washing shall be provided and maintained.
- Separate and adequate cleaning facilities shall be provided for the use of male and female workers. Such facilities shall be conveniently accessible and shall be kept in clean and hygienic condition and dully illuminated for night use.
- Overalls shall be supplied by the subcontractor to the workmen and adequate facilities shall be provided to enable the painters and other workers to wash during the cessation of work.

8.4.3 LATRINES AND URINALS

- Latrines and urinals shall be provided in every work place.
- Urinals shall also be provided at different elevations.
- They shall be adequately lighted and shall be maintained in a clean and sanitary condition at all times, by appointing designated person.
- Separate facilities shall be provided for the use of male and female worker if any.

8.4.4 PROVISION OF SHELTER DURING REST

Proper Shed & Shelter shall be provided for rest during break

8.4.5 MEDICAL FACILITIES

8.4.5.1 MEDICAL CENTRE (As per Schedule V, X and XI of BOCW central Rules, 1998)

- A medical centre shall be ensured/identified at site with basic facilities for handling medical emergencies. The medical center can be jointly developed on proportionate sharing basis with permission from BHEL
- A qualified medical professional, not less than MBBS, shall be deployed at the medical centre
- The medical centre shall be equipped with one ambulance, with trained driver and oxygen cylinder.
- Medical waste shall be disposed as per prevailing legislation (Bio-Medical Waste –Management and Handling Rules, 1998)

8.4.5.2 FIRST AIDER

- Ensure availability of Qualified First-aider throughout the working hours.
- Every injury shall be treated, recorded and reported.
- Refresher course on first aid shall be conducted as necessary.
- List of Qualified first aiders and their contact numbers should be displayed at conspicuous places.

8.4.5.3 FIRST AID BOX (as per schedule III of BOCW)

- The subcontractor shall provide necessary first aid facilities as per schedule III of BOCW. At every work place first aid facilities shall be provided and maintained.
- The first aid box shall be kept by first aider who shall always be readily available during the working hours of the work place. His name and contact no to be displayed on the box.
- The first aid boxes should be placed at various elevations so as to make them available within the reach and at the quickest possible time.
- The first aid box shall be distinctly marked with a Green Cross on white background.
- Details of contents of first aid box is given in Annexure No. 01
- Monthly inspection of First Aid Box shall be carried out by the owner as per format no. HSEP:14-F01
- The subcontractor should conduct periodical first –aid classes to keep his supervisor and Engineers properly trained for attending to any emergency.

8.4.5.4 HEALTH CHECK UP (As per schedule VII and Form XI)

The persons engaged at the site shall undergo health checkup as per the format no. HSEP:14-F02 before induction. The persons engaged in the following works shall undergo health checkup at least once in a year:

a. Height workers
b. Drivers/crane operators/riggers

c. Confined space workers
d. Shot/sand blaster
e. Welding and NDE personnel

8.4.6 PROVISION OF CANTEEN FACILITY

- Canteen facilities shall be provided for the workmen of the project inside the project site.
- Proper cleaning and hygienic condition shall be maintained.
- Proper care should be taken to prevent biological contamination.
- Adequate drinking water should be available at canteen.
- Fire extinguisher shall be provided inside canteen.
- Regular health check-up and medication to the canteen workers shall be ensured.

8.4.7 PROVISION OF ACCOMODATION/LABOUR COLONY

- The subcontractor shall arrange for the accommodation of workmen at nearby localities or by making a labour colony.
- Regular housekeeping of the labour colony shall be ensured.
- Proper sanitation and hygienic conditions to be maintained.
- Drinking water and electricity to be provided at the labour colony.
- Bathing/ washing bay
- Room ventilation and electrification.

8.4.8 PROVISION OF EMERGENCY VEHICLE

- Dedicated emergency vehicle shall be made available at workplace by each subcontractor to handle any emergency

8.4.9 PEST CONTROL

Regular pest control should be carried out at all offices, mainly laboratories, canteen, labour colony and stores.

8.4.10 SCRAPYARD

- In consultation with customer, scrapyard shall be developed to store metal scrap, wooden scrap, waste, hazardous waste.
- Scrap/Waste shall be segregated as Bio-degradable and non-bio-degradable and stored separately.

8.4.11 ILLUMINATION

- The subcontractor shall arrange at his cost adequate lighting facilities e.g. flood lighting, hand lamps, area lighting etc. at various levels for safe and proper working operations at dark places and during night hours at the work spot as well as at the pre-assembly area.

- Adequate and suitable light shall be provided at all work places & their approaches including passage ways as per IS: 3646 (Part-II). Some recommended values are given below:

S. No.	Location	Illumination (Lux)
A.	**Construction Area**	
1.	Outdoor areas like store yards, entrance and exit roads	20
2.	Platforms	50
3.	Entrances, corridors and stairs	100
4.	General illumination of work area	150
5.	Rough work like fabrication, assembly of major items	150
6.	Medium work like assembly of small machined parts rough measurements etc.	300
7.	Fine work like precision assembly, precision measurements etc.	700
8.	Sheet metal works	200
9.	Electrical and instrument labs	450
B.	**Office**	
1.	Outdoor area like entrance and exit roads	20
2.	Entrance halls	150
3.	Corridors and lift cars	70
4.	Lift landing	150
5.	Stairs	100
6.	Office rooms, conference rooms, library reading tables	300
7.	Drawing table	450
8.	Manual telephone exchange	200

- Lamp (hand held) shall not be powered by mains supply but either by 24V or dry cells.
- Lamps shall be protected by suitable guards where necessary to prevent danger, in case of breakage of lamp.
- Emergency lighting provision for night work shall be made to minimise danger in case of main supply failure.

If the subcontractor fails to take appropriate safety precautions or to provide necessary safety devices and equipment or to carry out instructions issued by the authorized BHEL official, BHEL shall have the right to take corrective steps at the risk and cost of the subcontractor

9.0 HSE TRAINING& AWARENESS

9.1 HSE INDUCTION TRAINING

All persons entering into project site shall be given HSE induction training by the HSE officer of BHEL /subcontractor before being assigned to work.

In-house induction training subjects shall include but not limited to:

- Briefing of the Project details.
- Safety objectives and targets.
- Site HSE rules.
- Site HSE hazards and aspects.
- First aid facility.
- Emergency Contact No.
- Incident reporting.
- Fire prevention and emergency response.
- Rules to be followed in the labour colony (if applicable)

- Proper safety wear & gear must be issued to all the workers being registered for the induction (i.e., Shoes/Helmets/Goggles/Leg guard/Apron etc.)
- They must arrive fully dressed in safety wear & gear to attend the induction.
- Any one failing to conform to this safety wear& gear requirement shall not qualify to attend.
- On completing attending subcontractor's in-house HSE induction, each employee shall sign an induction training form (format no. HSEP:14-F03) to declare that he had understood the content and shall abide to follow and comply with safe work practices. They may only then be qualified to be issued with a personal I.D. card, for access to the work site.

9.2 HSE TOOLBOX TALK

- HSE tool Box talk shall be conducted by frontline foreman/supervisor of subcontractor to specific work groups prior to the start of work. The agenda shall consist of the followings:
    - Details of the job being intended for immediate execution.
    - The relevant hazards and risks involved in executing the job and their control and mitigating measures.
    - Specific site condition to be considered while executing the job like high temperature, humidity, unfavorable weather etc.
    - Recent non-compliances observed.
    - Appreciation of good work done by any person.
    - Any doubt clearing session at the end.
- Record of Tool box talk shall be maintained as per format no. HSEP:14-F04
- Tool box talk to be conducted at least once a week for the specific work.

9.3 TRAINING ON HEIGHT WORK

Training on height work shall be imparted to all workers working at height by in-house/external faculty at least twice in a year. The training shall include following topics:

- Use of PPEs
- Use of fall arrester, retractable fall arrester, life line, safety nets etc.
- Safe climbing through monkey ladders.
- Inspection of PPEs.
- Medical fitness requirements.
- Mock drill on rescue at height.
- Dos & Don'ts during height work.

9.4 HSE TRAINING DURING PROJECT EXECUTION

- Other HSE training shall be arranged by BHEL/ subcontractor as per the need of the project execution and recommendation of HSE committee of site.
- The topics of the HSE training shall be as follows but not limited to:
    - Hazards identification and risk analysis (HIRA)
    - Work Permit System
    - Incident investigation and reporting
    - Fire fighting
    - First aid
    - Fire-warden training
    - EMS and OHSMS
    - T & Ps fitness and operation

- Electrical safety
- Welding, NDE & Radiological safety
- Storage, preservation & material handling.

- A matrix shall be maintained to keep an up-to-date record of attendance of training sessions carried out.

9.5 HSE PROMOTION-SIGNAGE, POSTERS, COMPETITION, AWARDS ETC

9.5.1 Display of HSE posters and banners

- Site shall arrange appropriate posters, banners, slogans in local/Hindi/English languages at work place

9.5.2 Display of HSE signage

- Appropriate HSE signage shall be displayed at the work area to aware workmen and passersby about the work going on and do's and don'ts to be followed

9.5.3 Competition on HSE and award

- Site will arrange different competition (slogan, poster, essay etc.) on HSE time to time (Safety day, BHEL day, World Environment Day etc.) and winners will be suitably awarded.

9.5.4 HSE awareness programme

- Subcontractor shall arrange HSE awareness programme periodically on different topics including medical awareness for all personnel working at site

10.0 HSE COMMUNICATION

10.1 INCIDENT REPORTING

- The subcontractor shall submit report of all incidents, fires and property damage etc to the Engineer immediately after such occurrence, but in any case not later than 24 hours of the occurrence. Such reports shall be furnished in the manner prescribed by BHEL. (Refer HSE procedure for incident investigation, analysis and reporting for details)
- In addition, periodic reports on safety shall also be submitted by the subcontractor to BHEL from time to time as prescribed by the Engineer. Compiled monthly reports of all kinds of incidents, fire and property damage to be submitted to BHEL safety officer as per prescribed formats.
- HSE incidents of site shall be reported to BHEL site Management as per Procedure for Incident Investigation and Reporting in format no. HSEP:14-F15. Corrective action shall be immediately implemented at the work place and compliance shall be verified by BHEL HSE officer and until then, work shall be put on hold by Construction Manager.

10.2 HSE EVENT REPORTING

- Important HSE events like HSE training, Medical camp etc. organized at site shall be reported to BHEL site management in detail with photographs for publication in different in-house magazines
- Celebration of important days like National Safety Day, World Environment Day etc. shall also be reported as mentioned above.

10.3 DAILY HSE ACTIVITY REPORTING

Daily HSE activities shall be reported by subcontractor to BHEL as per Format No. HSEP:14-F31A

11.0 OPERATIONAL CONTROL

All applicable OCPs (Operational control procedures) will be followed by subcontractor as per BHEL instructions. This will be done as part of normal scope of work. List of such OCPs is given below. In case any other OCP is found to be applicable during the execution of work at site, then subcontractor will follow this as well, within quoted rate. These OCPs (applicable ones) will be made available to subcontractor during work execution at site. However for reference purpose, these are kept with Safety Officer of BHEL at the Power Sector Regional HQ, or available in downloadable format in the website, which may be refereed by subcontractor, if they so desire.

LIST OF OCPs

Safe handling of chemicals	Safety in use of cranes	Hydraulic test
Electrical safety	Storage and handling of gas cylinders	Spray insulation
Energy conservation	Manual arc welding	Trial run of rotary equipment
Safe welding and gas cutting operation	Safe use of helmets	Stress relieving
Fire safety	Good house keeping	Material preservation
Safety in use of hand tools	Working at height	Cable laying/tray work
First aid	Safe excavation	Transformer charging
Food safety at canteen	Safe filling of hydrogen in cylinder	Electrical maintenance
Illumination	Vehicle maintenance	Safe handling of battery system
Handling and erection of heavy metals	Safe radiography	Computer operation
Safe acid cleaning	Waste disposal	Storage in open yard
Safe alkali boil out	Working at night	For sanitary maintenance
Safe oil flushing	Blasting	Batching
Steam blowing	DG set	Piling rig operation
Safe working in confined area	Handling & storage of mineral wool	Gas distribution test
Safe operation of passenger lift, material hoists & cages	Drilling, reaming and grinding(machining)	Cleaning of hotwell / deaerator
Electro-resistance heating	Compressor operation	O&M of control of AC plant & system
Air compressor	Passivation	Safe Loading of Unit
Safe EDTA Cleaning	Safe Chemical cleaning of Pre boiler system	Safe Boiler Light up
Safe Rolling and Synchronization		

11.1 HSE ACTIVITIES

HSE activities shall be conducted at site based on the HSEMSM developed by Power Sector and issued to site by Regions.
While planning for any activity the following documents shall be referred for infrastructural requirements to establish control measures:

1) HSE Procedure for Register of OHS Hazards and Risks
2) HSE Procedure for Register of Environmental Aspects and Impacts
3) HSE Procedure for Register of Regulations

4) Operational Control Procedures
5) HSE Procedure for Emergency Preparedness and Response Plan
6) Contract documents

11.2 WORK PERMIT SYSTEM

- The following activities shall come under Work Permit System
  a. Height working above 2 metres
  b. Hot working at height
  c. Confined space
  d. Radiography
  e. Excavation more than 4 meter depth
  f. Heavy lifting above 50 ton
  Refer Annexure 05 for Work permit formats.
- "HSE Procedure for Work Permit System" shall be followed while implementing permit system. Where customer is having separate Work Permit System the same shall be followed.
- Permit applicant shall apply for work permit of particular work activity at particular location before starting of the work with Job Hazard Analysis.
- Permit signatory shall check that all the control measures necessary for the activity are in place and issue the permit to the permit holder.
- Permit holder shall implement and maintain all control measures during the period of permit .He will close the permit after completion of the work. The closed permit shall be archived in HSE Department of site.

11.3 SAFETY DURING WORK EXECUTION

Respective OCPS are to be followed and adherence to the same would be contractually binding

11.3.1 WELDING SAFETY

All safety precautions shall be taken for welding and cutting operations as per IS-818. All safety precautions shall be taken for foundation and other excavation marks as per IS-3764.

11.3.2 RIGGING

Rigging equipment shall not be loaded in excess of its recommended safe working load. Rigging equipment, when not in use, shall be removed from the original work area so as not to present a hazard to employees.

11.3.3 CYLINDERS STORAGE AND MOVEMENT

All gas cylinders shall be stored in upright position. Suitable trolley shall be used. There shall be flash-back arrestors conforming to IS-11006 at both cylinder and burner ends. Damaged tube and regulators must be immediately replaced. No of cylinders shall not exceed the specified quantity as per OCP
Cylinders shall be moved by tilting and rolling them on their bottom edges. They shall not be intentionally dragged, struck or permitted to strike each other violently.

When cylinders are transported by powered vehicle they shall be secured in a vertical position.

11.3.4 DEMOLITION WORK

Before any demolition work is commenced and also during the process of the work the following shall be ensured:

- All roads and open areas adjacent to the work site shall either be closed or suitably protected.
- No electric cable or apparatus which is liable to be a source of danger nor a cable or an apparatus used by the operator shall remain electrically charged.
- All practical steps shall be taken to prevent danger to persons employed from the risks of fire or explosion or flooding. No floor, roof or other part of the building shall be so overloaded with debris or materials as to render them unsafe.

11.3.5 T&Ps

All T&Ps/ MMEs should be of reputed brand/appropriate quality & must have valid test/calibration certificates bearing endorsement from competent authority of BHEL..Subcontractor to also submit monthly reports of T&Ps deployed and validity test certificates to BHEL safety Officer as per the format/procedure of BHEL.

11.3.6 CHEMICAL HANDLING

Displaying safe handling procedures for all chemicals such as lube oil, acid, alkali, sealing compounds etc , at work place.Where it is necessary to provide and/or store petroleum products or petroleum mixture & explosives, the subcontractor shall be responsible for carrying out such provision / storage in accordance with the rules & regulations laid down in the relevant petroleum act, explosive act and petroleum and carbide of calcium manual, published by the chief inspector of explosives of India. All such storage shall have prior approval if necessary from the chief inspector of explosives or any other statutory authority. The subcontractor shall be responsible for obtaining the same.

11.3.7 ELECTRICAL SAFETY

- Providing adequate no. of 24 V sources and ensure that no hand lamps are operating at voltage level above 24 Volts.
- Fulfilling safety requirements at all power tapping points.
- High/ Low pressure welders to be identified with separate colour clothings. No welders will be deployed without passing appropriate tests and holding valid welding certificates. Approved welding procedure should be displayed at work place.
- The subcontractor shall not use any hand lamp energized by Electric power with supply voltage of more than 24 volts in confined spaces like inside water boxes, turbine casings, condensers etc.
- All portable electric tools used by the subcontractor shall have safe plugging system to source of power and be appropriately earthed. Only electricians licensed by appropriate statutory authority shall be employed by the subcontractor to carry out all types of electrical works. Details of earth resource ad their test date to be given to BHEL safety officer as per the prescribed formats of BHEL
- The subcontractor shall use only properly insulated and armored cables which conform to the requirement of Indian Electricity Act and Rules for all wiring, electrical applications at site.

- BHEL reserves the right to replace any unsafe electrical installations, wiring, cabling etc. at the cost of the subcontractor.
- All electrical appliances used in the work shall be in good working condition and shall be properly earthed.
- No maintenance work shall be carried out on live equipment.
- The subcontractor shall maintain adequate number of qualified electricians to maintain his temporary electrical installations.
- Area wise Electrical safety inspection is to be carried out on monthly basis as per "Electrical Safety Inspection checklist' and the report is to be submitted to BHEL safety officer
- Adequate precautions shall be taken to prevent danger for electrical equipment. No materials on any of the sites of work shall be so stacked or placed as to cause danger or inconvenience to any person or the public
- The subcontractor shall carefully follow the safety requirement of BHEL/ the purchaser with the regard to voltages used in critical areas.

11.3.8 FIRE SAFETY

- Providing appropriate fire fighting equipment at designated work place and nominate a fire officer/warden adequately trained for his job.
- Subcontractor shall provide enough fire protecting equipment of the types and numbers at his office, stores, temporary structure in labor colony etc. Such fire protection equipment shall be easy and kept open at all times.
- The fire extinguishers shall be properly refilled and kept ready which should be certified at periodic intervals. The date of changing should be marked on the Cylinders.
- All other fire safety measures as laid down in the "codes for fire safety at construction site" issued by safety coordinator of BHEL shall be followed.
- Non-compliance of the above requirement under fire protection shall in no way relieve the subcontractor of any of his responsibility and liabilities to fire incident occurring either to his materials or equipment or those of others.
- Emergency contacts nos must be displayed at prominent locations
- Tarpaulin being inflammable should not be used (instead, only non-infusible covering materials shall be used) as protective cover while preheating, welding, stress relieving etc. at site.

11.3.9 SCAFFOLDING

- Suitable scaffolds shall be provided for workman for all works that cannot safely be done from the ground, or from solid construction except in the case of short duration of work which can be done safely from ladders.
- When a ladder is used, it shall be of rigid construction made of steel. The steps shall have a minimum width of 45 cm and a maximum rise of 30 cm. Suitable handholds of good quality wood or steel shall be provided and the ladder shall be given an inclination not steeper then ¼ horizontal and 1 vertical.
- Scaffolding or staging more than 3.6 m above the ground floor, swung or suspended from an overhead support or erected with stationery support shall have a guard rail properly bolted, braced or otherwise secured, at least 90 cm above the floor or platform of such scaffolding or staging and extending along the entire length of the outside and ends thereof with only such openings as may be necessary for the delivery of materials. Such scaffolding or staging shall be so fastened as to prevent it from saver, from swaying, from the building or structure.

11.3.10 **WORK AT HEIGHT**:

- Guardrails and toe-board/barricades and sound platform conforming to IS:4912-1978 should be provided.

- Wherever necessary, life-line (pp or metallic) and fall arrestor along with Polyamide rope or Retractable lifeline should be provided.
- Safety Net as per IS:11057:1984 should be used extensively for prevention/ arrest of men and materials falling from height. The safety nets shall be fire resistant, duly tested and shall be of ISI marked and the nets shall be located as per site requirements to arrest or to reduce the consequences of a possible fall of persons working at different heights.
- Reaching beyond barricaded area without lifeline support, moving with support of bracings, walking on beams without support, jumping from one level to another, throwing objects and taking shortcut must be discouraged.
- Use of Rebar steel for making Jhoola and monkey-ladder (Rods welded to vertical or inclined structural members), temporary platform etc. must be avoided.
- Monkey Ladder should be properly made and fitted with cages.
- Jhoola should be made with angles and flats and tested like any lifting tools before use.
- Lanyard must be anchored always and in case of double lanyard, each should be anchored separately.
- In case of pipe-rack, persons should not walk on pipes and walk on platforms only.
- In case of roof work, walking ladder/ platform should be provided along with lifeline and/ or fall arrestor.
- Empty drums must not be used.
- For chimney or structure painting, both hanging platform and men should be anchored separately to a firm structure along with separate fall arrestor. Rope ladder should be discouraged.

11.3.11 WORKING PLATFORM

Working platforms, gangways and stairways shall be so constructed that they do not sag unduly or unequally and if the height of the platform gangways provided is more than 3.6 m above ground level or floor level, they shall be closely boarded and shall have adequate width which shall not be less than 750 mm and be suitably fenced as described above. Every opening in the floor or a building or in a working platform shall be provided with suitable means to prevent the fall of persons or materials by providing suitable fencing or railing whose minimum height shall be 90 cm.

11.3.12 EXCAVATION

Wherever there are open excavation in ground, they shall be fenced off by suitable railing and danger signals installed at night so as to prevent persons slipping into the excavations.

11.3.13 LADDER SAFETY

Safe means of access shall be provided to all working places. Every ladder shall be securely fixed. No portable single ladder shall be over 9 m in the length while the width between side rails in rung ladder shall in no case be less than app. 29.2 cm for ladder upto and including 3 m in length. For longer ladders this width shall be increased at least ¼'' for each additional foot of length.

A sketch of the ladders and scaffolds proposed to be used shall be prepared and approval of the Engineer obtained prior to Construction.

11.3.14 LIFTING SAFETY

- It will be the responsibility of the subcontractor to ensure safe lifting of the equipment, taking due precaution to avoid any incident and damage to other equipment and personnel.

- All requisite tests and inspection of handling equipment, tools & tackle shall be periodically done by the subcontractor by engaging only the Competent Persons as per law.
- Defective equipment or uncertified shall be removed from service.
- Any equipment shall not be loaded in excess of its recommended safe working load.

11.3.15 HOISTING APPLIANCE

- Motors, gearing, transmission, electric wiring and other dangerous parts of hoisting appliances should be provided with efficient safe guards.
- Hoisting appliance should be provided with such means as will reduce to the minimum the risk of any part of a suspended load becoming incidentally displaced.
- When workers employed on electrical installations which are already energized, insulating mats, wearing apparel, such as gloves, sleeves and boots as may be necessary should be provided.
- The worker should not wear any rings, watches and carry keys or other materials which are good conductor of electricity.

11.4 ENVIRONMENTAL CONTROL

Environment protection has always been given prime importance by BHEL. Environmental damage is a major concern of the principal subcontractor and every effort shall be made, to have effective control measures in place to avoid pollution of Air, Water and Land and associated life. Chlorofluorocarbons such as carbon tetrachloride and trichloroethylene shall not be used. Waste disposal shall be done in accordance with the guidelines laid down in the project specification.

Any chemical including solvents and paints, required for construction shall be stored in designated bonded areas around the site as per Material Safety Data Sheet (MSDS).

In the event of any spillage, the principle is to recover as much material as possible before it enters drainage system and to take all possible action to prevent spilled materials from running off the site. The subcontractor shall use appropriate MSDS for clean-up technique

All subcontractors shall be responsible for the cleanliness of their own areas.

The subcontractors shall ensure that noise levels generated by plant or machinery are as low as reasonably practicable. Where the subcontractor anticipates the generation of excessive noise levels from his operations the subcontractor shall inform to Construction Manager of BHEL accordingly so that reasonable &practicable precautions can be taken to protect other persons who may be affected.
It is imperative on the part of the subcontractor to join and effectively contribute in joint measures such as tree plantation, environment protection, contributing towards social upliftment, conversion of packing woods to school furniture, keeping good relation with local populace etc.
The subcontractor shall carry out periodic air and water quality check and illumination level checking in his area of work place and take suitable control measure.

11.5 HOUSEKEEPING

- Keeping the work area clean/ free from debris, removed scaffoldings, scraps, insulation/sheeting wastage /cut pieces, temporary structures, packing woods etc. will be in the scope of the subcontractor. Such cleanings has to be done by

subcontractor within quoted rate, on daily basis by an identified group. If such activity is not carried out by subcontractor / BHEL is not satisfied, then BHEL may get it done by other agency and actual cost along with BHEL overheads will be deducted from contractor's bill. Such decisions of BHEL shall be binding on the subcontractor

- Proper housekeeping to be maintained at work place and the following are to be taken care of on daily basis.
- All surplus earth and debris are removed/disposed off from the working areas to identified locations.
- Unused/Surplus cables, steel items and steel scrap lying scattered at different places/elevation within the working areas are removed to identified locations.
- All wooden scrap, empty wooden cable drums and other combustible packing materials, shall be removed from workplace to identified locations. Sufficient waste bins shall be provided at
- Different work places for easy collection of scrap/waste. Scrap chute shall be installed to remove scrap from high location.
- Access and egress (stair case, gangways, ladders etc.) path should be free from all scrap and other hindrances.
- Workmen shall be educated through tool box talk about the importance of housekeeping and encourage not to litter.
- Labour camp area shall be kept clear and materials like pipes, steel, sand, concrete, chips and bricks, etc. shall not be allowed in the camp to obstruct free movement of men and machineries.
- Fabricated steel structures, pipes & piping materials shall be stacked properly.
- No parking of trucks/trolleys, cranes and trailers etc. shall be allowed in the camp, which may obstruct the traffic movement as well as below LT/HT power line.
- Utmost care shall be taken to ensure over all cleanliness and proper upkeep of the working areas

11.6 WASTE MANAGEMENT

Take suitable measures for waste management and environment related laws/legislation as a part of normal construction activities. Compliance with the legal requirements on storage/ disposal of paint drums (including the empty ones), Lubricant containers, Chemical Containers, and transportation and storage of hazardous chemicals will be strictly maintained.

11.6.1 BINS AT WORK PLACE

- Sufficient rubbish bins shall be provided close to workplaces.
- Bins should be painted yellow and numbered.
- Sufficient nos. of drip trays shall be provided to collect oil and grease.
- Sufficient qty. of broomsticks with handle shall be provided.
- Adequate strength of employees should be deployed to ensure daily monitoring and service for waste management.

11.6.2 STORAGE AND COLLECTION

- Different types of rubbish/waste should be collected and stored separately.
- Paper, oily rags, smoking material, flammable, metal pieces should be collected in separate bins with close fitting lids.
- Rubbish should not be left or allowed to accumulate on construction and other work places.
- Do not burn construction rubbish near working site.

11.6.3 SEGREGATION

- Earmark the scrap area for different types of waste.
- Store wastes away from building.
- Oil spill absorbed by non-combustible absorbent should be kept in separate bin.
- Clinical and first aid waste stored and incinerated separately.

11.6.4 DISPOSAL

- Sufficient containers and scrap disposal area should be allocated.
- All scrap bin and containers should be conveniently located.
- Provide self-closing containers for flammable/spontaneously combustible material.
- Keep drainage channels free from choking.
- Make schedule for collection and disposal of waste.

11.6.5 WARNING AND SIGNS

- Appropriate sign to be displayed at scrap storage area
- No toxic, corrosive or flammable substance to be discarded into public sewage system.
- Waste disposal shall be in accordance with best practice.
- Comply with all the requirements of Pollution Control Board (PCB) for storage and disposal of hazardous waste.

11.7 TRAFFIC MANAGEMENT SYSTEM

11.7.1 SAFE WORKPLACE TRANSPORT SYSTEM

- Traffic routes in a work place shall be suitable for the persons or vehicles using them. This shall be sufficient in number and of sufficient size. This shall reflect the suitability of traffic routes for vehicles and pedestrians.
- Where vehicles and pedestrians use the same traffic routes there shall be sufficient space between them. Where necessary all traffic routes must be suitably indicated. Pedestrians or vehicles must be able to use traffic routes without endangering those at work. There must be sufficient separation of traffic routes from doors, gates and pedestrian traffic routes.
- For internal traffic, lines marked on roads / access routes and between buildings shall clearly indicate where vehicles are to pass.
- Temporary obstacles shall be brought to the attention of drivers by warning signs or hazard cones.
- Speed limits shall be clearly displayed. Speed ramps preceded by a warning signs or marker are necessary.
- The traffic route should be wide enough to allow vehicles to pass and re-pass oncoming or parked traffic and it may be advisable to introduce on-way system or parking restrictions.
- Safest route shall be provided between places where vehicles have to call or deliver.
- Avoid vulnerable areas/items such as fuel or chemicals tanks or pipes, open or unprotected edges and structures likely to collapse

- Safe areas shall be provided for loading and unloading.
- Avoid sharp or blind bends. If this is not possible hazards should be indicated e.g. blind corner.
- Ensure road crossings are minimum and clearly signed.
- Entrance and gateways shall be wide enough to accommodate a second vehicle without causing obstruction.
- Set sensible speed limits which are clearly sign posted.
- Where necessary ramps should be used to retard speed. This shall be preceded by a warning sign or mark on the road.
- Forklift trucks shall not pass over road hump unless of a type capable of doing so.
- Overhead electric cable, pipes containing flammable hazardous chemical shall be shielded by using goal posts height gauge posts or barriers.
- Road traffic signs shall be provided on prominent locations for prevention of incidents and hazards and for quick guidance and warning to employees and public. Safety signs shall be displayed as per the project working requirement and guideline of the state in which project is done. Vehicles hired or used shall not be parked within the 15m radius of any working area. Any vehicle, that is required to be at the immediate/near the vicinity, shall be approved by the person in-charge of the site.

11.7.2 TRAFFIC ROUTE FOR PEDESTRIANS

- Where traffic routes are used by both pedestrians and vehicles road shall be wide enough to allow vehicles and pedestrians safely.
- Separate routes shall be provided for pedestrians to keep them away from vehicles. Provide suitable barriers/guard at entrances/exit and the corners or buildings.
- Where pedestrian and vehicle routes cross, appropriate crossing shall be provided.
- Where crowd is likely to use roadway e.g. at the end of shift, stop vehicles from using them at such times.
- Provide high visibility clothing for people permitted in delivery area.

11.7.3 WORK VEHICLE

Work vehicle shall be as safe stable efficient and roadworthy as private vehicles on public roads. Site management shall ensure that drivers are suitably trained. All vehicle e.g. heavy motor vehicle forklift trucks dump trucks mobile cranes shall ensure that the work equipment conforms to the following:

- A high level of stability.
- A safe means of access/egress.
- Suitable and effective service and parking brakes.
- Windscreens with wipers and external mirrors giving optimum all round visibility.
- Provision of horn, vehicle lights, reflectors, reversing lights, reversing alarms.
- Provision of seat belts.
- Guards on dangerous parts.
- Driver protection - to prevent injury from overturning and from falling objects/materials.
- Driver protection from adverse weather.
- No vehicle shall be parked below HT/LT power lines.
- Valid Pollution Under Control certification for all vehicles

11.7.4 DAILY CHECK BY DRIVER

- There should also be daily safety checks containing below mentioned points by the driver before the vehicle is used.
  - Brakes.
  - Tires.
  - Steering.
  - Mirrors.
  - Windscreen waters.
  - Wipers.
  - Warning signals.
  - Specific safety system i.e. control interlocks
- Management should ensure that drivers carry out these checks.

11.7.5 TRANSPORTATION OF PERSONNEL AND MATERIALS BY VEHICLES

- All drivers shall hold a valid driving License for the class of vehicle to be driven and be registered as an authorized BHEL driver with the Administration Department.
- Securing of the load shall be by established and approved methods, i.e. chains with patented tightening equipment for steel/heavy loads. Sharp corners on loads shall be avoided when employing ropes for securing.
- All overhangs shall be made clearly visible and restricted to acceptable limits
- Load shall be checked before moving off and after traveling a suitable distance.
- On no account is construction site to be blocked by parked vehicles Drivers of vehicles shall only stop or park in the areas designate by the stringing foreman.
- Warning signs shall be displayed during transportation of material.
  All vehicles used by BHEL shall be in worthy condition and in conformance to the Land Transport requirement.

11.7.6 MAINTENANCE

All Vehicles used for transportation of man and material shall undergo scheduled inspections on frequent intervals to secure safe operation. Such inspections shall be conducted in particular for steering, brakes, lights, horn, doors etc. Site management shall ensure that work equipment is maintained in an efficient, working order and in good repair. Inspections and services carried out at regular intervals of time and or mileage. No maintenance shall be carried below HT/LT power lines.

11.8 EMERGENCY PREPAREDNESS AND RESPONSE

- Emergency preparedness and response capability of site shall be developed as per Emergency Preparedness and Response plan issued by Regional HQ
- Availability of adequate number of first aiders and fire warden shall be ensured with BHEL and its subcontractors
- All the subcontractor's supervisory personnel and sufficient number of workers shall be trained for fire protection systems. Enough number of such trained personnel must be available during the tenure of contract. Subcontractor should nominate his supervisor to coordinate and implement the safety measures.
- Assembly point shall be earmarked and access to the same from different location shall be shown
- Fire exit shall be identified and pathway shall be clear for emergency escape.

- Appropriate type and number of fire extinguisher shall be deployed as per Fire extinguisher deployment plan and validity shall be ensured periodically through inspection
- Adequate number of first aid boxes shall be strategically placed at different work places to cater emergency need. Holder of the first aid box shall be identified on the box itself who will have the responsibility to maintain the same.
- First aid center shall be developed at site with trained medical personnel and ambulance
- Emergency contact numbers (format given in EPRP) of the site shall be displayed at prominent locations.
- Tie up with fire brigade shall be done in case customer is not having fire station.
- Tie up with hospital shall be done in case customer is not having hospital.
- Disaster Management group shall be formed at site
- Mock drill shall be arranged at regular intervals. Monthly report of the above to be given to BHEL safety Officer as per prescribed BHEL formats
- Mock drill shall be conducted on different emergencies periodically to find out gaps in emergency preparedness and taking necessary corrective action

12.0 HSE INSPECTION

Inspection on HSE for different activities being carried out at site shall be done to ensure compliance to HSEMS requirements. The subcontractor shall maintain and ensure necessary safety measures as required for inspection and tests HV test, Pneumatic test, Hydraulic test, Spring test, Bend test etc. as applicable, to enable inspection agency for performing Inspection. If any test equipment is found not complying with proper safety requirements then the Inspection Agency may withhold inspection, till such time the desired safety requirements are met.

12.1 DAILY HSE CHECKS

Both the Site Supervisors and safety officer of Subcontractor are to conduct daily site Safety inspection around work activities and premises to ensure that work methods and the sites are maintained to an acceptable standard. The following are to form the common subjects of a daily safety inspection:

- Personal Safety wears & gear compliance.
- Complying with site safety rules and permit-to-work (PTW).
- Positions and postures of workers.
- Use of tools and equipment etc. by the workers.

The inspection should be carried out just when work starts in beginning of the day, during peak activities period of the day and just before the day's work ends.

12.2 INSPECTION OF PPE

- PPEs shall be inspected by HSE officer at random once in a week as per format no. HSEP:14-F06 for its compliance to standard and compliance to use and any adverse observation shall be recorded in the PPE register.
- The applicable PPEs for carrying out particular activities are listed below.

12.3 INSPECTION OF T&Ps

- A master list of T&Ps shall be maintained by each subcontractor.
- All T&Ps being used at site shall be inspected by HSE officer once in a month as per format no. HSEP:14-F07 for its healthiness and maintenance.
- The T&Ps which require third party inspection shall be checked for its validity during inspection. The third party test certificate should be accompanied with a copy of the concerned competent person's valid qualification record.
- The validity of T&P shall be monitored as per "Status of T&Ps" format no. HSEP:14-F08

12.4 INSPECTION OF CRANES AND WINCHES

- Cranes and winches shall be inspected by the operator through a daily checklist for its safe condition (as provided by the equipment manufacturer) before first use of the day.
- Cranes and Winches shall be inspected by HSE officer once in a month as per format no. HSEP:14-F09 for healthiness, maintenance and validity of third party inspection.
- The date of third party inspection and next due date shall be painted on cranes and winches.
- The operators/drivers shall be authorized by sub-contractor based on their competency and experience and shall carry the I-card.
- The operator should be above 18 years of age and should be in possession of driving license of HMV man & goods), vision test certificate and should have minimum qualification so that he can read the instructions and check list.

12.5 INSPECTION ON HEIGHT WORKING

- Inspection on height working shall be conducted daily by supervisors before start of work to ensure safe working condition including provision of
    - Fall arrestor
    - Lifelines
    - Safety nets
    - Fencing and barricading
    - Warning signage
    - Covering of opening
    - Proper scaffolding with access and egress.
    - Illumination
- Inspection on height working shall be conducted once in a week by HSE officer as per format no. HSEP:14-F10.
- Medical fitness of height worker shall be ensured.
- Height working shall not be allowed during adverse weather.

12.6 INSPECTION ON WELDING AND GAS CUTTING OPERATION

- Supervisor shall ensure that no flammable items are available in near vicinity during welding and gas cutting activity.
- Gas cylinders shall be kept upright.
- Use of Flash back arrestor shall be ensured at both ends.

- Inspection during welding and gas cutting operations shall be carried out by HSE officer once a month as per format no. HSEP:14-F11.
- Use of fire blanket to be ensured to avoid falling of splatters during welding or gas cutting operation at height.
- Availability of fire extinguisher at vicinity shall be ensured.

12.7 INSPECTION ON ELECTRICAL INSTALLATION / APPLIANCES

- Ensure proper earthing in electrical installation
- Use ELCB at electrical booth
- Electrical installation shall be properly covered at top where required
- Use appropriate PPEs while working
- Use portable electrical light < 24 V in confined space and potentially wet area.
- Monthly inspection shall be carried out as per format no. HSEP:14-F12.

12.8 INSPECTION OF ELEVATOR

- Elevators shall be inspected by concerned supervisors once in a week as per format no. HSEP:14-F13.
- All elevators shall be inspected by competent person and validity shall be ensured.
- The date of third party inspection and next due date shall be painted on elevator.

12.9 INSPECTION OF EXCAVATION

Excavation activities shall be inspected as per Format HSEP:14-F13A

13.0 HSE PERFORMANCE

- Contractor shall be assessed on monthly basis for HSE Compliance by BHEL Safety In-charge at site.
  The HSE compliance shall be based on Online HSE Evaluation System by BHEL as per Format No. HSEP:14-F33.
  Only if the bidder qualifies the 'HSE Compliance Criteria' then bidder shall be eligible for further assessment on other parameters.
  Average score of last 6 months for 'HSE Compliance Criteria' for a bidder shall be worked out and Minimum Average Score of last 6 months for a bidder to qualify for future tenders shall be 60. For new vendors (whose past record in Online HSE Evaluation System is not available with BHEL), this criterion shall not be applicable.

  Note: This criterion shall be subject to review by BHEL from time to time as per requirement/ prevailing conditions.

- Suitable HSE reward system shall be developed at site level to promote HSE compliance amongst workmen.
- To decide HSE reward performance towards HSE shall be evaluated for workmen and it shall be awarded regularly in public gathering.
- If safety record of the subcontractor in execution of the awarded job is to the satisfaction of safety department of BHEL, issue of an appropriate certificate to recognize the safety performance of the subcontractor may be considered by BHEL after completion of the job.

14.0 HSE PENALTIES

- As per contractual provision HSE penalties shall be imposed on subcontractors for non- compliance on HSE requirement as per format no. HSEP:14-F14. The list in the format is only indicative. For any other violation, not listed in the format, the minimum penalty amount is to be decided as per BOCW act.
- If principal customer/statutory and regulatory bodies impose some penalty on HSE due to the non-compliance of the subcontractor the same shall be passed on to them.
- The penalty amount shall be recovered by Site Finance department from subcontractors from the RA/Final bill.

15.0 OTHER REQUIREMENTS

- In case of any delay in completion of a job due to mishaps attributable to lapses by the subcontractor, BHEL shall have the right to recover cost of such delay from the payments due to the subcontractor, after notifying the subcontractor suitably.
- If the subcontractor fails to improve the standards of safety in its operation to the satisfaction of BHEL after being given reasonable opportunity to do so and/or if the subcontractor fails to take appropriate safety precautions or to provide necessary safety devices and equipment or to carry out instruction regarding safety issued by BHEL, BHEL shall have the right to take corrective steps at the risk and cost of the subcontractor after giving a notice of not less than 7 days indicating the steps that would be taken by BHEL.
- If the subcontractor succeeds in carrying out its job in time without any fatal or disabling injury incident and without any damage to property BHEL may, at its sole discretion, favorably consider to reward the subcontractor suitably for the performance.
- In case of any damage to property due to lapses by the subcontractor, BHEL shall have the right to recover the cost of such damages from the subcontractor after holding an appropriate enquiry.
- The subcontractor shall take all measures at the sites of the work to protect all persons from incidents and shall be bound to bear the expenses of defense of every suit, action or other proceeding of law that may be brought by any persons for injury sustained or death owing to neglect of the above precautions and to pay any such persons such compensation or which may with the consent of the subcontractor be paid to compromise any claim by any such person, should such claim proceeding be filed against BHEL, the subcontractor hereby agrees to indemnify BHEL against the same.
- The subcontractor shall not employ men below the age of 18 years and women on the work of painting with products containing lead in any form. Wherever men above the age of 18 are employed on the work of lead painting, overalls shall be supplied by the subcontractor to the workmen and adequate facilities shall be provided to enable the working painters to wash during the cessation of work.
- The subcontractor shall notify BHEL of his intention to bring to site any equipment or material which may create hazard.
- BHEL shall have the right to prescribe the conditions under which such equipment or materials may be handled and the subcontractor shall adhere to such instructions.

- BHEL may prohibit the use of any construction machinery, which according to the organization is unsafe. No claim for compensation due to such prohibition will be entertained by BHEL.

16. NON COMPLIANCE

NONCONFORMITY OF SAFETY RULES AND SAFETY APPLIANCES WILL BE VIEWED SERIOUSLY AND BHEL HAS RIGHT TO IMPOSE FINES ON THE SUBCONTRACTOR AS UNDER FOR EVERY INSTANCE OF VIOLATION NOTICED:

SN	Violation of Safety Norms	Fine (in Rs)
01	Not Wearing Safety Helmet	200/- *
02.	Not wearing Safety Belt or not anchoring life line	500/-*
03	Not wearing safety shoe	200/-*
04	Not keeping gas cylinders vertically	200/-
05	Not using flash back arrestors	100/-
06	Not wearing gloves	50/- *
07.	Grinding Without Goggles	50/- *
08.	Not using 24 V Supply For Internal Work	500/-
09.	Electrical Plugs Not used for hand Machine	100/-
10.	Not Slinging properly	200/-
11.	Using Damaged Sling	200/-
12.	Lifting Cylinders Without Cage	500/-
13.	Not Using Proper Welding Cable With Lot of Joints And Not Insulated Property.	200/-
14.	Not Removing Small Scrap From Platforms	500/-
15.	Gas Cutting Without Taking Proper Precaution or Not Using Sheet Below Gas Cutting	500/-
16.	Not Maintaining Electric Winches Which are Operated Dangerously	500/-
17.	Improper Earthing Of Electrical T&P	500/-
18	No or improper barricading	500/-
19.	Activity carried out without Safety work permit (Height work, Lifting activity, Hot work-each person/case)	1000/-
20.	Incident Resulting in Partial Loss in Earning Capacity	25,000/- per victim
21.	Fatal Incident Resulting in total loss in Earning Capacity	1,00,000/- per victim for first instance #

- Legend:-

  *: per head. For repeated violation by the same person, the penalty would be double of the previous penalty. Date of "Repeated violation" will be counted from subsequent days.

  #: or as deducted by customer, whichever is higher. For repeated fatal incident in the same Unit incremental penalty to be imposed. The subcontractor will pay 2 times the penalty compared to previously paid in case there are repeated cases of fatal incidents under the same subcontractor for the same package in the same unit.

Any other non-conformity noticed not listed above will also be fined as deemed fit by BHEL. The decision of BHEL engineer is final on the above. The amount will be deducted from running bills of the subcontractor. The amount collected above will be utilized for giving award to the employees who could avoid incident by following safety rules. Also the amount will be spent for purchasing the safety appliances and supporting the safety activity at site.

17.0 HSE AUDIT/INSPECTION

- Regular HSE Audit/inspection shall be carried out by Subcontractor as per Site HSE audit calendar.
- HSE checklist **(Annexure 02)** shall be used for carrying out audit/inspection and report shall be submitted to BHEL site management
- All non-conformities and observations on HSE identified during internal or external HSE audit shall be disposed off by site in a time bound manner and reported back the implementation status
- Corrective action and Preventive action on HSE issues raised by certification body issued by Regional HQs shall be implemented by site and reported to Site management.

18.0 MONTHLY HSE REVIEW MEETING

- Site shall hold HSE review meeting every month to discuss and resolve HSE issues of site and improve HSE performance. It will also discuss the incidents occurred since previous meeting,its root cause and Corrective action and Preventive action. The agenda is given below:
  - Implementation of earlier MOM
  - HSE performance
  - HSE inspection
  - HSE audit and CAPA
  - HSE training
  - Health check-up camp
  - HSE planning for the erection and commissioning and installation activities in the coming month
  - HSE reward and promotional activities
- The meeting shall be chaired by Construction Manager, convened by HSE coordinator and attended by all HOS, Site Incharge of Subcontractors and HSE officer of Subcontractors.
- MOM on the discussion will be circulated to the concerned for implementation.

19.0 FORMATS USED (Details available in Annexure-04)

SL. No.	Format Name	Format No.	Rev No.
01	Inspection of First Aid Box	HSEP:14-F01	00
02	Health Check Up	HSEP:14-F02	00
03	HSE Induction Training	HSEP:14-F03	00
04	Tool Box Talk	HSEP:14-F04	00
05	Monthly Site HSE Report	As specified by BHEL	00
06	Inspection of PPE	HSEP:14-F06	00

07	Inspection of T&Ps	HSEP:14-F07	00
08	Status of T&Ps	HSEP:14-F08	00
09	Inspection of Cranes and Winches	HSEP:14-F09	00
10	Inspection on Height Working	HSEP:14-F10	00
11	Inspection on Welding & Gas Cutting	HSEP:14-F11	00
12	Inspection on Electrical Installation	HSEP:14-F12	00
13	Inspection on Elevator	HSEP:14-F13	00
14	HSE Penalty	HSEP:14-F14	00
15	Accident /incident / property damage /fire incident report	HSEP:14-F15	00

20.0 ANNEXURES

ANNEXURE 01

As per Contract Labour (Regulation & Abolition Act), Central Rules, 1971,

(1) The first-aid box shall be distinctively marked with a Red Cross on a white background and shall contain the following items, namely:

(a) For establishments in which the number of contract labour employed does not exceed fifty, each first aid box shall contain the following equipment:

(i)	6 small sterilized dressings
(ii)	3 medium size sterilized dressings
(iii)	3 large size sterilized dressings
(iv)	6 pieces of sterilized eye pads in separate sealed packets.
(v)	6 roller bandages 10 cm wide.
(vi)	6 roller bandages 5 cm wide.
(vii)	One tourniquet
(viii)	A supply of suitable splints
(ix)	Three packets of safety pins.
(x)	Kidney tray.
(xi)	3 large sterilized burn dressings.
(xii)	1 (30ml) bottle containing a two percent alcoholic solution of iodine
(xiii)	1 (30 ml) bottle containing Sal volatile having the dose and mode of administration indicated on the label
(xiv)	1 snake bite lancet
(xv)	1 (30gms) bottle of potassium permanganate crystals.
(xvi)	1 pair scissors
(xvii)	1 copy of the First-Aid leaflet issued by the Director General, Factory Advice Service and Labour Institutes, Government of India.
(xviii)	A bottle containing 100 tablets (each of 5 grains) of aspirin
(xix)	Ointment for burns
(xx)	A bottle of suitable surgical anti-septic solution

(b) For establishment in which the number of contract labour exceeds fifty each first-aid box shall contain the following equipment:

(i)	12 small sterilized dressings
(ii)	6 medium size sterilized dressings
(iii)	6 large size sterilized dressings.
(iv)	6 large size sterilized burn dressings
(v)	6 (15 grams) packets sterilized cotton wool
(vi)	12 pieces of sterilized eye pads in separate sealed packets.

(vii)	12 roller bandages 10 cm wide.
(viii)	12 roller bandages 5 cm wide.
(ix)	One tourniquet.
(x)	A supply of suitable splints.
(xi)	Three packets of safety pins.
(xii)	Kidney tray.
(xiii)	Sufficient number of eye washes bottles filled with distilled water or suitable liquid clearly indicated by a distinctive sign which shall be visible at all times.
(xiv)	4 per cent Xylocaine eye drops, and boric acid eye drops and soda by carbonate eye drops.
(xv)	1 (60ml) bottle containing a two percent alcoholic solution of iodine
(xvi)	One (two hundred ml) bottle of mercurochrome (2 per cent) solution in water.
(xvii)	1 (120ml) bottle containing Sal volatile having the dose and mode of administration indicated on the label.
(xviii)	1 roll of adhesive plaster (6 cmX1 meter)
(xix)	2 rolls of adhesive plaster (2 cmX1 meter)
(xx)	A snake bite lancet.
(xxi)	1 (30 grams) bottle of potassium permanganate crystals.
(xxii)	1 pair scissors
(xxiii)	1 copy of the First-Aid leaflet issued by the Director-General, Factory Advice service and labour Institutes, Government of India.
(xxiv)	a bottle containing 100 tablets (each of 5 grains) of aspirin
(xxv)	Ointment for burns
(xxvi)	A bottle of a suitable surgical anti septic solution.

(2) Adequate arrangement shall be made for immediate recoupment of the equipment when necessary.

ANNEXURE 02

HSE AUDIT/INSPECTION CHECKLIST CUM COMPLIANCE REPORT

PROJECT:_____ SUBCONTRACTOR:_____

DATE : _____ OWNER :_____

INSPECTION BY:_____

Note : write 'NA' wherever the items is not applicable

Item	Yes	No	Remarks	Action
HOUSEKEEPING				
Waste containers provided and used				
Passageways and walkways clear				
General neatness of working area				
Other				
PERSONNELPROTECTIVEEQUIPTMENTS				
Goggles; shields				
Face protection				
Hearing protection				
Respiratory masks etc.				
Safety belts				
Other				
EXCAVATIONS / OPENINGS				
Openings properly covered or barricaded				
Excavations shored				
Excavations barricaded				
Overnight lighting provided				
Other				
WELDING, CUTTING				
Gas cylinders chained upright				
Cable and hoses not obstructing				
Fire extinguisher (s) accessible				
Others				
SCAFFOLDING				
Fully decked platforms				
Guard and intermediate rails in place				
Toe boards in place				
Adequate shoring				
Adequate access				
Others				
LADDER				
Extension side rails 1 m above				
Top of landing				
Properly secured				

Angle + 70^0 from horizontal				
Other				
HOISTS, CRANES AND DERRICKS				
Condition of cables and sheaf OK				
Condition of slings, chains, hooks OK				
Inspection & maintenance log maintained				
Outriggers used				
Signals observed and understood				
Qualified operators				
Others				
MACHINERY, TOOLS & EQUIPMENT				
Proper instruction				
Safety devices				
Proper cords				
Inspection and maintenance				
Other				
VEHICLE AND TRAFFIC				
Rules and regulations observed				
Inspection and maintenance				
Licensed drivers				
Other				
TEMPORARY FACILITIES				
Emergency instructions posted				
Fire extinguishers provided				
Fire-aid equipment available				
General neatness				
Others				
FIRE PREVENTION				
Personnel instructed				
Fire extinguishers checked				
No smoking in prohibited areas.				
Hydrants				
Clearance				
Others				
ELECTRICAL				
Proper wiring				
ELCB's provided				
Ground fault circuit interrupters				
Protection against damage				
Prevention of tripping hazards				
Other				
HANDLING & STORAGE OF MATERIALS				
Properly stored or stacked				
Passageways clear				
Other				
FLAMMABLE GASES AND LIQUIDS				
Containers clearly identified				
Proper storage				
Fire extinguisher nearby				

Other				
WORKING AT HEIGHT				
Safety nets				
Safety belts				
Safety helmets				
Anchoring of safety belt to the life line rope				
ENVIRONMENT				
Lubricant waste/engine oils properly dispose.				
Waste from Canteen, offices, sanitation etc. disposed properly.				
Disposal of surplus earth, stripping materials, expired batteries, oily rags and combustible materials done properly.				
HEALTH CHECKS				
Hygienic conditions at labor camps O.K.				
Availability of first-aid facilities				
Proper sanitation at site, office & labor camps.				
Arrangement of medical facilities.				
Measures for dealing with illness.				
Availability of potable drinking water for workmen & staff.				
Provision of crèches for children.				

ANNEXURE 03

REFERENCES

- Contract documents
- Relevant legislations
- HSEMSM
- Relevant Indian standards as listed below (illustrative only):

SL NO	CODE NAME	TITLE
(1)	IS : 818-1888 (Reaffirmed 2003)	Code of Practice for safety and health requirements in Electric and Gas Welding and Cutting operations.
(2)	IS: 1179-1967 (Reaffirmed 2003)	Specification for Equipment for Eye & Face protection during welding.
(3)	IS : 1989 (Part 2):1986 (Reaffirmed 1997)	Specification for Leather Safety Boots & Shoes
(4)	IS:2925 – 1984 (Reaffirmed 2010)	Specification for Industrial Safety Helmets
(5)	IS:3521 : 1999 (Reaffirmed 2002)	Industrial Safety Belts & Harnesses-Specification
(6)	IS:3646(Part II) – 1966 (Reaffirmed 2003)	Code of Practice for Interior Illumination
(7)	IS:3696 (Part I) – 1987 (Reaffirmed 2002)	Safety Code for Scaffolds and Ladders
(8)	IS: 3696(Part 2) : 1991 (Reaffirmed 2002)	Scaffolds and Ladders-Code of Safety
(9)	IS:3786 – 1983 (Reaffirmed 2002)	Method for Computation of Frequency and Severity Rates for Industrial Injuries and Classification of Industrial Incidents
(10)	IS:4770 : 1991 (Reaffirmed 2006)	Rubber Gloves – Electricals purposes-Specification
(11)	IS:4912 : 1978 (Reaffirmed 2002)	Safety Requirements for Floor and Wall Openings, Railings and Toe Boards
(12)	IS: 5983 – 1980 (Reaffirmed 2002)	Specification for Eye-Protectors
(13)	IS:6519 – 1971 (Reaffirmed 1997)	Code of Practice for Selection, Care and Repair of Safety Footwear
(14)	IS:9167:1979	Specification for Ear-Protectors
(15)	IS:6994(Part I)-1973 (Re affirmed 1996)	Specification for Industrial Safety Gloves Leather and Cotton Gloves
(16)	IS:8519 – 1977 (Reaffirmed 1983)	Guide for Selection of Industrial Safety Equipment for Body Protection.
(17)	IS 11006 : 2011	Flash Back(Flame Arrestor) Specification

(18)	IS:8520 – 1977 (Reaffirmed 2002)	Guide for Selection of Industrial Safety Equipment for Eye, Face and Ear Protection.
(19)	IS:9473:2002	Respiratory Protective Devices-Filtering Half Masks to protect against Particles-Specification.
(20)	IS:9944:1992 (Reaffirmed 2003)	Natural and Man-made Fiber Rope Slings-Recommendations on Safe working loads.
(21)	IS:11057 – 1884 (Reaffirmed 2001)	Specification for Industrial Safety Nets
(22)	IS:12254:1993 (Reaffirmed 2002)	Polyvinyl Chloride (PVC) Industrial Boots-Specification
(23)	IS:13367(Part 1):1992 (Reaffirmed 20030	Safe Use of Cranes-Code of Practice
(24)	IS:14166:1994 (Reaffirmed 2002)	Respiratory Protective Devices-Full Face Masks Specification
(25)	IS:14746 : 1999 (Reaffirmed 2003)	Respiratory Protective Devices-Half Masks and Quarter Masks - Specification
(26)	IS : 15397 :2003 (Reaffirmed 2008)	Portable Extinguisher Mechanical Foam Type(Stored Pressure)-Specification
(27)	IS: 19011:2002	Guidelines for Quality and/or Environmental Management Systems Auditing

ANNEXURE 04 : SAFETY FORMATS
&
ANNEXURE 05 : WORK PERMIT FORMATS

	POWER SECTOR	FORMAT NO: HSEP:14-F01 REV NO.: 00 PAGE NO. 01 OF 02
	INSPECTION OF FIRST AID BOX	

Name of Site :	
Name of Sub-Contractor :	
Inspected by :	
Date of Inspection :	

Number of employees on the site: -_____

Sl.No.	**Item**	**No. Available**	**Remarks**
1	No. of small sterilized dressings		
2	No of medium sized sterilized dressings		
3	No of large sized sterilized dressings.		
4	No of large sized sterilized burn dressings		
5	No of (15 grams) packets sterilized cotton wool		
6	No of pieces of sterilized eye pads in separate sealed packets.		
7	No of roller bandages 10 cm wide.		
8	No of roller bandages 5 cm wide.		
9	Whether tourniquet available		
10	Whether supply of Suitable splints available.		
11	No of packets of safety pins.		
12	Whether kidney tray available		
13	Whether sufficient number of eye wash bottles, filled with distilled water or suitable liquid, clearly indicated by a distinctive sign which shall be visible at all times, available.		
14	Whether 4%-xylocaine eye drops, and boric acid eye drops and soda by carbonate eye drops available.		
15	Whether (60ml) bottle containing a two percent alcoholic solution of iodine available		
16	Whether (two hundred ml) bottle of mercurochrome (2 per cent) solution in water available.		

Sl.No.	Item	No. Available	Remarks
17	Whether 120ml bottle containing Sal volatile having the dose and mode of administration indicated on the label, available.		
18	Whether roll of adhesive plaster (6 cmX1 meter) available		
19	No of rolls of adhesive plaster (2 cmX1 meter)		
20	Whether snake bite lancet available.		
21	Whether (30 grams) bottle of potassium permanganate crystals available.		
22	Whether a pair scissors available		
23	Whether copy of the First-Aid leaflet issued by the Director-General, Factory Advice service and labour Institutes, Government of India available.		
24	Whether bottle containing 100 tablets (each of 5 grains) of aspirin available		
25	Whether Ointment for burns available		
26	Whether bottle of a suitable surgical anti-septic solution available		

Signature of Subcontractor's Site I/C:

	POWER SECTOR	FORMAT NO: HSEP:14-F02 REV NO.: 00 PAGE NO. 1 OF 02
	HEALTH CHECK UP	

Name of Site :	
Name of Sub-Contractor :	
Name of Employee :	

NAME:

History Of Past Illness	H/O Epilepsy
	H/O Drug Allergy
	H/O Diabetics/ Hypertension
	H/O Unconsciousness
Personal History	

EXAMINATION		**OBSERVATION**	
General Physical Examination			
Height	:		
Weight	:		
BMI	:		
Built And nourishment	:		
Pallor	:		
Temperature	:		
Chest Expansion	:	Inspiration	Expansion
Lymph Node Enlargement	:		
Ear, Nose, Throat	:		
Ear	:		
Nose	:		
Throat	:		

EXAMINATION		OBSERVATION	
Cardiovascular System Examination :			
Inspection	:		
Palpation	:	Pulse	BP
Auscultation (Heart Sounds)	:		
Respiratory System	:		
Inspection	:	Respiratory Rate	
Palpation:	:		
Percussion	:		
Auscultation (Breath Sounds)	:		
Examination of Abdomen	:		
Inspection	:		
Palpation	:		
Auscultation (Bowel Sounds)	:		
Any Other	:		
Clinical Impression			

Signature of the examining doctor

	POWER SECTOR **HSE INDUCTION TRAINING**	FORMAT NO: HSEP:14-F03 REV NO.: 00 PAGE NO. 01 OF 01

Name of Site :	
Name of Sub-Contractor :	
Date :	
Name of Training Co-ordinator	

Sl No.	**Name**	**Designation**	**Organisation**	**Signature**

Signature of Training co-ordinator :

	POWER SECTOR **TOOL-BOX TALK**	FORMAT NO: HSEP:14-F04 REV NO.: 00 PAGE NO. 01 OF 01

Name of Site :	
Sub-Contractors Name :	
Date :	

Topic	**Name of person delivered Tool Box Talk**	**No. of Participants attended**	**Remarks**

Signature of Site I/C of Subcontractor :

	POWER SECTOR **PERSONAL PROTECTIVE EQUIPMENTS**	FORMAT NO: HSEP:14-F06 REV NO.: 00 PAGE NO. 01 OF 01

Name of Site :	
Name of Sub-Contractor :	
Inspected by :	
Date of Inspection :	

Item	**Issued this Month**	**Nos. Issued up to the Month**	**Percentage of usage at site**
Safety Helmet			
Safety Shoes			
Full Body Harness			
Fall Arrestor			
Safety Nets			
Other PPEs.			

Signature of Site I/C of Subcontractor :

	POWER SECTOR **INSPECTION OF T&Ps**	FORMAT NO: HSEP:14-F07 REV NO.: 00 PAGE NO. 01 OF 01

Name of Site :	
Name of Sub-Contractor :	
Date of Inspection :	

Sl.No.	Description	Remarks	
1.0	Name of equipment		
2.0	Basic Information of equipment		
2.1	Specification		
2.2	Sr. No. of equipment		
2.3	Make		
2.4	Year of manufacture		
3.0	Major repairs / overhauls(Furnish details of work carried out)		Date(s) of major repair/overhaul
3.1			
3.2			
3.3	Repairs carried out at site		
4.0	Any performance test conducted	Yes/No	
5.0	Document Submitted	Yes/No	
6.0	Manufacturer's test / guarantee certificate	Available/ Not available	
7.0	Performance test	Done/ Not Done	
8.0	Acceptance Norms		
9.0	Committee Observations		
10.0	Date of next review (if accepted)		

Signature-Site Safety Officer (BHEL)	**Signature-Subcontractor/ Subcontractor's Safety Officer**

	POWER SECTOR **STATUS OF T&Ps**	FORMAT NO: HSEP:14-F08 REV NO.: 00 PAGE NO. 01 OF 01

Name of Site	
Name of Sub-Contractor	
Date of Inspection	

Item	**Nos. Deployed**	**Identification No.**	**Nos. Tested by competent person**	**Validity of Test Certificate**
Winches				
Chain Blocks				
Wire Rope Slings				
Man Cages				
D-Shackles				
Air Compressors				
Crawler Cranes				
Mobile Cranes				
Hydra Cranes				
Others				

Signature of Site I/C of subcontractor:

	POWER SECTOR **INSPECTION OF CRANES AND WINCHES**	FORMAT NO: HSEP:14-F09 REV NO.: 00 PAGE NO. 01 OF 03

Name of Site :	
Name of Sub-Contractor :	
Inspected by :	
Date of Inspection:	

Crane Reg. No (Make/Model) _____

Name of Driver/Operator _____

Sl.no.	Description	Observation	Measures
1	Valid Driving license		
2	Hook & Hook Latch		
3	Over Hoist limit switch		
4	Boom limit switch		
5	Boom Angle Indicator		
6	Boom limit cutoff switch		
7	Condition of Boom		
8	Condition of ropes		
9	Number of load lines		
10	Size and condition of the slings		
11	Stability of the cranes		
12	Soil Condition		
13	Swing Break And Lock		
14	Proper Break And Lock		
15	Hoist Break And Lock		
16	Boom Break And Lock		
17	Main Clutch		
18	Leakage in Hydraulic Cylinders		
19	Out riggers filly extendable		
20	Tyre pressure		
21	Condition of Battery And Lamps		

Sl.no.	Description	Observation	Measures
22	Guards of moving and rotating parts		
23	Load chart provided		
24	Number and position of pedant ropes		
25	Reverse Horn		
26	Load Test Details		
27	Operator's fitness		
28	Pollution under control certificate		
29	Fire extinguisher of appropriate type.		
30	Training of the operator		

WINCH

Sl. No.	Description	YES	NO	NA	Remarks
1	Has the copy of Third Party Inspection certificate been provided in winch machine shed?				
2	Is winch machine operator experienced enough to operate the winch machine?				
3	Is the winch machine operated by someone other than the winch machine operator?				
4	Is there guard provided in all moving parts like wheel and motor's shaft?				
5	Will it protect against unforeseen operational contingencies?				
6	Are brakes, clutch and locking arrangement working properly?				
7	Has it been ensured that the guard does not constitute a hazard by itself?				
8	Are the cranks and the connecting rods protected by guardrails?				
9	Is there provision for fully covered shed with wooden plank roof?				

Sl. No.	Description	YES	NO	NA	Remarks
10	Is wire rope free from any kind of damage or wear and tear?				
11	Is split pin provided for the protection of clutch and brake locking arrangement?				
12	Is pulley inspected by competent person and certified before use?				
13	Is pulley free from any wear and tear visually?				
14	Is winch rope barricaded with clipsheet for the protection of rope and person?				
15	Is the wire rope lubricated by cardium oil?				
16	Is there any friction in wire rope which may damage the wire rope rather than the rolling parts?				
17	Is there any oil leakage in the hydraulic system of the winch machine?				
18	Has it been ensured that the guard will not cause discomfort or inconvenience to operator?				
	Total Number of NO:				
	Total Number of NA:				
	% Compliance :				

Signature of Site I/C of subcontractor :

	POWER SECTOR	FORMAT NO: HSEP:14-F10 REV NO.: 00 PAGE NO. 01 OF 02
	INSPECTION OF HEIGHT WORKING	

Name of Site :	
Name of Sub-Contractor :	
Inspected by :	
Date of Inspection:	

Sl. No.	**Descriptions**	**Observation (Yes/No)**	**Remarks**
1	All the workers have been explained safe work method?		
2	An established communication system has been established and explained to the workers.		
3	Adequate illumination has been ensured.		
4	Work area inspected prior to the start of the work.		
5	Area below the work place barricaded, particularly below hot work.		
6	Workers provided with bags /box to carry bolts, nuts and hand tools		
7	Arrangement for fastening hand tools made.		
8	All work platforms ensured to be of adequate strength and ergonomically suitable.		
9	Fabricated makeshift arrangements are checked for quality and type of material welding, anchoring etc.		
10.	Work at more than one elevation at the same segment is restricted.		
	ACCESS/EGRESS		
1	Walkways provided with handrail, mid-rail and toe guard?		
2	All checkered plates, gratings properly welded/ bolted?		
3	Are ladders inspected and they are in good condition?		
4	Are ladders spliced?		
5	Are ladders properly secured to prevent slipping, sliding or falling?		
6	Do side rails extend 36” above top landing?		
7	Are built up ladders constructed of sound materials?		

Sl. No.	Descriptions	Observation (Yes/No)	Remarks
8	Are rugs and cleats not over 12” on center?		
9	Metal ladders not used around electrical hazards.		
10	Proper maintenance and storage.		
11	Ladders placed at right slope.		
12	Ladders / staircases welded/ bolted properly.		
13	Any obstruction in the stairs.		
14	Are landing provided with handrails, knee rails, toe boards etc.?		
15	Whether ramp is provided with proper slope.		
16	Proper hand rails / guards provided in ramps.		
	Housekeeping		
1	Walkways, aisles & all overhead workplaces cleared of loose material.		
2	Flammable materials, if any, are cleared.		
3	All the de shuttering materials are removed after de shuttering is done.		
4	Platforms and walkways free from oil/grease or other slippery material.		
5	Collected scrap are brought down or lowered down and not dropped from height.		
	PPE And Safety Devices		
1	Use of safety helmet, safety belts ensured for all workers		
2	Anchoring points provided at all places of work.		
3	Common lifeline provided wherever linear movement at height is required.		
4	Safety nets are use wherever required.		
5	Proper fall arrest system is deployed at critical workplaces.		
6	Crawler boards/Safety system or works on fragile roof are used.		

Signature of Site I/C of subcontractor :

	POWER SECTOR **INSPECTION OF WELDING AND GAS CUTTING**	FORMAT NO: HSEP:14-F11 REV NO.: 00 PAGE NO. 1 OF 02

Name of Site	
Name of Sub-Contractor	
Inspected by	
Date of Inspection	

Welding				
Sl.no.	Description	Yes	No	Remarks
1	Is electric connection given through 30 mA ELCB/RCCB to welding m/c?			
2	Is electric cable fitted properly in junction box on m/c?			
3	Is electrical cable free from joints?			
4	Are the joints attached firmly & insulated with tape?			
5	Is double earthing given to body of m/c?			
6	Is the physical condition of the m/c good?			
7	Is ON/OFF switch connected to the m/c is working and in good condition?			
8	Are indication lamps on m/c working?			
9	Is the electrode holder in good condition?			
10	Are the cables of the welding m/c lugged & tight properly?			
11	Are return lead connected properly (Rod, Angle, Channels shall not be used)			
	Total No of NO			
	Total No of YES			

Gas Cutting				
Sl. no	Description	Yes	No	Remarks
1	Are Cylinders kept on trolleys?			
2	Physical condition of Gas cylinders Good?			
3	Is there Oil/Grease on valve of the cylinder?			
4	Are pressure regulators in good condition?			
5	Condition of hose pipe OK?			
6	Are hose pipe clamped with hose clip?			
7	Is flash back arrestor & NRV fitted on torch both for O2 and LPG cylinder?			
8	Is nozzle of the torch cleaned?			
	Total Number of NO			
	Total No of YES			
	% Compliance			

Signature of Site I/C of subcontractor :

	POWER SECTOR **INSPECTION OF ELECTRICAL INSTALLATION**	FORMAT NO: HSEP:14-F12 REV NO.: 00 PAGE NO. 01 OF 02

Name of Site	
Name of Sub-Contractor	
Inspected by	
Date of Inspection:	

Sr. No.	**Contents**	**Yes/No**	**Remarks**
A	**Cable**		
1.	Whether the condition of cable is checked?		
2.	Are cables received from other sites checked for insulation resistance before putting them into use?		
3.	Are all main cables taken either underground / overhead?		
4.	Are welding cables routed properly above the ground?		
5.	Are welding and electrical cables overlapping?		
6.	Is any improper joining of cables/wires prevailing at site?		
B	**DBs/SDBs**		
1.	Is earth conductor continued up to DB / SDB?		
2.	Whether DBs and extension boards are protected from rain / water?		
3.	Is there any overloading of DBs / SDBs?		
4.	Are correct / proper fuses & CBs provided at main boards and sub-boards?		
5.	Is energized wiring in junction boxes, CB panels & similar places covered all times?		
C	**ELCB**		
1.	Whether the connections are routed through ELCB?		
2.	Is ELCB sensitivity maintained at 30 mA?		

Sr. No.	Contents	Yes/No	Remarks
3.	Are the ELCB numbered and tested periodically & test results recorded in a logbook countersigned by a competent person?		
D	**Grounding**		
1.	Is natural earthing ensured at the source of power (main DB at Generator or Transformer)?		
2.	Whether the continuity and tightness of the earth conductor are checked?		
3.	Mention the gauge of the earth conductor used at the site.		
4.	Mention the value of Earth Resistance.		
E	**Electrically operated Machines or Accessories**.		
1.	Whether the plug top is provided everywhere.		
2.	Are all metal parts of electrical equipment and light fittings / accessories grounded?		
3.	Is there any shed or cover for welding machines?		
4.	Are halogen lamps fixed at proper places?		
5.	Are portable power tools maintained as per norms?		
6.	Any other information:		

Signature of Site I/C of subcontractor :

	POWER SECTOR **INSPECTION OF ELEVATOR**	FORMAT NO: HSEP:14-F13 REV NO.: 00 PAGE NO. 01 OF 01

Name of Site	
Name of Sub-Contractor	
Inspected by	
Date of Inspection	

Sr. No.	**Description**	**Remarks**
1.0	Name of equipment	
2.0	Basic Information of equipment	
2.1	Specification	
2.2	Sr. No. of equipment	
2.3	Make	
2.4	Year of manufacture	
3.0	Major repairs/overhauls(Furnish details of work carried out)	Date(s) of major repair/overhaul
3.1		
3.2		
3.3	Repairs carried out at site	
4.0	Any performance test conducted	Yes/No
5.0	Document Submitted	Yes/No
6.0	Manufacturer's test / guarantee certificate	Available/ Not available
7.0	Performance test	Done/ Not Done
8.0	Acceptance Norms	
9.0	Committee Observations	
10.0	Date of next review (if accepted)	

Signature-Subcontractor/ Subcontractor's Safety Officer	**Signature-Site Safety Officer (BHEL)**

	POWER SECTOR **Inspection of Excavation**	FORMAT NO: **HSEP:14-F13E** REV NO.: 00 PAGE NO. 01 OF 01

Name of Site :	
Name of Sub-Contractor :	
Inspected by :	
Date of Inspection :	

Sl.no.	Description	Yes	No	Remarks
1	Precautions taken for Underground Electrical Cable			
2	Precautions taken for Under / Above ground sewer/ Drinking Water Line			
3	Precautions taken for Underground Telecommunication Line			
4	Precautions taken for Underground Product/Utility Line			
5	Precautions taken for Underground Fire Water Line			
6	Shoring / Shuttering / Sheet piling done to prevent collapse of excavation walls. Strength of Excavation wall ensured at all times			
7	Slope Cutting / Angle Maintained			
8	Hard Barricading & Edge Protection provided			
9	Separate Safe Access for Man and Vehicle			
10	Lighting arrangement			
11	Banksman Provided			
12	Required basic PPEs provided			
13	Excavated soil / Construction Material / equipment kept away from the edge.			
14	First aid in attendance.			
15	Other:			
	Total No of YES			

Signature-Subcontractor/ Subcontractor's Safety Officer **Signature-Site Safety Officer (BHEL)**

Sub: MEMO for Penalty for non-compliances in Safety

Following lapse (tick marked) was observed and penalty is imposed as stated at the bottom of this memo. It is requested that such occurrences be please avoided in future.

Safety Area

SN	Violation of Safety Norms	Fine (in Rs)
01	Not Wearing Safety Helmet	200/- *
02.	Not wearing Safety Belt or not anchoring life line	500/-*
03	Not wearing safety shoe	200/-*
04	Not keeping gas cylinders vertically	200/-
05	Not using flash back arrestors	100/-
06	Not wearing gloves	50/- *
07.	Grinding Without Goggles	50/- *
08.	Not using 24 V Supply For Internal Work	500/-
09.	Electrical Plugs Not used for hand Machine	100/-
10.	Not Slinging properly	200/-
11.	Using Damaged Sling	200/-
12.	Lifting Cylinders Without Cage	500/-
13.	Not Using Proper Welding Cable With Lot of Joints And Not Insulated Property.	200/-
14.	Not Removing Small Scrap From Platforms	500/-
15.	Gas Cutting Without Taking Proper Precaution or Not Using Sheet Below Gas Cutting	500/-
16.	Not Maintaining Electric Winches Which are Operated Dangerously	500/-
17.	Improper Earthing Of Electrical T&P	500/-
18	No or improper barricading	500/-
19.	Activity carried out without Safety work permit (Height work, Lifting activity, Hot work-each person/case)	1000/-
20.	Incident Resulting in Partial Loss in Earning Capacity	25,000/- per victim
21.	Fatal Incident Resulting in total loss in Earning Capacity	1,00,000/- per victim for first instance #

Legend: -

*: per head. For repeated violation by the same person, the penalty would be double of the previous penalty. Date of "Repeated violation" will be counted from subsequent days.

#: or as deducted by customer, whichever is higher. For repeated fatal incident in the same Unit incremental penalty to be imposed. The subcontractor will pay 2 times the penalty compared to previously paid in case there are repeated cases of fatal incidents under the same subcontractor for the same package in the same unit.

Details (if any) related to non- compliance (Name of persons, Nature of deficiency, etc.)

_____

Penalty imposed:

1, Rate as per above chart_____

2. No. of Persons/ machine/ event/ labour _____

3. Total Penalty= 1. X 2. =_____

Signature:

Witnessed by: (Sub- Contractor representative) (BHEL Personnel)

Name_____ Name_____

Distribution: 1 Copy: to Sub- contractor,
1 Copy to Site Construction Manager (BHEL)

बी एच ई एल BHEL	**POWER SECTOR- HQ** **Incident Report** (To be submitted within 24 hours of time of incident)	FORMAT NO: HSEP:14-F15 REV NO.: 00 PAGE NO. 01 OF 01

Type of incident: Fatal/Major/ Minor/Fire/Property Damage/Near-miss

1	NAME OF SITE		3	ACTIVITY AREA	
2	SCOPE OF WORK		4	NAME OF CONTRACTOR	
			5	NAME & DESIGNATION OF BHEL ACTIVITY I/C	
6	DATE & TIME OF ACCIDENT		7	DATE RESUMED	
8	NO. OF WORK-DAYS LOST BY VICTIM (If duty not resumed, give estimated figure)				
9	NO. OF MANHOURS LOST BY OTHERS				
10	PERSONAL DETAILS OF INJURED AND / OR DETAILS OF MATERIALS / EQUIPMENT / PROPERTY DAMAGED				

NAME				NAME OF MATERIAL / EQUIPMENT / PROPERTY	
PERIOD OF EMPLOYMENT					
AGE	YRS	SEX	MALE/ FEMALE	ESTIMATED COST	ACTUAL COST
MARITAL STATUS	SINGLE / MARRIED				
OCCUPATION				NATURE OF DAMAGE	
PART OF BODY INJURED					
NATURE OF INJURY					
AGENCY (OBJECT / EQUIPMENT / SUBSTANCE) MOST RESPONSIBLE FOR CAUSING ACCIDENT / INJURY / DAMAGE					
12	PERSON (NAME & DESIGNATION) WITH MOST CONTROL OVER AGENCY (OBJECT / EQUIPMENT / SUBSTANCE) CAUSING ACCIDENT INJURY / DAMAGE				
13	DESCRIBE CLEARLY HOW THE ACCIDENT OCCURRED (USE ADDITIONAL SHEET, IF REQUIRED				
ANALYSIS					
14	WHAT ACTS AND / OR CONDITIONS CONTRIBUTED MOST DIRECTLY TO THIS ACCIDENT				
15	WHAT ARE THE BASIC REASON FOR THE EXISTENCE OF THESE ACTS AND / OR CONDITION ?				
16	WHAT CORRECTIVE ACTIONS HAVE BEEN TAKEN TO PREVENT ACCIDENT RECURRENCE ?				
	DATE :			SIGNATURE OF SITE HSE COORDINATOR	
17	COMMENTS OF HEAD / SOX				
	DATE:			SIGNATURE OF HEAD/SOX	

	POWER SECTOR	FORMAT NO: **HSEP:14-F30**
	Format for Monthly HSE Planning & Review	REV NO.: 00 PAGE NO. 01 OF 3

Note: This is a template and can be modified in consultation with BHEL			
Name of the Site		**Name of the Subcontractor**	
Scope of Work		**Date**	
PART- A: PLAN OF HSE ACTIVITIES FOR THE MONTH OF……			**PART-B: REVIEW ON ……**
SN.	**Description of HSE Activity & Formats**	**Plan & Targets for the month**	**Review**
1	Availability of First Aid Box at Required Places and Inspection thereof as per Format: F01	Areas 1. … …	
2	Health check-up as per Format: F02	Health check-up for Nos 1. New inductees 2. Drivers & Operators 3. Workers in following high risk areas: a. …	
3	Induction training of newly joined workers as per Format: F03	Minimum No. of workers:	
4	Toolbox talks (TBT) conducted before start of work as per Format: F04	Locations of TBTs & No. of workers **1.** …	
5	PPE usage and issue as per Format: F06		
6	Inspection of T&Ps as per Format: F07	List of T&Ps to be inspected 1.	
7	Identification & Inspection Status of T&Ps as per Format: F08		
8	Inspection of Cranes & Winches as per Format: F09	List of Cranes & Winches & Nos. 1. …	
9	Inspection of Height Working as per Format: F10	Areas: 1. …	
10	Inspection of Welding & Gas Cutting operations as per Format: F11	Areas: 1. …	
11	Inspection of Electrical Installations as per Format: F12	Locations: 1. …	
12	Inspection of Elevators (as applicable) as per Format: F13	Locations: 1. …	
13	Inspection of Excavation as per Format: F13E	**Locations:** **1. …**	

SN.	Description of HSE Activity & Formats	Plan & Targets for the month	Review
14	Job Safety Analysis as per Format F32B	**Activities:** **1. …**	
15	Regular Job Specific Training (Re-training) for workers involved in hazardous activities	Topics/ Hazards & No. of workers **1.** …	
16	Mass housekeeping (HK) drive in work areas	Areas **1.** …	
17	Vertigo Test of Height workers	Minimum No. of workers:	
18	Deployment of qualified HSE Officers as per contract	Location(s) & Nos. **1.** …	
19	Deployment of qualified HSE Stewards as per contract	Location(s) & Nos. **1.** …	
20	Deployment of Safety tools & Equipment (Safety Nets, Lifelines, Fall arrestors, Man-cages, flashback arrestors, scaffolding etc.)	Tool/ Equipment & Location **1.** …	
21	Safety Walks by site in charge of agency (4 -Weekly once)	Dates:	
22	Safety walks by departmental head (8-Weekly twice)	Dates:	
23	Availability/ deployment of Safety posters/ placards/ signage at strategic locations	Locations: Nos. **1.** …	
24	Provision of clean drinking water sources for workers	Locations: Nos. **1.** …	
25	Provision of toilets for workers (separate for male & female workers)	Locations: Nos. **1.** …	
26	Rest sheds for workers during lunchtime, rain, dust storm etc.	Locations: Nos. **1.** …	
27	Availability of following in Labor colony	**1. Clean drinking water** **2. Toilets** **3. Cleanliness & Hygiene** **4. Grass cutting,** **5. Fogging** **6. Electrical Inspection …**	

SN.	Description of HSE Activity & Formats	Plan & Targets for the month	Review
28	Availability of dust/ waste bins at various locations	Locations: **1.** …	
29	Availability of Ambulance (individual/ joint) in each shift	Ambulance No.	
30	Availability of emergency vehicle in each shift	Emergency vehicle	
31	Deployment/ Availability of tested Fire Extinguishers	Locations & Nos. **1.** …	
32	Tree plantation	Locations & Nos. **1.** …	
33	Waste disposal & Scrap Bins	Locations **1.** …	
34	Illumination checks	Locations **1.** …	
35	Safety award function: 1. Display of good practices Award presentation	Minimum 1 per month	
36	**Submission of Daily Reports as per Format No.F31A**	**Daily Reports (Night & Day Shifts)**	

PLAN		**REVIEW**	
Agency Name: Sign: Date:	**BHEL** Name: Sign: Date:	**Agency** Name: Sign: Date:	**BHEL** Name: Sign: Date:

	POWER SECTOR	FORMAT NO: **HSEP:14-F31** A REV NO.: 00 PAGE NO. 01 OF 1
	Format for Daily HSE Reporting	

Note: Following format to be submitted (preferably) in excel/ soft copy by subcontractor daily at the end of each shift. Any photographs/ records to be attached

Site									**Subcontractor**																		
Year								**Month**												**Day**							
SHIFT	Submitted By	Work Area(s)	Staff	Man-Power	Safety Officers	Safety Stewards	Tool Box (Topics and No. of Participants)	Induction Training (No. of Participants)	Vertigo Test (Numbers Tested)	On-the-Job Training (Topic & participants)	Work Permits	Job Safety Analyses conducted	Height Work Inspection	Other Hazardous Activities Inspection	T&P Inspection (Names & Nos. Inspected)	Safety Walk (Designation, Areas)	HSE Meeting	Safety Reward (Details)	Housekeeping/ Dust Suppression/ Tree Plantation Activities (Locations/Details)	Lost time Accident	Restricted Work Case	Medical Treatment Case	First Aid Case	Near miss	Property Damage/ Fire	Non-Compliances Submitted by BHEL	Complied by Agency	Any other Remarks/ Inputs
Day																											
Night															NA		NA	NA	NA								

	POWER SECTOR **Job Safety Analysis Format**	FORMAT NO: **HSEP:14-F32B** REV NO.: 00 PAGE NO. 01 OF 1

Name of the Site	
Name of the Subcontractor	
Activity, Area	

HAZARDS	**PRECAUTIONS**

(Name)	**Submitted By (Agency HSE)**		**Reviewed By (BHEL Execution)**		**Approved By (BHEL HSE)**	
(Sign)						
(Date)						

SL	Parameter for Measurement	M/ O	Wt	Supporting Documents
1a	Induction training for new workers conducted through audio-visual medium & documented ?	M	1	Induction Training Records
1b	Tool box talk conducted regularly as per plan, and documented?	M	1	Toolbox Talk Records
1c	Contractor in charge and safety in charge attended safety meetings?	M	2	Minutes of Meeting
1d	Whether observations in safety meetings are complied before next meeting?	M	2	-do-
1e	Preparation and submission of Monthly HSE report within stipulated time	M	1	Report submission date
1f	Preparation and submission of Incident/near-miss report and RCA Report (as applicable) within stipulated time	M	1	Incident/ Near Miss Records
1g	Carrying out Inspections and submission of Inspection reports within stipulated time	M	1	Inspection Records
1h	Regular Job Specific Training ensured for High Risk Workers (through audio-visual medium) as per plan	M	1	Training & Attendance Records
2a	Whether the contractor is registered under BOCW	M	2	BOCW Registration Certificate
2b	Availability of Qualified safety officer (1 for every 500 labour)	M	2	Safety Officer qualification & experience records
2c	Availability of Qualified safety supervisor (1 for every 100 labour)	M	2	Safety Officer qualification & experience records
2d	All the workers are provided and using safety helmets and safety shoes/gum boots	M	2	PPE Issue Records, Inspection/ non-conformity records
2e	Housekeeping done on regular basis and scrap removal at site	M	1	Housekeeping records, Inspection/ non-conformity records
2f	Usage of Goggles/Face shields and Hand gloves for gas cutter and grinders		1	PPE Issue Records, Inspection/ non-conformity records
2g	Wall openings & floor openings are guarded?		1	Inspection/ non-conformity records
2h	Adequate illumination provided in all working area?		1	Inspection/ non-conformity records
2i	Safety posters, sign boards and emergency contact numbers in all prominent location are displayed?		1	Inspection/ non-conformity records
2j	Availability of automatic reverse horns, Main horn, hook latches for Vehicles, mobile cranes, Hydras		1	Inspection/ non-conformity records
2k	Ban of carrying mobile phones to work place is implemented for workers		1	Inspection/ non-conformity records
2l	Availability of Tags & Inspection Certificates for Cranes of all capacities		1	Master T&P List with internal & external test details
2l.2	Availability of Tags & Inspection Certificates for Winches of all capacities		1	Master T&P List with internal & external test details
2l.3	Availability of Tags & Inspection Certificates, color coding for Chain pulley blocks		1	Master T&P List with internal & external test details
2l.4	Availability of Tags & Inspection Certificates for Vehicles - Trailers, Dozers, Dumpers, Excavators. Mixers etc.		1	Master T&P List with internal & external test details
2l.5	Availability of Tags & Inspection Certificates for Welding machines, grinders, Drilling machines, etc.		1	Master T&P List with internal & external test details
2l.6	Availability of Tags & Inspection Certificates, colour coding for Wire rope slings etc.		1	Master T&P List with internal & external test details
2l.7	Availability of Tags & Inspection Certificates for Batching plants		1	Master T&P List with internal & external test details

SL	Parameter for Measurement	M/ O	Wt	Supporting Documents
2m.1	Use of Lifting Permit as per requirement		1	Permit Records
2m.2	Use of Height Permit as per requirement		1	Permit Records
2m.3	Use of Hot Work Permit as per requirement		1	Permit Records
2m.4	Use of Excavation permit as per requirement		1	Permit Records
2m.5	Use of Confined space work permit as per requirement		1	Permit Records
2m.6	Use of Grating removal and safety net removal permit as per requirement		1	Permit Records
2m.7	Use of Lockout-Tag out permit as per requirement		1	Permit Records
2m.8	Use of Radiography permit as per requirement		1	Permit Records
2m.9	Use of Night/ Holiday Work Permit as per requirement		1	Permit Records
2m.10	Use of Any other Applicable Permit as per requirement		1	Permit Records
3a	Material safety data sheet(MSDS) available for all chemicals and displayed in usage and storage area?		1	Inspection/ non-conformity records
3b	Spillages of oil/concrete and other chemical is controlled and cleaned by proper method in case of spill?		1	Inspection/ non-conformity records
3c	Availability of adequate number of urinals in workplace and in elevations and maintained	M	1	
3d	Availability of rest rooms for workers at site	M	1	
3e	Availability of Drinking water facility at work spot		1	
3f	Hygienic Labour colony is provided for workers.		1	
4a	Is heavy/complex critical lifting permit obtained for heavy, complex materials before handling/erection activity?		1	Work Permit records
4b	Whether area below lifting activities barricaded		1	Inspection/ non-conformity records
4c	Availability of experienced rigging foreman		1	Experience details of rigging foreman
4d	Is agency is following proper storage and handling procedure as per manufacturer standard for all hazardous material?		1	Procedure for storage & handling
4e	Are oxygen and acetylene cylinders are transported to work place from storage area in trolleys		1	
5a	Whether all deep excavation has been protected by barrier		1	Inspection/ non-conformity records
5b	Sloping/benching & shoring provided for excavation as per requirement?		1	-do-
5c	Proper access and egress provided for excavations?		1	-do-
5d	Blasting is done in controlled manner?		2	-do-
6a	Whether Electrical booth is equipped with Co_2 fire extinguishers and fire buckets filled with sand?		2	Inspection/ non-conformity records
6b	Availability of Illumination lamp in electric booth?		1	-do-
6c	whether Caution Boards have been displayed?		1	-do-
6d	Usage of Metal Plug top for all hand power tools ?		1	-do-
6e	Usage of Insulated welding cables.		1	-do-
6f	Electrical Booth/Distribution Board to be covered by proper Canopy.		1	-do-
6g	Availability of functional & individual 30ma ELCB / RCCB and MCB for protection and conducting periodical check-up?		1	-do-
6h	Double earthing for panel boards and all machinery & proper earth pit with regular inspection available?		1	-do-
6i	Whether Electrician is qualified and experienced		1	Qualification & Experience records of electrician
6j	Availability and usage of Rubber hand gloves by electrician?		1	Inspection/ non-conformity records

SL	Parameter for Measurement	M/ O	Wt	Supporting Documents
7a	Whether Scaffolding pipes made with steel or aluminum, are being used and checked periodically by experienced/ certified scaffolder?		2	Inspection/ non-conformity records
7b	8mm Stainless Steel wire rope with plastic cladding is provided for life line (Vertical / Horizontal) during height work?		2	-do-
7c	Availability of emergency lighting in case of power failure		1	-do-
7d	Whether all the openings are covered with Safety Nets made of fire proof Nylon?		1	-do-
7e	Whether MS pipe rails around staircases & platforms in usage are provided with top, middle rails and toe guard ?		1	-do-
7f	Whether Ladder with vertical life line /Fall arrestor is available to climb?		1	-do-
7g	Whether all workers deployed for working at height have been issued height pass after undergoing vertigo test?		1	Height Pass records
7h	Whether all workers deployed for height work / climbing ladder are provided and using Double lanyard safety belt?		1	PPE Issue records, inspection/ non-conformity reports
7i	Is all hand tools/Small material used by height workers is tied firmly to prevent fall?		1	-do-
8a	Flash back arrestors for all gas cutting sets is available on Torch side and cylinder side		1	Inspection/ non-conformity records
8b	Oxygen/Acetylene/LPG cylinders not in use have caps in place and stored separately?		1	-do-
8c	Availability of Face screen, Hand gloves, and Apron, for welders		1	-do-
8d	Protection from falling hot molten metal during metal cutting / welding at height by providing GI sheet below the cutting area especially in fire prone areas		1	-do-
9a	Pre-employment medical check-up done for all workers and submitted?		1	Medical check records
9b	Availability of first aid center, with MBBS doctor(Own or Sharing basis)	**M**	2	Attendance records
9c	Availability of Ambulance facility 24 hours (Own or sharing basis)	**M**	2	-do-
9d	Is First aid trained personnel's are available and their names are displayed at site?	**M**	1	-do-
9e	Availability of Emergency vehicle at site		1	
9f	Periodical medical check-up is conducted for all the workers and submitted?		1	Medical check records
9g	Availability of sufficient number of first aid box as per standard list and maintaining record		1	Inspection records
10a	Availability of Fire extinguishers, buckets at all vulnerable points		2	Fire extinguisher records
10b	Periodic fire mock drill conducted?		1	Fire, Mock drill records
10c	Are all flammable materials are stored separately?		1	
10d	Periodic grass cutting is done in material storage area?		1	
10e	Availability of 24V DC lighting in confined space work area		1	
10f	Availability of exhaust fan in confined space work area		1	

Note:

- **M: Mandatory; O: Optional**. Points other than mandatory can be excluded with appropriate justification (scope etc.) by BHEL
- Additionally: 30 Marks for each Fatal Accident and 10 mark for each major accident shall be deducted.

	SAFETY WORK CLEARANCE	**Permit no.**
	Project:	**Emergency Contact Nos:**
	Subcontractor:	

BURNING/WELDING /HOT WORK PERMIT

Area :_____ Date:_____ Time:_____

Name of Site Engineer (Permit Requesting Authority):_____ Sign:_____

Name of Work Performing Contractor: _____

Name of Package In charge:_____ Sign:_____ Date:_____

Description of Work: _____

_____

Work Execution Date:_____ Time Valid from:_____ to _____

The above signing person(s) will be responsible to ensure that the above described work will be done under all the safety precautions mentioned on the permit to work.

The following precautions are to be taken:

No.	Item	Yes	Not required
1.	Proper Access/Exit available		
2.	Proper ventilation and /or lighting provided.		
3.	Proper and safe scaffolding, platform, ladder provided.		
4.	Welding machine located in a clean and dry area.		
5.	Welding machine grounded at the equipment and proper leakage current protection device (ELCB) provided for welding machine.		
6.	Emergency STOP buttons are in working condition. Welder /Helper knows how to operate it.		
7.	Welding machine input/output cables, welding holder and weld return clamp (Holder) are insulated and in good condition.		
8.	Welder & Fitter trained to connect ground/work return clamps (Holder) to work place prior to energization of welding machine.		
9.	Gas cylinders are stacked vertically and not below the welding / cutting area. Regulator key is available with cylinder.		
10.	Pressure gauges/Flash back arrestor provided and in working condition.		
11.	Personal Protective equipment Minimum applicable: safety helmet, safety goggles, welding helmet, safety shoes, leather gloves, long sleeve and nose mask -provided		
12.	In case of pits, water removed from the pit and wood/rubber insulation provided.		
13.	Safety signboards are in place.		
14.	Adequate and Suitable nos. of fire fighting extinguisher provided.		
15.	Nearby combustible material removed. Housekeeping done.		
16.	Other		

Name of Contractor Safety Officer:_____ Sign:_____ Date:_____ Time: _____

Reviewed and approved by BHEL Site Engineer (Permit Issuing Authority):

Name:_____ Sign:_____ Date:_____ Time:_____

Name of BHEL Safety Representative:_____ Sign: _____

I understand the precaution to be taken as described above and as per project requirement and hereby confirm that work will be executed under my supervision by following all precaution and Safety Rules.

Name of Work Performing Authority:_____ Sign:_____ Date:_____ Time:_____

Permit Cancellation:

I hereby declare that the work is complete, all workers under my control have been withdrawn and the site restored to safe tidy condition.

Name of Work performing Authority:_____ Sign:_____ Date:_____ Time:_____

Name of Site Engr. (Permit Requesting Authority):_____ Sign:_____ Date:_____ Time:_____

Name of BHEL Site Engr. (Permit Issuing Authority):_____ Sign:_____ Date:_____ Time: _____

(This permit is valid only for the date it is issued)

Original at BHEL site **Second Copy – BHEL SAFETY** **Third Copy : Contractor**

SAFETY WORK CLEARANCE	Permit no.
Project:	Emergency Contact Nos:
Subcontractor:	

LIFTING ACTIVITY PERMIT

Area :_____ Date:_____ Time:_____

Name of Site Engineer (Permit Requesting Authority):_____ Sign: Name of Work

Performing Contractor: _____

Name of Package In charge:_____ Sign:_____ Date:_____

Description of Work: _____

_____

Work Execution Date:_____ Time Valid from:_____ to _____

The above signing person(s) will be responsible to ensure that the above described work will be done under all the safety precautions mentioned on the permit to work.

The following precautions are to be taken:

No.	Item	Yes	Not required
1.	Crane used for lifting activity tested, certified and approved for rated lifting		
2.	All lifting tackles, gears/appliances are tested and certified for lifting works.		
3.	Crane operator is trained and competent for lifting operation.		
4.	Lifting sling/ belt is protected against sharp edge of the jobs to be lifted.		
5.	Access and exit marked and without obstruction.		
6.	Lifting arrangement adequate.		
7.	Unwanted rubbish material removed from work platform.		
8.	Minimum 2 guidelines have been provided for balancing and guiding jobs to be lifted.		
9.	Periphery area of crane booms as well as lifting job is barricaded and unauthorized/no-entry sign board posted.		
10.	Rigger and signal man is trained and competent for lifting work.		
11.	No lifting activity to be carried out during lightening, heavy wind/rain.		
12.	If scaffolding to be used during lift, scaffolding with valid tag available for use.		
13.	Double lanyards safety harness/belt checked an in working condition.		
14.	Safety shoes (non-slip), helmet with chin strap available with employees.		
15.	Others.		

Name of Contractor Safety Officer:_____ Sign:_____ Date:_____ Time: _____

Reviewed and approved by BHEL Site Engineer (Permit Issuing Authority):

Name:_____ Sign:_____ Date:_____ Time:_____

Name of BHEL Safety Representative:_____ Sign: _____

I understand the precaution to be taken as described above and as per project requirement and hereby confirm that work will be executed under my supervision by following all precaution and Safety Rules.

Name of Work Performing Authority:_____ Sign:_____ Date:_____ Time:_____

Permit Cancellation:

I hereby declare that the work is complete, all workers under my control have been withdrawn and the site restored to safe tidy condition.

Name of Work performing Authority:_____ Sign:_____ Date:_____ Time:_____

Name of Site Engr. (Permit Requesting Authority):_____ Sign:_____ Date:_____ Time:_____

Name of BHEL Site Engr. (Permit Issuing Authority):_____ Sign:_____ Date:_____ Time: _____

(This permit is valid only for the date it is issued)

Original at BHEL site **Second Copy – BHEL SAFETY** **Third Copy : Contractor**

SAFETY WORK CLEARANCE	Permit no.
Project:	**Emergency Contact Nos:**
Subcontractor:	

WORKING AT HEIGHT PERMIT

Area :_____ Date:_____ Time:_____

Name of Site Engineer (Permit Requesting Authority):_____ Sign: Name of Work

Performing Contractor: _____

Name of Package In charge:_____ Sign:_____ Date:_____

Description of Work: _____

_____

Work Execution Date:_____ Time Valid from:_____ to _____

The above signing person(s) will be responsible to ensure that the above described work will be done under all the safety precautions mentioned on the permit to work.

The following precautions are to be taken:

No.	Item	Yes	Not required
1.	All workers on job are medically fit for working at height (Person should not have vertigo)		
2.	Scaffolding with valid tag available for use		
3.	Safety harness with life line support/ fall arrester are checked and in working condition		
4.	Safety shoes (non-slip), Helmet with chin strip available with employees		
5.	Safety nets are provided as per design and provided 25 ft. below working area & extending 8 ft beyond.		
6.	Horizontal life lines are provided to cater to design specification of 2300kg per person.		
7.	Ladders have been inspected and provided as per BHEL standard/contract.		
8.	All lifting / tightening tools, hand tools/equipment checked and in good condition		
9.	Access and exit marked and without obstruction.		
10.	Lighting arrangement adequate.		
11.	Unwanted and rubbish material removed from working platform.		
12.	Electrical cable, welding Hose/Compressed air hose properly secured and lay down without obstruction.		
13.	Signboards provided on working platforms		
14.	Hazards in the vicinity are identified and communicated to the worker.		
15.	Other		

Name of Contractor Safety Officer:_____ Sign:_____ Date:_____ Time: _____

Reviewed and approved by BHEL Site Engineer (Permit Issuing Authority):

Name:_____ Sign:_____ Date:_____ Time:_____

Name of BHEL Safety Representative:_____ Sign: _____

I understand the precaution to be taken as described above and as per project requirement and hereby confirm that work will be executed under my supervision by following all precaution and Safety Rules.

Name of Work Performing Authority:_____ Sign:_____ Date:_____ Time:_____

Permit Cancellation:

I hereby declare that the work is complete, all workers under my control have been withdrawn and the site restored to safe tidy condition.

Name of Work performing Authority:_____ Sign:_____ Date:_____ Time:_____

Name of Site Engr. (Permit Requesting Authority):_____ Sign:_____ Date:_____ Time:_____

Name of BHEL Site Engr. (Permit Issuing Authority):_____ Sign:_____ Date:_____ Time: _____

(This permit is valid only for the date it is issued)

Original at BHEL site **Second Copy – BHEL SAFETY** **Third Copy : Contractor**

REVISION HISTORY SHEET

Date	Revision No.	Details of Changes	Reason	Prepared	Reviewed	Approved
12.08.2014	00	First Issue	First Issue	S. B. Jayant, Dy Manager-FQA & Safety	A. K. Sinha, GM-FQA & Safety	Anuj Bhatnagar, ED-FQA & Safety
17.01.2020	01	Formats added: **HSEP:14-F30 – Monthly HSE Planning & Review** (Page 11, Clause 8.0 - updated) HSEP:14-F13E-Excavation Inspection Format (part of F30)) HSEP:14-F32B – Job Safety Analysis Format (part of F30) **HSEP:14-F31A – Daily HSE Reporting** (Page 18, Clause 10.3 – added) **HSEP:14-F33 – HSE Performance Evaluation** (Page 31, Clause 13 – revised)	IOM No. **PSHQHSE/MONREP/02** Dated 08-Jan-2020	Rohit Kumar	Santosh Nair, GM (MSX & HSE)	


बी एच ई एल
BHEL

PSSR	MONTHLY PLAN & REVIEW WITH CONTRACTOR	Page **1** of **6**

Name of Project		Contract No.	
Name of Work		Name of Contractor	

PART- A: PLAN/ REVIEW OF WORK FOR THE MONTH OF …….. Date of Plan/ Review……

SN.	Description of Work	Unit of Measur-ement	Unit Rate	Planned (QTY Planned for the month as per Part –C of last month)		Cumulative Shortfall attributable to contractor upto last month (Refer Note 1)		Achieved		Shortfall attributable to BHEL w.r.t Plan (as per Col. 3 of Part-D)		Cumulative Shortfall attributable to Contractor upto & including this month		REMARKS (Reasons for Shortfall attributable to Contractor. Supporting documents to be kept as record.)
(a)	(b)	(c)	(d)	A		B		C		D		E=A+B-C-D		
				Phy.	Financial	Phy	Financial	Phy.	Financial	Phy.	Financial	Phy.	Financial	
	Value of Other Items not mentioned above but planned to be executed in this month													
Total					ΣA		ΣB		ΣC		ΣD		ΣE	

BHEL
(Sign with name, designation and date)

CONTRACTOR
(Sign with name, designation and date)

Name of Project		Contract No.	
Name of Work		Name of Contractor	

PART- A: Contd…….

Note 1: **In addition to the work planned as per Col. 'A', Contractor shall also make full efforts to minimize the 'Cumulative shortfall attributable to contractor upto the month' as mentioned in Col. 'B' by enhancing its resources, so as to achieve the completion of activities as per agreed schedule. In case contractor is not able to execute the entire shortfall, then BHEL 'Engineer in-charge', shall decide the priority of work to be executed and it shall be binding on the contractor.**

Note 2: Percentage Shortfall attributable to contractor w.r.t. "Plan - Shortfall attributable to BHEL" for the month = $[(\Sigma E-\Sigma B)/(\Sigma A-\Sigma D)]x100$
In case, $(\Sigma E-\Sigma B)$ is negative, then it shall be treated as zero percent."

Note 3: Form 14 should include all items being planned in the current month, and all items against which shortfall was attributable to contractor till previous month. However, for practical reason, if it is not possible to mention some of the items in Form-14 being planned to be executed in this month, then also value of such items shall necessarily be included in calculation of Total Value.

Note 4: In case reason for shortfall attributable to contractor is w.r.t. T&P and Manpower, it should be in conformity with Part B1 and B2.

BHEL
(Sign with name, designation and date)

CONTRACTOR
(Sign with name, designation and date)

PSSR	MONTHLY PLAN & REVIEW WITH CONTRACTOR	Page **3** of **6**

Name of Project		Contract No.	
Name of Work		Name of Contractor	

PART – B-1: PLAN/REVIEW OF DEPLOYMENT OF MAJOR T&Ps FOR THE MONTH OF …….. Date of Plan/ Review……

CONTRACTOR'S SCOPE: -

SN.	PLAN				DEPLOYMENT STATUS			
	Major T&P to be deployed as per work planned for the month	QTY	Deployment Period (in days)	Weightage assigned to planned T&P (in fraction such that ΣC =1)	Actual Deployed Quantity	Actual Deployment Period (in days)	Weighted T&P Deployed	REMARKS (Works affected due to non-deployment of T&Ps)
		A	B	C	D	E	F=(C x D x E) / (A x B)	

Note: In case, E>B, it shall be considered as E=B. Similarly, in case D>A, it shall be considered as D=A.
Percentage of T&P Deployed = ΣF x 100

BHEL SCOPE: -

SN.	PLAN			DEPLOYMENT STATUS		
	Major T&P to be deployed as per work planned for the month	QTY	Deployment Period (in days)	Actual Deployed Quantity	Actual Deployment Period (in days)	REMARKS (Works affected due to non-deployment of T&Ps)

BHEL
(Sign with name, designation and date)

CONTRACTOR
(Sign with name, designation and date)

Name of Project		Contract No.	
Name of Work		Name of Contractor	

PART – B-2: PLAN/ REVIEW OF DEPLOYMENT OF MANPOWER FOR THE MONTH OF …….. Date of Plan/ Review……

CONTRACTOR'S SCOPE: -

SN.	Area of Work	Category of Labour	No. of Labour required as per category	Deployment Period (in days)	No. of Labour actually deployed	Actual Deployment Period (in days)	REMARKS (Works affected due to non-availability of labour)
			A	B	C	D	

Percentage of Manpower Deployed=100 x Σ(CxD)/Σ(AxB)

BHEL
(Sign with name, designation and date)

CONTRACTOR
(Sign with name, designation and date)

PSSR	MONTHLY PLAN & REVIEW WITH CONTRACTOR	Page **5** of **6**

Name of Project		Contract No.	
Name of Work		Name of Contractor	

PART – C: PLAN(PHYSICAL) FOR THE NEXT MONTH i.e. …….. Date of Plan ……

SN.	Description of work	Original Planned Quantity	Planned Quantity (excluding shortfalls attributable to contractor till date)	Unit of Measu-rement	T&Ps Required				Manpower Required		REMARKS (Reasons for difference in Original Planned Quantity w.r.t. Planned quantity to be given)
					Contractor Scope		BHEL Scope		Category of Labour	No. of Labour required as per Category	
					Major T&P to be deployed as per work planned for the month	Quantity	Major T&P to be deployed as per work planned for the month	Quantity			

Note 1: Planned quantity should be based on available/ expected fronts/ inputs in the next month

Note 2: "Original Planned Quantity" shall be as per latest jointly agreed programme between BHEL and Contractor before commencement of work or at the time of latest Time Extension, as the case may be.

BHEL
(Sign with name, designation and date)

CONTRACTOR
(Sign with name, designation and date)

Name of Project		Contract No.	
Name of Work		Name of Contractor	

PART – D: REASONS FOR SHORTFALL ATTRIBUTABLE TO BHEL IN RESPECT OF PLAN FOR THE MONTH……

SN.	Description of Work (from Part-A)	Quantities Affected		Reasons for Shortfall attributable to BHEL	Agency responsible for reasons for Shortfall	Remarks (Supporting Documents in respect of agency responsible)
		(Physical Quantity)	Unit of Measu-rement			
1	2	3	4	5	6	7

Note1: Reasons for shortfall shall include non-availability of fronts/ drawings/ materials/ T&P (BHEL Scope)/ clearances etc. and other hindrances for which contractor is not responsible.

Note2: Agency responsible may be BHEL Site/ MUs/ Design Centre/ BHEL Customer/ other Contractors etc.

BHEL
(Sign with name, designation and date)

Project		Vendor			Package/Unit	
Sl. No.	Parameter for Measurement	Classification	Max Score	Score Obtained	Measurement Key/Scheduled date	Supporting Documents
#1.01	Cumulative number of days in the month, the nominated Quality Officer or his authorised nominee was not available	QUALITY	1.5		Quality Officer or his authorised nominee should be available for all the days of working at site	Daily Log Book entry/Incident Registers/letter references
#1.02	Number of instances of non- compliance wrt FQP, Standard Drawings, Specifications, E&C Manuals etc.	QUALITY	1.5		No deviation from FQP, Standard Drawings, Specifications, E&C Manuals etc is allowed without BHEL Engineer's approval.	Daily Log Book entry/Incident Registers/letter references
#1.03	Percentage submission of test certificates for batches of welding electrodes, cement, sand, aggregate, consumable, Paints etc. as applicable for this month OR In case of MM & MH package, monthly checks for Storage/Preservation of material.	QUALITY	1		Submission of 100% Test certificates for materials as per FQP is mandatory. MM & MH package: Storage/Preservation as per manual/procedure.	Daily Log Book entry/Incident Registers/letter references
#1.04	Number of incidences of improper storage & preservation (not in accordance to the guidelines of BHEL MUs or approved FQP) of materials, consumables (viz. gases, welding electrodes & fluxes, fuel etc.) & bought-out items (paints, fasteners etc.) under the custody of the contractor	QUALITY	1		Total number of non-compliances	Daily Log Book entry/Incident Registers/letter references
#1.05	Rework/ Rejection instances in a month necessitated due to deviation from Standard Drawings /Specifications /Manuals /E&C procedures /FQPs or due to Poor Workmanship by contractor	QUALITY	2		Reworks/ Rejection should be as minimum as possible. Total number of reworks/ rejections due to reasons attributable to contractor.	Daily Log Book entry/Incident Registers/letter references
#1.06	Delay in preparation & submission of signed protocols / log sheets / site register / NDT test reports as per approved FQP/ Qualified Welder List along with photocopies of Welder ID cards / Welder Performance Evaluation records etc. in the month OR in case of MM / MH package reconciliation statement / verification report.	QUALITY	1		Within 2 days of measurements taken or within first 3 working days of next month, as advised by BHEL Engineer	Daily Log Book entry/Incident Registers/letter references
#1.07	Number of instances for Major equipment/product failure due to negligence/improper work/poor workmanship by contractor	QUALITY	1		No such event should happen	Daily Log Book entry/Incident Registers/letter references
#1.08	Total number of complaints received in the month on the quality of finish / aesthetics	QUALITY	1		Total number of non-compliances	Daily Log Book entry/Incident Registers/letter references

Name and Signature of BHEL Package In-charge

Name and Signature of Contractor

Project		Vendor			Package/Unit	
Sl. No.	Parameter for Measurement	Classification	Max Score	Score Obtained	Measurement Key/Scheduled date	Supporting Documents
#2.01	Cumulative number of days of delay in submission of Plan FOR THE MONTH supported by deployment plan of Major T&Ps and Manpower (as per Form F-14) and relevant construction/layout drawings - like A4 plan / elevation views of plan status for structures / pressure parts/Civil Works, Piping isometrics for piping, Layout / PID / System reference sketch, Unloading / storage plans etc.as applicable.	PERFORMANCE	5		Number of days delayed from second working day of the month	Daily Log Book entry/Incident Registers/letter references
#2.02	Percentage of timely submission of Daily Reports for Progress of work, Resources, Consumables etc.	PERFORMANCE	1.5		Percentage of timely submission of daily reports/ Scheduled date is successive next day for each day	Daily Log Book entry/Incident Registers/letter references
#2.03	Number of days delayed for submission of FQP log sheets / protocols / Monthly Progress Reports for the work executed during the month under measurement	PERFORMANCE	1.5		Number of days delayed/Scheduled date is first 2 working days of next month	Daily Log Book entry/Incident Registers/letter references
#2.04	Percentage Shortfall attributable to contractor w.r.t. "Plan - Shortfall attributable to BHEL" for the month as per Form-14	PERFORMANCE	35		As per Part-A of Form-14	Progress review formats
#2.05	Number of days delayed in submission of Running bills with complete supporting documents (including updated reconciliation statement of BHEL issued material) for the month	PERFORMANCE	2		Number of days delayed / Scheduled date is 7th day of next month	Daily Log Book entry/Incident Registers/letter references
#2.06	Number of times the Top Management of contractor did not respond to critical issues of site, for the month	PERFORMANCE	1		Total number of instances	Daily Log Book entry/Incident Registers/letter references
#2.07	Cumulative number of days in the month the works were stopped / refused on interpretation of contract clauses/scope due to tendency of taking undue advantage by interpreting contract clauses in their favour	PERFORMANCE	2		Cumulative number of days lost	Daily Log Book entry/Incident Registers/letter references
#2.08	Number of times rework was refused by contractor	PERFORMANCE	1		Total number of non-compliances	Daily Log Book entry/Incident Registers/letter references

Name and Signature of BHEL Package In-charge

Name and Signature of Contractor

Project		Vendor			Package/Unit	
Sl. No.	Parameter for Measurement	Classification	Max Score	Score Obtained	Measurement Key/Scheduled date	Supporting Documents
#2.09	Cumulative number of days in the month recording / logging was not done in daily log / history register / hindrance register / soft form in a PC maintained at BHEL Site Office	PERFORMANCE	1		Cumulative number of days recording or logging was not done / all days of the month	Daily Log Book entry/Incident Registers/letter references
#3.01	Percentage of Manpower Deployed w.r.t. Plan for the month as per Form-14.	RESOURCES	7		As per Part-B2 of Form-14	Daily Log Book entry/Incident Registers/letter references
#3.02	Percentage of T&P Deployed w.r.t. Plan for the month as per Form-14.	RESOURCES	7		As per Part-B1 of Form-14	Daily Log Book entry/Incident Registers/letter references
#3.03	Cumulative number of major instances in the month hampering / affecting progress of work due to breakdown or non-availability of major T&P and MME for the work, under the scope of Contractor	RESOURCES	3		Cumulative number of instances	Daily Log Book entry/Incident Registers/letter references
#3.04	Cumulative number of major instances in the month hampering / affecting progress of work due to non-availability of Consumables/ use of improper consumables under the scope of contractor	RESOURCES	3		Cumulative number of instances	Daily Log Book entry/Incident Registers/letter references
#4.01	Number of non-compliances during the month for Statutory requirements like validity of Labour Licence, Insurance Policy, Labour Insurance, PF, BOCW Compliance etc. and any other applicable laws/ Regulation, Electrical Licence, T&P fitness certificate, Contractors' All Risk Policy etc. as applicable	SITE INFRASTRUCTURE & SERVICE	1		Total number of non-compliances	Daily Log Book entry/Incident Registers/letter references
#4.02	Cumulative number of days in a month poor illumination is reported at storage area, erection area, pre-assembly area and other designated areas by BHEL site.	SITE INFRASTRUCTURE & SERVICE	0.5		Total number of non-compliances/random checks	Daily Log Book entry/Incident Registers/letter references
#4.03	Cumulative number of days of non-availability of well-maintained toilets facilities for workers (separate for men and women) and non-availability of potable drinking water stations for workers in specified areas.	SITE INFRASTRUCTURE & SERVICE	1		Total number of non-compliances/random checks	Daily Log Book entry/Incident Registers/letter references

Name and Signature of BHEL Package In-charge

Name and Signature of Contractor

Project		Vendor			Package/Unit	
Sl. No.	Parameter for Measurement	Classification	Max Score	Score Obtained	Measurement Key/Scheduled date	Supporting Documents
#4.04	Total number of instances in the month, Housekeeping NOT attended to in spite of instructions by BHEL -i.e. removal / disposal of surplus earth / debris / scrap / unused / surplus cable drums / other electrical items / surplus steel items / packing materials, thrown out scrap like weld butts, cotton waste etc. from the working area to identified locations	SITE INFRASTRUCTURE & SERVICE	2		Total number of non-compliances/random checks	Daily Log Book entry/Incident Registers/letter references
#4.05	Total number of instances in a month, Site Office with reasonably good facilities including enough nos. of computers and printers etc. for use by office and supporting staff was not made available/maintained.	SITE INFRASTRUCTURE & SERVICE	0.5		No discrepancy during regular or surprise visits	Photograph and report of the Engineer
#5.01	Number of days delayed in making labour payments for the last month	SITE FINANCE	2		Number of days delayed / Scheduled date is 7th day of next month	Daily Log Book entry/Incident Registers/letter references
#5.02	Number of complaints from labour/ sub supplier/ sub-contractor for non-receipt of payments from contractor	SITE FINANCE	1.5		Total number of complaints or reporting	Daily Log Book entry/Incident Registers/letter references
#5.03	Number of times the site operations were hampered for want of funds at the disposal of site-in-charge.	SITE FINANCE	1.5		Total number of non-compliances	Daily Log Book entry/Incident Registers/letter references
#6.01	Cumulative number of days in a month the nominated Safety Officer was not available	HSE & SA	1		Safety Officer should be available for all the days	Daily Log Book entry/Incident Registers/letter references
#6.02	Shortfall in number of weekly safety meetings in the month conducted or attended by the Safety Officer	HSE & SA	0.5		Safety meetings to be held every week	Copy of Minutes of meeting
#6.03	Level of compliance w.r.t decisions taken in previous Safety meetings	HSE & SA	0.5		Number of consolidated issues discussed in Safety meetings	Copy of Minutes of meeting, Non-compliance intimation documents from BHEL site
#6.04	Delay in submission of monthly report on safety (including electrical safety for equipment & personnel etc.) in the prescribed form	HSE & SA	1		Number of days delayed/Scheduled date is third working day of next month	Daily Log Book entry/Incident Registers/letter references
#6.05	Number of days taken for lodging FIRs from date of occurrence/notice of incident of theft / accident etc.	HSE & SA	0.5		Number of days delayed/Scheduled date is within 24 Hrs of occurrence/notice of incidence	Copy of FIR lodged by Contractor

Name and Signature of BHEL Package In-charge

Name and Signature of Contractor

Project		Vendor			Package/Unit	
Sl. No.	Parameter for Measurement	Classification	Max Score	Score Obtained	Measurement Key/Scheduled date	Supporting Documents
#6.06	Number of times written(email, letters etc.) warning issued for non-availability/ use of improper Fall protection and rescue arrangement as lifeline, fall arrestors, safety net, hand-railings, covered floors, man-basket, rescue basket & kit etc. by the contractor	HSE & SA	2		Total number of non-compliances	Daily Log Book entry/Incident Registers/letter references
#6.07	Number of times punitive fines imposed for unsafe practices as per contract like non-availability/use of PPEs as safety shoes, helmets, goggles, gloves, lifeline, safety belts etc.	HSE & SA	1		Total number of non-compliances	Non-compliance intimation documents from BHEL site
#6.08	Percentage compliance to Emergency preparedness and response plan: Portable Fire-extinguishers, Buckets, Fire-wardens, display of emergency numbers, mock-drills, Hazard Identification and Risk Assessment(HIRA) etc.	HSE & SA	1		Compliance should be 100% as per HSE Plan or as finalized in Safety Meetings	Non-compliance intimation documents from BHEL site
#6.09	Number of times the agency has defaulted on display of safety posters / safety slogans / safety barriers/emergency numbers etc. in identified areas	HSE & SA	0.5		Total number of instances	Non-compliance intimation documents from BHEL site
#6.10	Non compliances observed during HSE and Safety Audit	HSE & SA	0.5		Total number of non-compliances	Non-compliance intimation documents from BHEL site, Audit Reports
#6.11	Cumulative number of days in the month, non-availability of First Aid Kit, First Aider & Emergency Vehicles/Ambulance.	HSE & SA	0.5		Cumulative number of days	Non-compliance intimation documents from BHEL site
#6.12	Number of days taken for submission of Root Cause analysis (RCA) for the accident from the cut-off date intimated by BHEL for submission of RCA	HSE & SA	0.5		Number of days delayed/Scheduled date is cut-off date intimated by BHEL	Daily Log Book entry/Incident Registers/letter references
#6.13	Non conductance of training (induction, job specific, height work etc.), tool box meeting and health check-up as per Contract requirements	HSE & SA	0.5		Number of incidences of non-conductance during the month	Daily Log Book entry/Incident Registers/letter references
		Total	**100**			

Name and Signature of BHEL Package In-charge

Name and Signature of Contractor

Project		Vendor			Package/Unit	
Sl. No.	**Parameter for Measurement**	**Classification**	**Max Score**	**Score Obtained**	**Measurement Key/Scheduled date**	**Supporting Documents**
Less Deduction in Score Due to Major Accidents (Fatal, Permanent Disability or bodily injury by which person injured is prevented to resume to work within 48 hours or more after accident,, Major Damage to Equipment etc.) attributable to the contractor @ 3 points/ accident						
Less Deduction in Score Due to Minor Accidents attributable to the contractor @ 1 point/ accident						
Less Deduction in Score Due to not Maintaining of Labour Colony (if applicable) as per BHEL HSE policy @2 points in a month on verification any day						
				Final Score		

Performance Score Summary for the Month	Total Score	Score Obtained
QUALITY	10	
PERFORMANCE	50	
RESOURCES	20	
SITE INFRASTRUCTURE & SERVICE	5	
SITE FINANCE	5	
HSE & SA	10	
OTHERS (deductions if any)	0	
TOTAL	**100**	

Note:

1) It is only indicative and shall be as per the online format issued by BHEL time to time.
2) No request will be entertained after specified date of current month w.r.t. changes requested in the scores of immediate previous month.

Name and Signature of BHEL Package In-charge

Name and Signature of Contractor

Form WAM 23

PROFORMA OF BANK GUARANTEE (in lieu of EARNEST MONEY)
(On non-Judicial paper of appropriate value)
(Para 4.7.6 of Works Accounts Manual)

Bank Guarantee No……
Date……

To
(Employer's Name and Address)
……..

Dear Sirs,

In accordance with the terms and conditions of Invitation for Bids/Notice Inviting Tender No……[1] (Tender Conditions), M/s. ……[2] having its registered office at ……[3] (hereinafter referred to as the 'Tenderer'), is submitting its bid for the work of……..[4] invited by Bharat Heavy Electricals Limited (hereinafter referred to as the 'Employer' which expression shall unless repugnant to the context or meaning thereof, include its successors and permitted assigns) incorporated under the Companies Act, 1956 and having its registered office at *BHEL House, Siri Fort, Asiad, New Delhi – 110049* through its unit at *Bharat Heavy Electricals Limited, Power Sector Southern Region, 690, Anna Salai, Nandanam, Chennai 600035*

The Tender Conditions provide that the Tenderer shall pay a sum of Rs ……..[5] as Earnest Money Deposit in the form therein mentioned. The form of payment of Earnest Money Deposit includes Bank Guarantee executed by a Scheduled Bank.

In lieu of the stipulations contained in the aforesaid Tender Conditions that an irrevocable and unconditional Bank Guarantee against Earnest Money Deposit for an amount of .....[6] is required to be submitted by the Tenderer as a condition precedent for participation in the said Tender and the Tenderer having approached us for giving the said Guarantee,

we, the .....(Name & address of the Bank) ..... having our Head Office at ……..(hereinafter referred to as the Bank) being the Guarantor under this Guarantee, hereby irrevocably and unconditionally undertake to forthwith and immediately pay to the Employer without any demur, merely on your first demand any sum or sums of Rs.....[6] (in words Rupees.....) without any reservation, protest, and recourse and without the beneficiary needing to prove or demonstrate reasons for its such demand.

Any such demand made on the Bank shall be conclusive as regards the amount due and payable by the Bank under this guarantee. However, our liability under this guarantee shall be restricted to an amount not exceeding Rs. _____.[6]

We undertake to pay to the Employer any money so demanded notwithstanding any dispute or disputes raised by the Tenderer in any suit or proceeding pending before any Court or Tribunal, Arbitrator or any other authority, our liability under this present being absolute and unequivocal.

The payment so made by us under this Guarantee shall be a valid discharge of our liability for payment hereunder and the Tenderer shall have no claim against us for making such payment.

We ……. Bank further agree that the Employer shall have the fullest liberty without our consent and without affecting in any manner our obligations hereunder to vary any of the terms and conditions of the said Tender or to extend the time of submission of from time to time or to postpone for any time or from time to time any of the powers exercisable by the Employer against the said

Tenderer and we shall not be relieved from our liability by reason of any such variation, or extension being granted to the said Tenderer or for any forbearance, act or omission on the part of the Employer or any indulgence by the Employer to the said Tenderer or by any such matter or thing whatsoever which under the law relating to sureties would but for this provision have effect of so relieving us.

The Bank also agrees that the Employer at its option shall be entitled to enforce this Guarantee against the Bank as a principal debtor, in the first instance without proceeding against the Tenderer and notwithstanding any security or other guarantee that the Employer may have in relation to the Tenderer's liabilities.

This Guarantee shall be irrevocable and shall remain in force upto and including…….[7] and shall be extended from time to time for such period as may be desired by the Employer.

This Guarantee shall not be determined or affected by liquidation or winding up, dissolution or change of constitution or insolvency of the Tenderer but shall in all respects and for all purposes be binding and operative until payment of all money payable to the Employer in terms hereof. However, unless a demand or claim under this Guarantee is made on us in writing on or before the ……[8] we shall be discharged from all liabilities under this Guarantee.

We, …… Bank lastly undertake not to revoke this guarantee during its currency except with the previous consent of the Employer in writing.
Notwithstanding anything to the contrary contained hereinabove:

a) The liability of the Bank under this Guarantee shall not exceed……[6]
b) This Guarantee shall be valid up to …….[7]
c) Unless the Bank is served a written claim or demand on or before _____[8] all rights under this guarantee shall be forfeited and the Bank shall be relieved and discharged from all liabilities under this guarantee irrespective of whether or not the original bank guarantee is returned to the Bank

We, _____ Bank, have power to issue this Guarantee under law and the undersigned as a duly authorized person has full powers to sign this Guarantee on behalf of the Bank.

For and on behalf of
(Name of the Bank)

(Signature of Authorised signatory)

Date…….
Place of Issue…….

[1] Details of the Invitation to Bid/Notice Inviting Tender (Tender Ref. No. Eg. - BHEL PSSR SCT XXXX)
[2] Name of Tenderer
[3] REGISTERED Office Address of the Tenderer
[4] Details of the Work i.e Tender Description
[5] EMD Amount as mentioned in Notice Inviting Tender
[6] BG Amount in words and Figures (BG Amount shall be Minimum of EMD amount less Rs. 2 Lakhs)
[7] Validity Date
[8] Date of Expiry of Claim Period (Claim Period shall be minimum of 3 Months after the validity date of Bank Guarantee)

Note:
1. The BG should be on Non-Judicial Stamp paper/e-stamp paper of appropriate value as per Stamp Act prevailing in the State(s) where the BG is submitted or is to be acted upon or the rate prevailing in the State where the BG was executed, whichever is higher. The Stamp Paper/e-stamp paper shall be purchased in the name of Vendor/Contractor/Supplier /Bank issuing the guarantee.
2. In Case of Bank Guarantees submitted by Foreign Vendors-

a. From Nationalized/Public Sector / Private Sector/ Foreign Banks (BG issued by Branches in India) can be accepted subject to the condition that the Bank Guarantee should be enforceable in the town/city or at nearest branch where the Unit is located i.e. Demand can be presented at the Branch located in the town/city or at nearest branch where the Unit is located.

b. From Foreign Banks (wherein Foreign Vendors intend to provide BG from local branch of the Vendor Country's Bank)

   b.1 In such cases, in the Tender Enquiry/ Contract itself, it may be clearly specified that Bank Guarantee issued by any of the Consortium Banks only will be accepted by BHEL. As such, Foreign Vendor needs to make necessary arrangements for issuance of Counter- Guarantee by Foreign Bank in favour of the Indian Bank's (BHEL's Consortium Bank) branch in India. It is advisable that all charges for issuance of Bank Guarantee/ counter- Guarantee should be borne by the Foreign Vendor. The tender stipulation should clearly specify these requirements.

   b.2 In case, Foreign Vendors intend to provide BG from Overseas Branch of our Consortium Bank (e.g. if a BG is to be issued by SBI Frankfurt), the same is acceptable. However, the procedure at sl.no. b.1 will required to be followed.

   b.3 The BG issued may preferably be subject to Uniform Rules for Demand Guarantees (URDG) 758 (as amended from time to time).

PROFORMA OF BANK GUARANTEE (in lieu of SECURITY DEPOSIT)
(On non-Judicial paper of appropriate value)
(Para 4.7.6 of Works Accounts Manual)

Bank Guarantee No……
Date……

To
(Employer's Name and Address)
……..

In consideration of Bharat Heavy Electricals Limited (hereinafter referred to as the 'Employer' which expression shall unless repugnant to the context or meaning thereof, include its successors and permitted assigns) incorporated under the Companies Act, 1956 and having its registered office at *BHEL House, Siri Fort, Asiad, New Delhi – 110049* through its unit at *Bharat Heavy Electricals Limited, Power Sector Southern Region, 690, Anna Salai, Nandanam, Chennai 600035* having agreed to exempt _____[1] (Name of the Vendor / Contractor / Supplier) with its registered office at_____[2] (hereinafter called the said "Contractor" which term includes supplier), from demand under the terms and conditions of the Contract arising vide Letter of Intent (LOI) reference No._____ dated _____[3] valued at Rs. _____[4] (Rupees _____ only)[4] (hereinafter called the said Contract), of Security Deposit for the due fulfilment by the said Contractor of the terms and conditions contained in the said Contract, on production of a Bank Guarantee for Rs. _____[5] (Rupees _____ only),

We, the ……(Name & address of the Bank) …… having our Head Office at ……..(hereinafter referred to as the Bank), at the request of _____ [Contractor(s)], being the Guarantor under this Guarantee, do hereby irrevocably and unconditionally undertake to forthwith and immediately pay to the Employer, an amount not exceeding Rs._____ without any demur, immediately on demand from the Employer and without any reservation, protest, and recourse and without the Employer needing to prove or demonstrate reasons for its such demand

Any such demand made on the bank, shall be conclusive as regards the amount due and payable by the Bank under this guarantee. However, our liability under this guarantee shall be restricted to an amount not exceeding Rs. _____[5].

We undertake to pay to the Employer any money so demanded notwithstanding any dispute or disputes raised by the Contractor(s) in any suit or proceeding pending before any Court or Tribunal or Arbitrator or any other authority, our liability under this present being absolute and unequivocal.

The payment so made by us under this guarantee shall be a valid discharge of our liability for payment hereunder and the Contractor(s) shall have no claim against us for making such payment.

We, further agree that the guarantee herein contained shall remain in full force and effect during the period that would be taken for the performance of the said Contract and that it shall continue to be enforceable till all the dues of the Employer under or by virtue of the said Contract have been fully paid and its claims satisfied & the Employer certifies that the terms and conditions of the said Contract have been fully and properly carried out by the said contractor(s) or acceptance of the final bill or discharge of this guarantee by the Employer, whichever is earlier. This guarantee shall initially remain in force upto and including _____[6] and shall be extended from time to time for such period as may

be desired by the Employer. Unless a demand or claim under this guarantee is made on us in writing on or before the _____[7], we shall be discharged from all the liability under this guarantee thereafter.

We, _____(indicate the name of the Bank) further agree with the Employer that the Employer shall have the fullest liberty without our consent and without affecting in any manner our obligations hereunder to vary any of the terms and conditions of the said Contract or to extend time of performance by the said contractor(s) from time to time or to postpone for any time or from time to time any of the powers exercisable by the Employer against the said contractor(s) and to forbear or enforce any of the terms and conditions relating to the said Contract and we shall not be relieved from our liability by any reason of any such variation or extension being granted to the said contractor(s) or for any forbearance, act or omission on the part of the Employer or any indulgence by the Employer to the said contractor(s) or by any such matter or thing whatsoever which under the law relating to sureties would but for this provision have effect of so relieving us.

The Bank also agrees that the Employer at its option shall be entitled to enforce this Guarantee against the Bank as a principal debtor, in the first instance without proceeding against the Contractor and notwithstanding any security or other guarantee that the Employer may have in relation to the Contractor's liabilities.

This Guarantee shall not be determined or affected by liquidation or winding up, dissolution or change of constitution or insolvency of the Contractor but shall in all respects and for all purposes be binding and operative until payment of all money payable to the Employer in terms thereof. This guarantee will not be discharged due to the change in the constitution of the Bank or the Contractor(s).

We, ……. BANK lastly undertake not to revoke this guarantee during its currency except with the previous consent of the Employer in writing.
Notwithstanding anything to the contrary contained hereinabove:

a) The liability of the Bank under this Guarantee shall not exceed……[5]

b) This Guarantee shall be valid up to ……[6]

c) Unless the Bank is served a written claim or demand on or before _____[7] all rights under this guarantee shall be forfeited and the Bank shall be relieved and discharged from all liabilities under this guarantee irrespective of whether or not the original bank guarantee is returned to the Bank.

We, _____ Bank, have power to issue this Guarantee under law and the undersigned as a duly authorized person has full powers to sign this Guarantee on behalf of the Bank.

Date _____ Day of _____

for_____ (indicate the name of the Bank)

(Signature of Authorised signatory)

[1] NAME OF VENDOR /CONTRACTOR / SUPPLIER
[2] REGISTERED OFFICE ADDRESS OF THE VENDOR /CONTRACTOR / SUPPLIER.
[3] LETTER OF INTENT(LOI) REFERENCE NO. WITH DATE
[4] CONTRACT VALUE (AS MENTIONED IN LOI)
[5] BG AMOUNT IN FIGURES AND WORDS
[6] VALIDITY DATE
[7] DATE OF EXPIRY OF CLAIM PERIOD (CLAIM PERIOD SHALL BE MINIMUM OF 3 MONTHS AFTER VALIDITY DATE)

Note:

1. The BG should be on Non-Judicial Stamp paper/e-stamp paper of appropriate value as per Stamp Act prevailing in the State(s) where the BG is submitted or is to be acted upon or the rate prevailing in the State where the BG was executed, whichever is higher. The Stamp Paper/e-stamp paper shall be purchased in the name of Vendor/Contractor/Supplier /Bank issuing the guarantee.
2. In Case of Bank Guarantees submitted by Foreign Vendors-
   a. From Nationalized/Public Sector / Private Sector/ Foreign Banks (BG issued by Branches in India) can be accepted subject to the condition that the Bank Guarantee should be enforceable in the town/city or at nearest branch where the Unit is located i.e. Demand can be presented at the Branch located in the town/city or at nearest branch where the Unit is located.
   b. From Foreign Banks (wherein Foreign Vendors intend to provide BG from local branch of the Vendor Country's Bank)
      b.1 In such cases, in the Tender Enquiry/ Contract itself, it may be clearly specified that Bank Guarantee issued by any of the Consortium Banks only will be accepted by BHEL. As such, Foreign Vendor needs to make necessary arrangements for issuance of Counter- Guarantee by Foreign Bank in favour of the Indian Bank's (BHEL's Consortium Bank) branch in India. It is advisable that all charges for issuance of Bank Guarantee/ counter- Guarantee should be borne by the Foreign Vendor. The tender stipulation should clearly specify these requirements.

      b.2 In case, Foreign Vendors intend to provide BG from Overseas Branch of our Consortium Bank (e.g. if a BG is to be issued by SBI Frankfurt), the same is acceptable. However, the procedure at sl.no. b.1 will required to be followed.
      b.3 The BG issued may preferably be subject to Uniform Rules for Demand Guarantees (URDG) 758 (as amended from time to time).

Procedure-2.3

PROCEDURE FOR CONDUCT OF CONCILIATION PROCEEDINGS

1. The proceedings of Conciliation shall broadly be governed by Part-III of the Arbitration and Conciliation Act 1996 or any statutory modification thereof and as provided herein:

2. The party desirous of resorting to Conciliation shall send an invitation/notice in writing to the other party to conciliate specifying all points of Disputes with details of the amount claimed. The party concerned shall not raise any new issue thereafter. Parties shall also not claim any interest on claims/counter-claims from the date of notice invoking Conciliation till the conclusion of the Conciliation proceedings. If BHEL is to initiate Conciliation, then, the invitation to Conciliate shall be extended to the concerned Stakeholder in **Format 7** hereto. Where the stakeholder is to initiate the Conciliation, the notice for initiation of Conciliation shall be sent in **Format-8** hereto.

3. The party receiving the invitation/notice for Conciliation shall within 30 days of receipt of the notice of Conciliation intimate its consent for Conciliation along with its counter-claims, if any.

4. The Conciliation in a matter involving claim or counter-claim (whichever is higher) up to Rs 5 crores shall be carried out by sole Conciliator nominated by BHEL while in a matter involving claim or counter-claim (whichever is higher) of more than Rs 5 crores Conciliation shall be carried out by 3 Conciliators nominated by BHEL. The appointment of Conciliator(s) shall be completed and communicated by the concerned Department/Group of BHEL Unit/Division/Region/Business Group to the other party and the Conciliator(s) within 30 days from the date of acceptance of the invitation to conciliate by the concerned party in the **Format-9**. The details of the Claim, and counter-claim, if any, shall be intimated to the Conciliator(s) simultaneously in **Format-5**.

5. The Parties shall be represented by only their duly authorized in-house executives/officers and neither Party shall be represented by a Lawyer.

6. The first meeting of the IEC shall be convened by the IEC by sending appropriate communication/notice to both the parties as soon as possible but not later than 30 days from the date of his/their appointment. The hearings in the Conciliation proceeding shall ordinarily be concluded within two (2) months and, in exceptional cases where parties have expressed willingness to settle the matter or there exists possibility of settlement in the matter, the proceedings may be extended by the IEC by a maximum of further 2 months with the consent of the Parties subject to cogent reasons being recorded in writing.

7. The IEC shall thereafter formulate recommendations for settlement of the Disputes supported by reasons at the earliest but in any case within 15 days from the date of conclusion of the last hearing. The recommendations so formulated along with the reasons shall be furnished by the IEC to both the Parties at the earliest but in any case within 1 month from the date of conclusion of the last hearing.

8. Response/modifications/suggestions of the Parties on the recommendations of the IEC are to be submitted to the IEC within time limit stipulated by the IEC but not more than 15 days from the date of receipt of the recommendations from the IEC.

9. In the event, upon consideration, further review of the recommendations is considered necessary, whether by BHEL or by the other Party, then, the matter can be remitted back to the IEC with request to reconsider the same in light of the issues projected by either/both the Parties and to submit its recommendations thereon within the following 15 days from the date of remitting of the case by either of the Parties.

10. Upon the recommendations by the Parties, with or without modifications, as considered necessary, the IEC shall be called upon to draw up the Draft Settlement Agreement in terms of the recommendations.

11. When a consensus can be arrived at between the parties only in regard to any one or some of the issues referred for Conciliation the draft Settlement Agreement shall be accordingly formulated in regard to the said Issue(s), and the said Settlement Agreement, if signed, by the parties, shall be valid only for the said issues. As regards the balance issues not settled, the parties may seek to resolve them further as per terms and conditions provided in the contract.

12. In case no settlement can be reached between the parties, the IEC shall by a written declaration, pronounce that the Conciliation between the parties has failed and is accordingly terminated.

13. Unless the Conciliation proceedings are terminated in terms of para 22 (b), (c) & (d) herein below, the IEC shall forward his/its recommendations as to possible terms of settlement within one (1) month from the date of last hearing. The date of first hearing of Conciliation shall be the starting date for calculating the period of 2 months.

14. In case of 3 members IEC, 2 members of IEC present will constitute a valid quorum for IEC and meeting can take place to proceed in the matter after

seeking consent from the member who is not available. If necessary, videoconferencing may be arranged for facilitating participation of the members. However, the IEC recommendations will be signed by all members. Where there is more than one (1) Conciliator, as a general rule they shall act jointly. In the event of differences between the Members of IEC, the decision/recommendations of the majority of the Members of IEC shall prevail and be construed as the recommendation of the IEC.

15. The Draft Settlement Agreement prepared by the IEC in terms of the consensus arrived at during the Conciliation proceedings between the Parties shall be given by the IEC to both the parties for putting up for approval of their respective Competent Authority.

16. Before submitting the draft settlement agreement to BHEL's Competent Authority viz. the Board Level Committee on Alternative Dispute Resolution (BLCADR) for approval, concurrence of the other party's Competent Authority to the draft settlement agreement shall be obtained by the other party and informed to BHEL within 15 days of receipt of the final draft settlement agreement by it. Upon approval by the Competent Authority, the Settlement Agreement would thereafter be signed by the authorized representatives of both the Parties and authenticated by the members of the IEC.

17. In case the Draft Settlement Agreement is rejected by the Competent Authority of BHEL or the other Party, the Conciliation proceedings would stand terminated.

18. A Settlement Agreement shall contain a statement to the effect that each of the person(s) signing thereto (i) is fully authorized by the respective Party(ies) he/she represents, (ii) has fully understood the contents of the same and (iii) is signing on the same out of complete freewill and consent, without any pressure, undue influence.

19. The Settlement Agreement shall thereafter have the same legal status and effect as an arbitration award on agreed terms on the substance of the dispute rendered by an arbitral tribunal passed under section 30 of the Arbitration and Conciliation Act, 1996.

20. Acceptance of the Draft Settlement Agreement/recommendations of the Conciliator and/or signing of the Settlement Agreement by BHEL shall however, be subject to withdrawal/closure of any arbitral and/or judicial proceedings initiated by the concerned Party in regard to such settled issues.

21. Unless otherwise provided for in the agreement, contract or the Memorandum of Understanding, as the case may be, in the event of likelihood of prolonged

absence of the Conciliator or any member of IEC, for any reason/incapacity, the Competent Authority/Head of Unit/Division/Region/Business Group of BHEL may substitute the Conciliator or such member at any stage of the proceedings. Upon appointment of the substitute Conciliator(s), such reconstituted IEC may, with the consent of the Parties, proceed with further Conciliation into the matter either de-novo or from the stage already reached by the previous IEC before the substitution.

22. The proceedings of Conciliation under this Scheme may be terminated as follows:

a. On the date of signing of the Settlement agreement by the Parties; or,

b. By a written declaration of the IEC, after consultation with the parties, to the effect that further efforts at conciliation are no longer justified, on the date of the declaration; or,

c. By a written declaration of the Parties addressed to the IEC to the effect that the Conciliation proceedings are terminated, on the date of the declaration; or,

d. By a written declaration of a Party to the other Party and the IEC, if appointed, to the effect that the Conciliation proceedings are terminated, on the date of the declaration; or,

e. On rejection of the Draft Settlement Agreement by the Competent Authority of BHEL or the other Party.

23. The Conciliator(s) shall be entitled to following fees and facilities:

Sl No	**Particulars**	**Amount**
1	Sitting fees	Each Member shall be paid a Lump Sum fee of Rs 75,000/- for the whole case payable in terms of paragraph No. 27 herein below.
2	Towards drafting of settlement agreement	In cases involving claim and/or counter-claim of up to Rs 5crores. Rs 50,000/- (Sole Conciliator) In cases involving claim and/or counter-claim of exceeding Rs 5 crores but less than Rs 10 crores. Rs 75,000 (per Conciliator)

Sl No	Particulars	Amount
		In cases involving claim and/or counter-claim of more than Rs 10 crores. Rs 1,00,000/- (per Conciliator) Note: The aforesaid fees for the drafting of the Settlement Agreement shall be paid on the, Signing of the Settlement Agreement after approval of the Competent Authority or Rejection of the proposed Settlement Agreement by the Competent Authority of BHEL.
3	Secretarial expenses	Rs 10,000/- (one time) for the whole case for Conciliation by a Sole Member IEC. Where Conciliation is by multi member Conciliators –Rs 30,000/- (one time)- to be paid to the IEC
4	Travel and transportation and stay at outstation Retired Senior Officials of other Public Sector Undertakings (pay scale wise equivalent to or more than E-8 level of BHEL)	As per entitlement of the equivalent officer (pay scale wise) in BHEL.
	Others	As per the extant entitlement of whole time Functional Directors in BHEL. Ordinarily, the IEC Member(s) would be entitled to travel by air Economy Class.
5	Venue for meeting	Unless otherwise agreed in the agreement, contract or the Memorandum of Understanding, as the case may be, the venue/seat of proceedings shall be the location of the concerned Unit / Division / Region /

Sl No	Particulars	Amount
		Business Group of BHEL. Without prejudice to the seat/venue of the Conciliation being at the location of concerned BHEL Unit / Division / Region / Business Group, the IEC after consulting the Parties may decide to hold the proceedings at any other place/venue to facilitate the proceedings. Unless, Parties agree to conduct Conciliation at BHEL premises, the venue is to be arranged by either Party alternately.

24. The parties will bear their own costs including cost of presenting their cases/evidence/witness(es)/expert(s) on their behalf. The parties agree to rely upon documentary evidence in support of their claims and not to bring any oral evidence in IEC proceedings.

25. If any witness(es) or expert(s) is/are, with the consent of the parties, called upon to appear at the instance of the IEC in connection with the matter, then, the costs towards such witness(es)/expert(s) shall be determined by the IEC with the consent of the Parties and the cost so determined shall be borne equally by the Parties.

26. The other expenditures/costs in connection with the Conciliation proceedings as well as the IEC's fees and expenses shall be shared by the Parties equally.

27. Out of the lump sum fees of Rs 75,000/- for Sitting Fees, 50% shall be payable after the first meeting of the IEC and the remaining 50% of the Sitting Fees shall be payable only after termination of the conciliation proceedings in terms of para 22 hereinabove.

28. The travelling, transportation and stay at outstation shall be arranged by concerned Unit as per entitlements as per Serial No. 4 of the Table at para 23 above, and in case such arrangements are not made by the BHEL Unit, the same shall be reimbursed to the IEC on actuals limited to their entitlement as per Serial No. 4 of the Table at Para 23 above against supporting documents. The IEC Member(s) shall submit necessary invoice for claiming the fees/reimbursements.

29. The Parties shall keep confidential all matters relating to the conciliation proceedings. Confidentiality shall extend also to the settlement agreement,

except where its disclosure is necessary for purposes of its implementation and enforcement or as required by or under a law or as per directions of a Court/Governmental authority/ regulatory body, as the case may be.

30. The Parties shall not rely upon or introduce as evidence in any further arbitral or judicial proceedings, whether or not such proceedings relate to the Disputes that is the subject of the Conciliation proceedings:

a. Views expressed or suggestions made by the other party in respect of a possible settlement of the Disputes;

b. admissions made by the other party in the course of the Conciliator proceedings;

c. proposals made by the Conciliator;

d. The fact that the other Party had indicated his willingness to accept a proposal for settlement made by the Conciliator.

31. The Parties shall not present the Conciliator(s) as witness in any Alternative Dispute Resolution or Judicial proceedings in respect of a Disputes that is/was the subject of that particular Conciliation proceeding.

32. None of the Conciliators shall act as an arbitrator or as a representative or counsel of a Party in any arbitral or judicial proceeding in respect of a Disputes that is/was the subject of that particular Conciliation proceeding.

33. The Parties shall not initiate, during the Conciliation proceedings, any arbitral or judicial proceedings in respect of a Disputes that is the subject matter of the Conciliation proceedings except that a Party may initiate arbitral or judicial proceedings where, in his opinion, such proceedings are necessary for preserving his rights including for preventing expiry of period of limitation. Unless terminated as per the provisions of this Scheme, the Conciliation proceedings shall continue notwithstanding the commencement of the arbitral or judicial proceedings and the arbitral or judicial proceedings shall be primarily for the purpose of preserving rights including preventing expiry of period of limitation.

34. The official language of Conciliation proceedings under this Scheme shall be English unless the Parties agree to some other language.

FORMAT-5

STATEMENT OF CLAIMS/COUNTER CLAIMS TO BE SUBMITTED TO THE IEC BY BOTH THE PARTIES

1. Chronology of the Disputes

2. Brief of the Contract/MoU/Agreement/LOI/LOA

3. Brief history of the Disputes:

4. Issues:

5. Details of Clam(s)/Counter Claim(s):

SI. No.	**Description of claim(s)/Counter Claim**	**Amount (in INR)Or currency applicable in the contract**	**Relevant contract clause**

6. Basis/Ground of claim(s)/counter claim(s) (along with relevant clause of contract)

Note– *The Statement of Claims/Counter Claims may ideally be restricted to maximum limit of 20 pages. Relevant documents may be compiled and submitted along with the statement of Claims/Counter Claims. The statement of Claims/Counter Claims is to be submitted to all IEC members and to the other party by post as well as by email.*

FORMAT-7

FORMAT FOR NOTICE INVOKING CONCILIATION CLAUSE BY BHEL FOR REFERRING THE DISPUTES TO CONCILIATION THROUGH IEC

To,

M/s. (Stakeholder's name)

Subject: **NOTICE FOR INVOCATION OF THE CONCILIATION CLAUSE OF THE CONTRACT BY BHEL**

Ref: Contract No/MoU/Agreement/LOI/LOA& date _____.

Dear Sir/Madam,

As you are aware, with reference to above referred Contract/MoU/Agreement/LOI/LOA, certain disputes have arisen, which, in-spite of several rounds of mutual discussions and various correspondences have remained unresolved. The brief particulars of our claims which arise out of the above- referred Contract/MoU/Agreement/LOI/LOA are reproduced hereunder:

Sl. No.	Claim description	Amount involved

As you are aware, there is a provision in the captioned Contract/MoU/Agreement/LOI/ LOA for referring disputes to conciliation.

In terms of Clause ---------of Procedure i.e., Annexure ------ to the Contract/MoU /Agreement / LOI / LOA, we hereby seek your consent to refer the matter to Conciliation by Independent Experts Committee to be appointed by BHEL. You are invited to provide your consent in writing to proceed with conciliation into the above mentioned disputes within a period of 30 days from the date of this letter along with details of counter-claims, if any, which you might have with regard to the subject Contract/ MoU/ Agreement/ LOI/ LOA.

Please note that upon receipt of your consent in writing within 30 days of the date of receipt of this letter by you, BHEL shall appoint suitable person(s) from the BHEL Panel of Conciliators.

This letter is being issued without prejudice to our rights and contentions available under the contract and law.

Thanking you
Yours faithfully

Representative of BHEL

Note: The Format may be suitably modified, as required, based on facts and circumstances of the case.

FORMAT-8

FORMAT FOR NOTICE INVOKING CONCILIATION CLAUSE BY A STAKEHOLDER FOR REFERRING THE DISPUTES TO CONCILIATION THROUGH IEC

To,
BHEL (Head of the Unit/Division/Region/Business Group)

Subject: **NOTICE FOR INVOCATION OF THE CONCILIATION CLAUSE OF THE CONTRACT BY A STAKEHOLDER**

Ref: Contract No/MoU/Agreement/LOI/LOA& date _____.

Dear Sir/Madam,

As you are aware, with reference to above referred Contract/MoU/Agreement/LOI/LOA, certain disputes have arisen, which, in-spite of several rounds of mutual discussions and various correspondences have remained unresolved. The brief particulars of our claims which have arisen out of the above-referred Contract/MoU/Agreement/LOI/LOA are enumerated hereunder:

Sl. No.	Claim description	Amount involved

As you are aware, there is a provision in the captioned Contract/MoU/Agreement/LOI/ LOA for referring inter-se disputes of the Parties to conciliation.

We wish to refer the above-said disputes to Conciliation as per the said Clause of the captioned Contract/MoU/Agreement/LOI/ LOA. In terms of Clause ---------of Procedure i.e., Annexure ------ to the Contract/MoU /Agreement / LOI / LOA, we hereby invite BHEL to provide its consent in writing to proceed with conciliation into the above mentioned disputes within a period of 30 days from the date of this letter along with details of counter-claims, if any, which it might have with regard to the subject Contract/ MoU/ Agreement/ LOI/ LOA and to appoint suitable person(s) as Conciliator(s) from the BHEL Panel of Conciliators.

This letter is being issued without prejudice to our rights and contentions available under the contract and law.

Thanking you
Yours faithfully

Representative of the Stakeholder

Note: The Format may be suitably modified, as required, based on facts and circumstances of the case.

FORMAT-9

FORMAT FOR INTIMATION TO THE STAKEHOLDER ABOUT APPOINTMENT OF CONCILIATOR/IEC

To,

M/s. (Stakeholder's name)

Subject: **INTIMATION BY BHEL TO THE STAKEHOLDER AND CONCILIATOR(S) ABOUT APPOINTMENT OF CONCILIATOR/IEC**

Ref: Contract No/MoU/Agreement/LOI/LOA& date _____.

Sir,

This is with reference to letter dated ---------- regarding reference of the disputes arising in connection with the subject Contract No /MoU/Agreement/LOI/LOA to conciliation and appointment of Conciliator(s).

In pursuance of the said letter, the said disputes are assigned to conciliation and the following persons are nominated as Conciliator(s) for conciliating and assisting the Parties to amicably resolve the disputes in terms of the Arbitration & Conciliation Act, 1996 and the Procedure ---- to the subject Contract ...../MoU/Agreement/LOI/LOA, if possible.

Name and contact details of Conciliator(s)

a) .....

b) .....

c) .....

You are requested to submit the Statement of Claims or Counter-Claims (strike off whichever is inapplicable) before the Conciliator(s) in Format 5 (enclosed herewith) as per the time limit as prescribed by the Conciliator(s).

Yours faithfully,

Representative of BHEL

CC: To Conciliator(s)… for Kind Information please.
Encl: As above

Note: The Format may be suitably modified, as required, based on facts and circumstances of the case.