

VOLUME – IA
Part I & II

TECHNICAL
CONDITIONS OF
CONTRACT
(TCC)

BHARAT HEAVY ELECTRICALS LIMITED



TECHNICAL CONDITIONS OF CONTRACT (TCC)

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VOLUME - IA PART – I CHAPTER – I

1.1 PROJECT INFORMATION

1X18.5 MW SETS AT NALCO DAMANJODI TPS

A.1.1	Project Title	:	5th Stream Alumina Refinery Expansion at Damanjodi, Odisha
A.1.2	Owner	:	National Aluminium Company Limited
A.1.3	Plant site location	:	Damanjodi village, Semiliguda block, Koraput District ,Odisha
A.1.4	Location co-ordinates	:	18.82°N 82.72°E
A.1.5	Nearest Village	:	Damanjodi, Odisha
A.1.6	Nearest Town & City	:	Koraput (36 km)
A.1.7	State Capital	:	Bhubaneswar (475 km)
A.1.8	Nearest Railway Station	:	Damanjodi Railway Station (6 km)
A.1.9	Nearest Airport	:	Domestic airport at Vishakhapatnam (140 km)
A.1.10	Nearest Seaport	:	Vishakhapatnam (140 km)
A.1.11	Nearest Road access	:	10 km from South west of NH 26
A.2.0	Meteorological Condition		
A.2.1	Site Elevation	:	910 m avg. altitude from mean sea level
A.2.2	Temperature		
a.	Maximum Dry bulb temperature	:	46.6°C
b.	Minimum Dry bulb temperature	:	3°C
c.	Ambient temperature for design purpose	:	35°C
A.2.3	Relative Humidity for design purpose		70 ± 20%
A.2.4	Annual Rainfall		
	Average	:	1430 mm (avg.)
A.2.5	Basic Design Wind Pressure	:	As per IS: 875 (Latest Edition) 50m/sec
A.2.6	Wind Direction	:	Predominantly in Southwest direction
A.2.7	Seismic zone	:	Zone II as defined in IS:1893-Part-I

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VOLUME-IA PART-I CHAPTER – II

1.2 SCOPE OF WORKS

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

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

- 1.2.1 The work to be carried out under the scope of these specifications is broadly as under:
- 1.2.2 The scope of work are as follows:
 - A. Material Unloading, stacking, preservation works at stores for all the materials supplied for the Power Plant.
 - B. Erection, testing & commissioning of Boiler & Auxiliaries, SCR, Rotating Machines, ESP, FGD & Auxiliaries.
 - C. Erection, testing & commissioning of Steam Turbine, Turbo Generator and Auxiliaries,
 - D. Erection, testing & commissioning of Complete Piping for the Boiler Turbine & associated area of the power plant.
 - E. Application of Insulation for B, C & D above.
 - F. Fabrication, erection, testing, commissioning of Misc Items as defined in Chapter IX.
 - G. Civil works & Fabrication & erection of structures, racks & trestles as given in Price Bid - Rate Schedule ID 9.
- 1.2.3 The work to be carried out at quoted / accepted rates by the Contractor under the scope of these specifications covers the complete work of receipt, unloading and handling of materials from Trucks/ Trailers etc. to project stores sheds / storage yards, loading and transporting from Stores/storage yards to site of erection or pre-assembly yard and unloading at pre-assembly area/erection site, checking, cleaning, chipping and leveling of foundations, providing packers and shims/pre-assembling of equipment at the pre-assembly yard, inspection, minor rectification, preservation, erection, leveling, and other adjustments, cutting, edge / surface preparation, welding, grinding, radiography, LPI/ MPI/ UT testing wherever needed, heat treatment, carrying out air tightness test by soap solution / kerosene, hydraulic test, steam / air blowing, light up, chemical cleaning, passivation, steam blowing and safety valve floating including inter connection of all the termination points, erection and dismantling of all temporary piping, valves, pumps, tanks etc., required for the above operations, all pre-commissioning tests and trial runs of the Boiler & Aux, Rotating Equipments, SCR system (Selective Catalytic Reduction), ESP, FGD, Steam turbine, Generator & auxiliaries, complete Piping, BOI Items & Misc items and

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Civil works & Fabrication & erection of structures, racks & trestles structure as mentioned in the specification and application of Insulation & refractory, supply and application of preservative & final painting and etc ***including obtaining statutory clearances if any***, for 5th Stream Alumina Refinery Expansion at Damanjodi, Odisha of National Aluminium Company Limited. The bidder shall visit the site and study the total area before quoting.

1.2.4 For (A) Material Handling, scope is as follows:

- 1.2.4.1 Scope includes receipt, unloading & material handling from trucks/ trailers etc., transportation to site/ site stores & storage yard, reshifting of materials, verification, stacking, tracking location of materials along with associated documentation in the computerized MM/ SCMS package with BHEL and manual registers and preservation of materials/ components of boiler, TG, etc. and their auxiliaries, steel materials like TMT bars, structural steels, plates, reinforcement, tools and plants, office furniture, miscellaneous items etc.
- 1.2.4.2 The number of storage yard may be one or more. All the yards shall be divided in to many locations and shall be marked visibly (Grid marking). Each location shall be identified by a display board which shall be visible from distant locations. All the materials and consumables required for this shall also be in the scope of the contractor. The contractor shall submit the yard layout - with grid positions marked-drawing to BHEL Engineer prior to commencement of first unloading.
- 1.2.4.3 It would be the responsibility of the contractor to keep in contact with the BHEL authorities at site to find out the arrival of the consignments. The lorry way bill / truck way bill for the consignments would be handed over to the contractor immediately on receipt.
- 1.2.4.4 The contractor shall examine the packages, consignments etc., on arrival and bring to the notice of Transport authorities and BHEL authorities regarding loss/ damages, if any observed in the consignments proposed to be taken delivery of, before, taking delivery, particularly of consignment in smalls the weight of the packages and any discrepancies shall be reported immediately to BHEL/ Transport authorities. In case it becomes necessary to take open delivery from the authorities, contractor should make all arrangements for taking open deliveries. All expenses connected there with shall be to the account of the contractor. Any loss that occurs to BHEL on account this will be recovered from his progress bills.
- 1.2.4.5 Contractor shall examine all the shipment and notify BHEL Engineer immediately for the purpose of engineer's information. The contractor shall submit a report every week detailing in this regard.

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- 1.2.4.6 In case of apparent damages/ shortage to consignment/ packing noticed by the contractor, such cases shall be brought to the notice of BHEL and cleared only with BHEL's knowledge/ approval.
- 1.2.4.7 Any discrepancy/ shortage/ damage found in the consignment after taking delivery from the carriers after giving clear receipt would be the responsibility of the contractor and the amount liable to be lost by BHEL on such amount is recoverable from the contractor.
- 1.2.4.8 The contractor is required to find out from concerned authorities, regarding arrival of consignment prior to the receipt of consignment note, if any, and take delivery of the same on "Indemnity Bond". Indemnity Bonds would be executed by BHEL, when intimation regarding arrival of consignment is furnished by the contractor.
- 1.2.4.9 Detailed verification of materials with reference to packing list/ Loading advise slip/ etc., after unpacking of boxes & crates; repacking where called for, after detailed verification; preparation of receipt inspection reports etc shall be carried out within the quoted rate within 30 days of the unloading. If the verification is not carried out within 30 days for reasons attributable to the contractor, then BHEL is having right to carry-out the verification at the risk and cost of the contractor.
- 1.2.4.10 Consignment coming on Sundays and Holidays are also required to be handled by the contractor on the same day. Since the offices and godown will probably remain closed on these days, it will be the responsibility of the contractor to contact the Site Engineer/ his authorized representative at BHEL at their residence and obtain instructions.
- 1.2.4.11 Since the consignment are expected to arrive during any time of the day or night, contractor shall have his workmen round-the-clock at site as well as other places as required to unload the materials. Contractor's quoted rate shall include all such contingencies.
- 1.2.4.12 Unloading of materials/ components at the storage yard, using contractor's own Lorries, Trailers and other equipment with valid road permits for their operation, unloading and stacking handling at storage yard for verification shall be the responsibility of the contractor under this contract.
- 1.2.4.13 Unloading of all materials including ODC and heavy consignments either by the crane or by rigging method, at the location decided by BHEL engineer shall be carried out by the contractor within the quoted rate. All T&Ps including hydraulic jacks and wooden sleepers required for rigging method of unloading shall be arranged by the contractor.
- 1.2.4.14 Unloading from Transport equipments, transportation, unloading at storage area/ work site of heavy sophisticated equipment like heavy motors, modules, Drums,

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heavy bearings, fans, Transformers, Electricals Panels, components of Turbine & Generator, etc., shall be done in the presence of and as per the direction of BHEL representative including stacking and restacking if necessary.

- 1.2.4.15 All the materials shall be stored at minimum of 6" height above the ground level by the use of concrete or wooden sleepers or wooden logs. No material shall be allowed to remain on ground at any time. Materials shall not be stacked in low lying areas, where it is likely to get flooded during rain.
- 1.2.4.16 FOR STACKING THE MATERIALS ABOVE THE GROUND LEVEL, WOODEN/ CONCRETE SLEEPERS, WOODEN LOGS, CONCRETE BLOCKS AND FIRE RESISTANT COVERING MATERIAL (TARPAULINS) ETC, WHEREVER DEEMED NECESSARY, WILL BE ARRANGED BY BHEL FREE OF COST AS DECIDED BY BHEL ENGINEER. However, for unloading the materials, wooden sleepers shall be provided by the contractor.
- 1.2.4.17 Stacking of the materials shall be done as per the instructions and to the satisfaction of BHEL Engineers. The materials shall be stacked so that it should facilitate easy handling during erection and also enable traceability and "ready to lift" position in the stacked area. In case any negligence or improper stacking is noticed, it shall be the responsibility of the contractor to re-stack at his cost. Failure to do so may force BHEL to get the job done through other agencies and recover the same from the contractor.
- 1.2.4.18 Under the scope of this contract, it shall be the responsibility of the contractor to provide facilities to open the package in the presence of BHEL Engineers verifying the same, repacking wherever and whenever necessary properly stacking them as may be directed by BHEL so as to facilitate proper handling and verification.
- 1.2.4.19 The contractor shall execute the work in the most substantial and workmen like manner. The stores shall be handled with care and diligence. Any loss to BHEL due to contractor's lapse shall have to be made good by the contractor.
- 1.2.4.20 General cleaning, grass cutting and upkeep of storage yard, stores area shall be carried out within the quoted rates for unloading, verification, identification and storage.
- 1.2.4.21 Transportation of certain materials from Godown of Transport carriers, unloading, verification of components which includes unpacking of cases/ crates, repacking after verification, preservation, stacking of all the components at stores/ storage space, shifting of materials from one location to another location within plant boundary and wherever required keeping the materials/ components by raising height.
- 1.2.4.22 As per instruction of BHEL Engineer, on receipt of "Stores Issue Voucher" the contractor shall locate, identify the material and shall keep it in ready to lift position immediately.

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- 1.2.4.23 The contractor, with his manpower shall update and maintain the documents and records of BHEL's Material Management department as per the instruction of the BHEL engineer. Entering the data in the BHEL computer as per the instruction of the BHEL engineer is also in the scope of the contractor.
- 1.2.4.24 Handling and loading of outgoing materials those are to be sent to other destinations shall be carried out by the contractor.
- 1.2.4.25 In case of delay in unloading/ failure to unload the equipment immediately, BHEL reserve the right to unload the equipments/ components through other agencies at the risk and cost of the contractor.
- 1.2.4.26 The owner/ employer or his authorized agents may inspect stores, storage yard, etc 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.
- 1.2.4.27 The contractor will arrange for gate passes and any other permits required for carrying out his work from the respective agencies at his own cost. He will also comply with regulations of the customer within the project area, any of the State Government and other Government agencies.
- 1.2.4.28 Materials shall be stacked neatly, preserved and stored in the stores in an orderly manner. Sometimes it may become necessary for the contractor to handle, reshift certain unrequired components in order to take out/ stack the required materials. The contractor has to take this contingency also into account. No extra payment is payable for such contingencies.
- 1.2.4.29 Contractor with his own T& Ps and manpower shall receive, verify and transport all the materials received at Transporters godowns within a radius of 40 km in and around Project site and the materials received at railway stations within a radius of 30 km from Project site to the BHEL stores within the quoted rate.
- 1.2.4.30 From the area/ delivery points of all materials/ components pertaining to generating units, auxiliaries, piping, miscellaneous plants and equipments, panels/ cables and other electrical equipments, oil drums/ tools/ plants or any other items and equipments meant for erection, commissioning, and office equipment/ furniture and miscellaneous items, contractor to use his own cranes, tractor/ trailers, trucks, lorries, slings, jacks, lifting tackles and any other equipments for this job. Handling of equipments for verification of components including opening of cases/ crates/ boxes and repacking/ stacking after verification shall also be the responsibility of the contractor.

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- 1.2.4.31 The contractor shall provide the necessary resources like trained PC operators, clerical/ secretarial staff/ helpers for maintaining the Computerised Material Management Package provided by BHEL and carry out all operations of maintenance of documentation (soft as well as hard copies) including housekeeping for the works covered under this tender. The computer terminals for this purpose will be provided by BHEL.
- 1.2.4.32 For material preservation, all the preservative consumables like paint, grease etc shall be issued by BHEL free of cost and contractor has to arrange for application of preservatives with their own T&P, consumables like brush, emery sheet etc.
- 1.2.4.33 RESHIFTING AND RESTACKING OF MATERIALS/ COMPONENTS:
- 1.2.4.33.1 Reshifting and restacking of the materials/ components within the plant boundary shall be carried out by the contractor as per the instruction of BHEL engineer without any delay. Charges for Reshifting and restacking shall be inline with Rate Schedule Id 8.6.
- 1.2.4.33.2 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 and shall be considered as Reshifting and restacking of materials/ components.
- 1.2.5 **The scope of work for (B), (C), (D), (E), (F) & (G) above is as follows :**
- 1.2.5.1 The scope of work as defined in this specification covers the complete work of Handling at Site Stores / Storage yard, Transportation to Site of Work from Stores/storage yards to site of erection or pre-assembly yard and unloading at pre-assembly area/erection site, checking, cleaning chipping and leveling of foundations, providing packers and shims/pre-assembling of equipments at the pre-assembly yard, inspection, minor rectification, preservation, erection, leveling, and other adjustments, cutting, edge / surface preparation, welding, grinding, radiography, LPI/ MPI/ UT testing wherever needed, heat treatment, carrying out air tightness test by soap solution / kerosene, hydraulic test, steam / air blowing, light up, chemical cleaning, passivation, steam blowing and safety valve floating including inter connection of all the termination points, erection and dismantling of all temporary piping, valves, pumps, tanks etc., required for the above operations, all pre-commissioning tests and trial runs of the Boiler & Aux, Rotating Equipments, SCR system (Selective Catalytic Reduction), ESP, FGD, Steam turbine, Generator & auxiliaries, complete Piping, BOI Items & Misc items mentioned in the specification and application of Insulation & refractory, supply and application of preservative & final painting and Civil works, Fabrication and Erection of structures, racks, Trestles etc as metioned in Rate Schedule including obtaining statutory clearances if any, for 5th Stream Alumina Refinery Expansion at Damanjodi, Odisha of National Aluminium

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Company Limited. The bidder shall visit the site and study the total area before quoting.

- 1.2.5.2 The quantities indicated in the tender specification are approximate and are liable for variation and alteration at the discretion of BHEL. The quoted unit rate shall be applicable for any additional product group also, if included at a later date integral to the main scope of work / package envisaged. The work executed shall be measured and priced as per the unit rate arrived at for each work area as mentioned in the relevant clauses.
- 1.2.5.3 The detailed PG wise breakup of Boiler and Auxiliaries, Rotating Machinery, SCR, ESP, FGD, Steam Turbine, Generator & Aux., Piping, Insulation etc are indicated in Chapter-IX, but the contractor is required to erect actual tonnage which may be necessary to complete the work in all respects as detailed in the tender specifications, for which payments shall be released on finally settled rates. The qty, weights and dimensions of material shown are approximate and are liable to vary. No increase in quoted / accepted rates / prices shall be allowed due to change in weights and dimensions of the equipment / materials.
- 1.2.5.4 The BOQ quantities and weights given in the Volume-II (Price Bid) are approximate and these are subject to change as per site conditions.
- 1.2.6 **For HFO & LDO Tanks**, Scope includes fabrication, erection, testing & commissioning of tanks as defined in Chapter IX, including obtaining all statutory clearances as applicable.
- 1.2.7 During the course of execution of work, certain rework / modification / rectification / repairs / fabrication etc will be necessary on account of feedback from various relevant source, and also on account of design discrepancies/ alterations, manufacturing defects, site operations/ maintenance requirements. Contractor shall carry out such rework / modification / rectification / fabrication / repairs etc promptly and expeditiously. Daily log sheets indicating the details of work carried out, man-hours etc as applicable shall be maintained by the contractor and got signed by BHEL engineer every day. Claims of contractor, if any, for such works will be dealt as per conditions of contract and payments will be released as per the agreed rates.
- 1.2.8 **Resources** like manpower including Supervisors / Engineers, T&P, consumable etc shall be provided by the contractor for this scope of work. All the expenditure including taxes and incidentals in this connection will have to be borne by him unless otherwise specified in the relevant clause. The contractor's quoted rates should be inclusive of all such contingencies.

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- 1.2.9 It shall be specially noted that the contractor's labour and staff may have to work round the clock to meet the completion schedules / plans, which may involve payment of considerable overtime. The contractor's quoted rates should be inclusive of all such contingencies.
- 1.2.10 The terminal points can be inferred from the relevant drawings and any further clarifications can be obtained/ decided by BHEL and that is final and binding on the contractor for deciding the scope of work and effecting the payment for the work one up to the terminals. Carrying out work 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, welding, 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, within the quoted rate.
- 1.2.11 The contractor shall submit a copy of license to undertake construction / repair of Boilers & Piping issued by Boiler inspectorate before commencement of Pressure Parts / Piping Erection.
- 1.2.12 The work shall conform to dimensions and tolerances given in various drawings and quality manuals provided by BHEL. If any portion of work is found to be defective in workmanship not conforming to drawings or other stipulations, the contractor shall dismantle and redo the work duly replacing the defective materials at his cost, failing which the job will be carried out by BHEL by engaging other agencies / departmentally and recoveries will be effected from contractor's bill towards expenditure incurred including BHEL's overhead charges.
- 1.2.13 Contractor shall execute the work as per sequence and procedure prescribed by BHEL at site. The erection manuals for boiler pressure parts, structures ESP, etc., which are available with BHEL site office are to be referred for compliance and guidance before taking up the work. Any failure to comply with the above might lead to rework and the cost for the same shall be borne by the contractor only. BHEL engineer, depending upon the availability of materials, fronts etc., will decide the sequence of erection and methodology. No claims for extra payment from the contractor will be entertained on the grounds of deviation from the method of erection adopted in erection of similar jobs or for any reason whatsoever.
- 1.2.14 Contractor has to work in close co-ordination with other erection agency at site. BHEL engineer will co-ordinate area clearance. In a project of such magnitude, it is possible that the area clearance may be less/more at a particular given time. Activities and

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erection program have to be planned in such a way that the milestone events like boiler light up, steam blowing, SV Floating, Coal Firing, Turbine box up, Oil Flushing etc., are achieved as per schedule/ plans. Contractor shall arrange & augment the resources accordingly.

- 1.2.15 No member of the already erected structure/ platform, pipes, grills, platform, other component and auxiliaries should be cut without specific approval of BHEL engineer.
- 1.2.16 **Civil Works:** Contractor to refer Volume II Price Bid - Rate Schedule (**Rate Schedule ID 9**) for scope of Civil works & structural fabrication & erection. The works to be performed under this contract consist of providing all labour, supervision, material as indicated in BOQ / Price bid, scaffolding, construction equipment's, tools and plants, temporary works, supplies including POL (Petrol, Oil & Lubricants), transportation and all incidental items not shown or specified but reasonably implied or necessary for the proper completion of work in all respects. Testing of all materials, preparation of fabrication drawings etc. are included on the rates of items of work. Works shall only be carried out with approved structural fabrication drawings. Steel required for fabrication will be provided by BHEL free of cost.
- 1.2.16.1 Only basic structural drawing will be provided to the contractor by BHEL. Contractor shall prepare detailed engineering structural and fabrication drawings and get approval from BHEL before fabrication and erection of the same respectively. The cost of preparation of the drawings shall be within the quoted rates of the contract
- 1.2.16.2 The unit rates shall include all material equipment, fixtures, labour, construction T&Ps, temporary works and everything whether of permanent or temporary nature necessary for the completion of job in all respects.
- 1.2.16.3 The unit rates quoted for various items of Rate Schedule shall include all the stipulations mentioned in technical specifications and nothing extra over Rate Schedule rates shall be payable.
- 1.2.16.4 Drawings showing enough details for the construction as per the specification shall be furnished to the contractor in a phased manner.
- 1.2.16.5 The bidder should fully apprise himself of the prevailing conditions at the proposed site, climatic conditions including monsoon pattern, local conditions, soil strata and site specific parameters and shall include for all such conditions and contingent measures in the bid, including those which may have not been specifically brought out in the specifications.
- 1.2.17 **Painting:** Refer Painting chapters (Vol IA Part I Chapter XVIII) and (relevant chapters of Vol I A Part II) for all Painting requirements.

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1.2.18 Recommendations for Covid:

Special arrangements to be made for tackling COVID-19 pandemic –

Contractor shall make arrangements for stay of workers within their premises as far as possible and/ or adjacent building and for implementation of STANDARD OPERATING PROTOCOL (SOP) as per government order. The transportation of workers to work place shall be arranged by the contractor in dedicated transport by ensuring social distance. Any person violating the COVID -19 measures published vide government order time to time will be liable to be proceeded for legal action as per the government order. Following shall be observed in work place:

- 1.2.18.1 All work places shall have adequate arrangements for temperature screening and provide sanitizers at convenient places.
- 1.2.18.2 Work places shall have a gap of one hour between shifts and will stagger the lunch breaks of staff, to ensure social distancing.
- 1.2.18.3 Use of AROGYA SETU will be encouraged for all employees both private and public.
- 1.2.18.4 Contractor shall sanitize their work place between shifts.
- 1.2.18.5 Large meetings to be prohibited. Spitting shall be strictly prohibited. Wearing of face cover is compulsory.
- 1.2.18.6 Government order (state/ center) being issued time to time for protective measures of COVID-19 pandemic shall be complied with strictly until government (state/ center) declares end of pandemic.
- 1.2.18.7 **Standard operating procedure for social distancing for workplace and offices**

The following measures shall be implemented by contractor for their office and workplaces:

 - i. All areas in the work premises including the following shall be disinfected completely using user friendly disinfectant mediums:
 - a. Entrance gate of work place, office, if any
 - b. Cafeteria and canteens, if any
 - c. Meeting room, conference halls/ open area available/ verandah/ entrance gate of site, bunkers, porta cabins, buildings, etc.
 - d. Equipments and lifts
 - e. Washroom, toilet, sink, water points, etc
 - f. Wall/ all other surfaces
 - ii. For workers coming from outside, special transportation facility shall be arranged without any dependency on the public transport system. These vehicles should be allowed to work only with 30-40% passenger

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capacity.

- iii. All vehicles and machinery entering the premise should be disinfected by spray mandatorily.
- iv. Mandatory thermal scanning of everyone entering and exiting the work place to be done.
- v. Medical insurance for the workers to be made mandatory.
- vi. Provision for hand wash & sanitizer preferably with touch free mechanism shall be made at all entry and exit points and common areas. Sufficient quantities of all the items should be available.
- vii. Work places shall have a gap of one hour between shifts and will stagger the lunch breaks of staff, to ensure social distancing.
- viii. Large gatherings or meetings of 10 or more people to discouraged. Seating at least 6 feet away from others on job sites and in gatherings, meetings and training sessions.
- ix. Not more than 2/4 persons (depending on size) will be allowed to travel in lifts or hoists.
- x. Use of staircase for climbing should be encouraged.
- xi. There should be strict ban of gutka, tobacco, etc. and spitting should be strictly prohibited.
- xii. There should be total ban on non-essential visitors at sites.
Hospitals/ clinics in the nearby areas, which are authorized to treat COVID-19 patients, should be identified and list should be available at work place all the times.

Note:

The bidder should visit site and acquire full knowledge & information about site conditions. Bidder must visit site, to acquaint themselves with the conditions prevailing at site and in & around the plant premises, together with all statutory, obligatory, mandatory requirements of various authorities before submission of bid.

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

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VOLUME IA PART – I CHAPTER – III

1.3 FACILITIES & CONSUMABLES IN THE SCOPE OF CONTRACTOR / BHEL (SCOPE MATRIX)

SI 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	Firefighting 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	Refer Cl. No. 1.3.3.3.
1.3.1.1.2.2	Living accommodation		Yes	
1.3.1.2	ELECTRICITY			
1.3.1.2.1	Electricity of Voltage 415 / 440 V For construction purposes			
1.3.1.2.1.1	Single point source	Yes		Chargeable at 3 Points
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	

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SI No.	Description	Scope to be taken care by		Remarks
		BHEL	Bidder	
1.3.1.2.2.1	Distribution from single point including supply of materials and service		Yes	
1.3.1.2.2.2	Supply, installation and connection of material of energy meter including operation and maintenance		Yes	Calibration certificate to be provided
1.3.1.2.2.3	Duties and deposits including statutory clearances for the above		Yes	
1.3.1.2.2.4	Living facilities for office use including charges		Yes	
1.3.1.2.2.5	Demobilization of the facilities after completion of works		Yes	
1.3.1.2.3	Electricity for living accommodation of the bidder's staff, engineers, supervisors etc on the above lines.		Yes	
1.3.1.3	WATER SUPPLY			
1.3.1.3.1	<i>For construction purposes:</i>			
1.3.1.3.1.1	Making the water available at single point	Yes		
1.3.1.3.1.2	Further distribution as per the requirement of work including supply of materials and execution		Yes	
1.3.1.3.2	<i>Water supply for bidder's office, stores, canteen etc</i>			
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	

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SI No.	Description	Scope to be taken care by		Remarks
		BHEL	Bidder	
1.3.1.4.2	For construction work (Execution of the lighting work / arrangements) At office storage area At the preassembly area At the construction site /area		Yes	
1.3.1.5	COMMUNICATION FACILITIES for site operations of the bidder			
1.3.1.5.1	Telephone, Fax, internet, intranet, email etc		Yes	
1.3.1.6	COMPRESSED AIR SUPPLY			
1.3.1.6.1	Supply of Compressor and all other 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	

SI No.	Description	Scope to be taken care by		Remarks
		BHEL	Bidder	
1.3.2	PART II			
1.3.2.1	ERECTION FACILITIES			
1.3.2.1.0	Engineering works for construction	Yes		
1.3.2.1.1	Providing the erection drawings for all the equipments covered under this scope	Yes		
1.3.2.1.2	Drawings for construction methods		Yes	
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		In consultation with BHEL

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SI No.	Description	Scope to be taken care by		Remarks
		BHEL	Bidder	
1.3.2.1.5	Preparation of site erection schedules and other input requirements		Yes	
1.3.2.1.6	Review of performance and revision of site erection schedules in order to achieve the end dates and other commitments		Yes	
1.3.2.1.7	Weekly erection schedules based on SI No 1.3.2.1.5		Yes	
1.3.2.1.8	Daily erection / work plan based on SI 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 OPEN SPACE:

- 1.3.3.1 To establish a temporary site office, fabrication yard and storage area at the job site, minimum open space will be provided free of charges.
- 1.3.3.2 Location and area requirement for office / storage sheds / fabrication yard shall be discussed and mutually agreed to after award of work at site. Construction of his site office, covered store or any other temporary building shall be in contractor's scope. Security of stores & work place shall be in Contractor's scope.
- 1.3.3.3 Land for residential accommodation for Contractor's staff and labour, if available & as provided by NALCO Damanjodi, may be made available to Bidder outside plant boundary limit at the discretion of BHEL and rent for the same will be as decided by BHEL according to location and the area occupied by the Bidder.

TECHNICAL CONDITIONS OF CONTRACT (TCC)

1.3.4 **ELECTRICITY:**

1.3.4.1 Construction Power will be provided at 415 V at three (3 Nos.) different points at the nearest sub-station, as defined below, on chargeable basis, as charged by NALCO Damanjodi. **The present Rate is Rs.4.30/kWh** and any change in power tariff shall be intimated to the contractor:

- a.) One Point near BTG Area
- b.) One Point Near Limestone Handling Area
- c.) One Point near Fabrication yard area

The contractor will make his own arrangement for temporary distribution of power from the nearest substation.

1.3.4.2 Only motors up to 3 HP will be allowed to be started direct on line. For motors above 3 HP and up to 100 HP, a suitable starting devices approved by the Engineer-in-Charge shall be provided by the Bidder. For Motors above 100 HP slipping induction motors with suitable starting devices as approved by the Engineer-in-Charge shall be provided by the Bidder.

1.3.4.3 Contractor has to make his own arrangements for his electricity requirement for his labor colony at his cost.

1.3.4.4 The bidder shall have to provide earth leakage circuit breaker at each point wherever human operated electrical drives / T&Ps are deployed.

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

1.3.4.6 Necessary "Capacitor Banks" to maintain/ 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.

1.3.5 **CONSTRUCTION WATER**

1.3.5.1 Water for Construction purpose will be provided at one single point free of cost. Further distribution of water inside plant shall be by contractor.

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

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

Contractor has to provide minimum 2 computers [along with one operator per PC] for online material management, reporting of daily progress, billing and other similar

TECHNICAL CONDITIONS OF CONTRACT (TCC)

activities, within the quoted rate. Computers shall have minimum configuration of Windows 7 OS, 4GB RAM and Internet Explorer 8 or above.

1.3.7 **CONSUMABLES:**

- 1.3.7.1 Such of those consumables as indicated as consumables provided by BHEL alone will be provided to the contractor by BHEL free of charge for erection activities. Other required consumables like electrodes, all gases, and other materials for this scope of work are to be arranged by the contractor at their cost.
- 1.3.7.2 All the required electrodes (in his scope) as approved by BHEL & Customer shall be arranged by contractor at his cost. 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.
- 1.3.7.3 TIG welding wires for CS, AS & SS welding will be supplied by BHEL free of cost for applicable Boiler Pressure Parts as provided by BHEL manufacturing units. All other electrodes including stainless steel electrodes required for the scope of work under this tender shall be arranged by the contractor at his cost. The bidder shall use the Customer approved quality welding electrodes only. The utilization of the TIG welding wires issued by BHEL shall be duly accounted for exercising maximum care and ensuring economical usage for minimum wastage. If during erection, it is found that the consumption of filler wire is more than the actual requirement due to improper usage, the cost for the additional quantity so consumed shall be recovered from the contractor.
- 1.3.7.4 The contractor shall provide within finally accepted price / rates, all consumables like welding electrodes (including alloy steel and stainless steel), all gases (inert, welding, and cutting), soldering material, dye penetrants, radiography films. Other erection consumables such as tapes, jointing compound, grease, mobile oil, M-seal, Araldite, petrol, CTC / other cleaning agents, grinding and cutting wheels are to be provided by the contractor. Steel, H&S, packers, shims, wooden planks, scaffolding 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.
- 1.3.7.5 All the shims, gaskets and packing, which go finally as part of equipment, shall be supplied by BHEL free of cost.

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1.3.8 MATERIAL SUPPLY:

- 1.3.8.1 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, Ammonia required for commissioning the erected equipments and chemicals required for chemical cleaning of equipments will be supplied free of cost by BHEL.
- 1.3.8.2 For fabrication & erection of structures, racks & trestles etc., Steel as available in commercial market, shall be supplied by BHEL for item No. 2301(A) of Rate Schedule ID 9. However, for other components, material supply is in contractor scope, as given in Rate Schedule ID 9.
- 1.3.8.3 All fabrication & erection including all statutory clearances are in scope of contractor.

1.3.9 POSSESSION OF GENERATORS:

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

1.3.10 LIGHTING FACILITY:

- 1.3.10.1 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.

1.3.11 GASES:

- 1.3.11.1 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.
- 1.3.11.2 BHEL reserves the right to reject the use of any gas in case required purity is not maintained.
- 1.3.11.3 The contractor shall submit weekly / fortnightly / monthly statement report regarding consumption of all consumables for cost analysis purposes.
- 1.3.11.4 The contractor shall ensure safe keeping of the inflammable cylinder at a separate place away from normal habit with proper security etc.

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1.3.12 ELECTRODES SUPPLY AND STORAGE

1.3.12.1 **The bidder shall use the Customer approved quality welding electrodes only.**

1.3.12.2 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 subjected to inspection and approval by BHEL. The contractor shall inform BHEL, details regarding type of electrodes, batch number and date of expiry etc.

1.3.12.3 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.

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

1.3.12.5 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.

1.3.12.6 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.

1.3.12.7 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.

1.3.13 OTHER FACILITIES

Adequate water less urinals [at least 2 nos per level at suitable locations] shall be arranged by the contractor within quoted rates, at site of construction at different level and different areas like Boiler, ESP, TG with proper disposal arrangement.

1.3.14 BID DRAWINGS

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

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1.4 T&Ps TO BE DEPLOYED BY CONTRACTOR

- 1.4.1 The following minimum major Tools & Plants (T&P) shall be arranged by the Contractor for execution of items mentioned in Chapter IX of Technical Conditions of Contract including Bunker of this tender within the quoted rate.

Sl.No.	Description	Quantity	Deployment Duration
1	75 T Crawler Crane	1 Nos.	Crane is to be made available at site from the Commencement of Boiler erection work to till completion of all physical works which require this capacity as decided by Engineer Incharge.
2	40 T Mobile Crane	1 No.	Crane shall be made available at site from commencement of work till completion of all physical works which require this capacity as decided by Engineer Incharge
3	New Generation Pick and Carry crane – Minimum capacity 8T	As required (Minimum 2 nos.)	As per the site requirement
4	Trailer –60T	1 No.	As per the site requirement
5	Trailer –30T	2 Nos.	As per the site requirement
6	Passenger cum Goods Lift of min 1000 Kgs capacity	1 No.	To be made available for operation from 3th month from the start of Boiler erection work and maintained in operational condition till the end of contract period and extended period if any.
7	Boiler furnace inside maintenance platform (Sky Climber or equivalent make)	1 No.	As per the site requirement
8	Resistance Heating Based Local PWHT Equipment with Flexible Ceramic	3 Nos	As per the site requirement

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Sl.No.	Description	Quantity	Deployment Duration
	Pad		
9	Tube Expander Machine for Boiler	As required	As per the site requirement
10	Winch arrangement for Boiler Drum Lifting	As required	As per the site requirement

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

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

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

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

ii) **BHEL provides hired T&P:** In all cases other than that specified in Sl No. i above, actual expenses incurred by BHEL along with applicable overheads will be back-charged to the contractor.

1.4.3 All the tools and plants required for this scope of work including the above, except the Tools & Plants provided by BHEL are to be arranged by the contractor within the quoted rates. Which includes the T&Ps viz. Blast cleaning accessories with compressor along with Corrugated Galvanised Iron shed, Painting Equipment along with accessories, Plate Bending machine, Ultrasonography machine required for structural works.

1.4.4 For loading, transportation, unloading, all necessary T&P such as Trailors, Cranes, Winches, Welding Machines, slings, jacks, sleepers, rails etc., are to be arranged by the contractor within the quoted rates.

1.4.5 Material handling including unloading from Trucks/ Trailors, loading, transportation, & unloading of heavier Boiler, APH, STG components / equipments like Boiler drums,

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Turbine casing, large dia pipes, Dampers & Gates, bunker, etc., the contractor has to make his own arrangements by deploying the required T&Ps at his cost. BHEL will not provide any crane / T & Ps for the above components.

- 1.4.6 The contractor has to furnish a list of Tools and plants including cranes / tractors / trailers / trucks etc which he has proposed to deploy for this work.
- 1.4.7 Crane operators deployed by the contractor shall be tested by BHEL before he is allowed to operate the cranes. **The crane load test has to be conducted as per statutory guidelines before deployment.**
- 1.4.8 The contractor shall arrange crane operator, diesel, petrol and other consumables required for the tools and plants, equipments etc. Preventive and routine maintenance of T & P are also to be arranged by the contractor at his cost without any delay. Required number of experienced mechanics and helpers for routine maintenance of the above cranes shall be provided by the contractor within his quoted rate.
- 1.4.9 The contractor has to supply, erect and maintain the **passenger cum goods lift (temporary lift)**, as per instruction of BHEL Engineer. Civil Foundation, necessary grouting including supply of grout materials shall be in the scope of the bidder. The operation and maintenance shall be carried out during the deployment period at his cost. The contractor has to arrange operators, technicians for round the clock operation at his cost. The lift facility shall be used by BHEL/Customer/other Contractors as per the requirement as decided by BHEL.
- 1.4.10 Also refer following clauses published in Technical conditions of Contract Volume IA (Volume I Book I):
 - 1.4.10.1 Clause no 1.3.6 on SCMS in chapter III
 - 1.4.10.2 Clause no 1.5.4 on steel plates for crane movement in chapter V
 - 1.4.10.3 Clause no 1.5.5.1 on crane operator and mechanic in chapter V
 - 1.4.10.4 Clause no 1.5.6 on replacement of spares for BHEL's T & P in chapter V
 - 1.4.10.5 Relevant clauses in Volume 1A -Special Conditions of Contract (SCC) shall also be referred.
 - 1.4.10.6 For uniform heating and better closed loop control, pre heating, post heating, controlled rate of heating & cooling and post weld heat treatment cycles for alloy steel should be carried out using flexible **ceramic pads with suitable heating machines.**
- 1.4.11 **CRANE OPERATOR**
 - 1.4.11.1 Must be capable of independently operating Hydraulic/Mechanical Crawler / Tyre mounted Cranes of respective categories.
 - 1.4.11.2 Must have minimum 2 years' experience in Operation of Hydraulic/Mechanical Crawler / Tyre Mounted Cranes in respective categories & hold valid HMV / TRANS license.

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Should be able to read and interpret the operation and maintenance manual, boom load chart, boom angle and other indicating devices.

- 1.4.11.3 Operator shall have latest Physician's certification for their physical fitness in vision with/without Lenses & adequate hearing with or without hearing aid.

Note:

1. The age of the contractor deployed cranes upto 75 MT should be within 15 years as on date of deployment.
2. Contractor has to provide documentary proof for the age of the crane at the time of deployment to BHEL Site.

Additional clause:

T&Ps mentioned above is tentative requirement considering parallel working in all areas mentioned in the scope of work. However, mobilization schedule and quantity / numbers as mutually agreed at site for major T&Ps, have to be adhered to. Numbers/ time of requirement of T&Ps will be reviewed time to time by BHEL site and contractor will provide required T&Ps / 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 the engineer incharge. Retaining of the T&Ps during the contract period will be mutually agreed in line with construction requirement.

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

- 1.5.1 List of T&Ps to be made available by BHEL to contractor free of hire charges on sharable basis is as below:

SI No	Description	Quantity
1	In addition to the cranes to be provided by the contractor, BHEL shall provide One crane of capacity above 75 T to the contractor as per site requirement on sharing basis free of hire charges to facilitate erection.	1 No.
2	Hydraulic Pressure Testing Pump with accessories	As Required
3	Chemical Cleaning Pumps with Motor	As Required
4	Air Blower for Air Leak Test	As Required
5	Boiler fill pump	As Required
6	Huck bolting machine	As Required
7	Venturimeter	As Required
8	EOT Crane (35 T capacity) at TG Hall without crane	1 no

- 1.5.2 All the T&Ps mentioned in clause 1.5.1 above shall be given to contractor on sharable basis and the allotment is made by BHEL on need basis.
- 1.5.3 Besides the T & P mentioned above, which is being made available to the contractor on free of hire charges, any additional crane and other T & P which may be required for successful and timely execution of the work covered within the scope of this tender shall be arranged and provided at site by the contractor at his cost. In case if the contractor fails to provide such equipments, BHEL will arrange for the same and the cost will be recovered from the contractor's bill with BHEL overheads, as applicable from time to time which may vary even during contract period.
- 1.5.4 Levelled land will be provided by BHEL/Customer for the cranes. Consolidation of the ground, if required, and preparation (including civil works and supply of required consolidation materials) for placing crane for operation shall be done by the contractor, at his cost. Necessary plates / sleepers required for marching and placing of crane for operation shall also be provided by the contractor within quoted rates. REQUIRED NUMBERS OF MILD STEEL PLATES OF 40 MM THICK AND 12 METRE LENGTH X 3 METRE WIDTH (APPROXIMATELY 6 NUMBERS) FOR THE ABOVE PURPOSE IS TO BE ARRANGED BY CONTRACTOR WITHIN HIS QUOTED RATE.

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- 1.5.5 BHEL may provide either owned cranes or hired cranes at the discretion of BHEL as below:
 - 1.5.5.1 In the event of providing BHEL Cranes:
 - 1.5.5.1.1 For all BHEL's own cranes of capacity greater than 75T, BHEL shall provide operators, free of charges. Fuel and lubricants for BHEL's own cranes of capacity greater than 75T, are to be arranged by the contractor within the quoted rate.
 - 1.5.5.1.2 Tentative List of consumables required to be provided by contractor is as below:
 - a. Engine Oil 15 W 40
 - b. Fuel Filters
 - c. Air Filters
 - d. Hydraulic Filters
 - e. Hydraulic Oil –Servo 68
 - f. Gear Oil- Servo 90
 - g. Engine oil Filter
 - h. Oil Separator Filter
 - i. Rope- CRG 100 Grease
 - j. Grease- Servo Multi-Purpose Grease
 - 1.5.5.1.3 Maintenance for the BHEL crane shall be carried out by BHEL. Bidder shall extend support (if required) required for routine maintenance works.
- 1.5.5.2 In the event of providing hired cranes:
 - 1.5.5.2.1 Crane Operators for hired cranes will be provided by BHEL, on free of charges.
 - 1.5.5.2.2 Fuel for cranes are to be arranged by the contractor within the quoted rate.
- 1.5.6 The day-to-day and routine maintenance including replacement of spares for the BHEL T&Ps (excepting cranes) will be carried out by the contractor at his own cost. However, BHEL shall supply spare parts free of charges for normal wear and tear only.
- 1.5.7 Since EOT crane is customer's crane, Allotment will be made only on need basis. Experienced EOT crane-operators are to be arranged in shifts by the contractor within the quoted rates. Contractor has to plan the activities on item wise where the EOT crane is required to be used and submitted to BHEL site for approval. In case the erection can be carried out by using other T&Ps, contractor shall make his own arrangement within the quoted price. The decision of BHEL Site in-charge on this will be final and binding. Providing required manpower assistance for moving the trailing cable of EOT Crane is included in the scope of this contract.
- 1.5.8 BHEL will provide only one set of 12mm and 16mm jaws per Huck bolting Machine. Further requirement of jaws to be arranged by the contractor at his cost.

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Consumables like O-ring, backup ring, springs, hydraulic fluid for top-up etc., required for maintenance of the Huck bolting machine to be arranged by contractor at his cost.

- 1.5.9 Any loss / damage of tools by the contractor shall have to be replaced or otherwise cost thereof shall be recovered from the contractor.
- 1.5.10 In case of non-availability of these equipments, due to any reason i.e., unavoidable breakdown, major overhaul or any other reason etc., the contractor should make arrangement at his own cost to meet the erection targets. No extra claim will be admitted due to non-availability of any of the above equipments. No delay in execution of work shall be accepted on this account.
- 1.5.11 BHEL deployed Cranes are only for erection purpose and shall not be available for material handling or transportation purpose. Contractor shall make their own arrangements for material transportation to erection site.
- 1.5.12 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.
- 1.5.13 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.
- 1.5.14 Filling pump for other than main boiler, for hydro test shall be arranged by the contractor, if required. For testing LP lines, necessary Hydraulic Test Pumps / Hand pumps are to be arranged by the contractor.

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VOLUME-IA PART-I CHAPTER – VI

1.6 TIME SCHEDULE

1.6.1. TIME SCHEDULE

- 1.6.1.1. The entire work of Boilers and auxiliaries, Aux Boiler, ESP, SCR, Rotating Machines, FGD, Steam Turbine, Turbo Generator, Piping etc., including Application of Insulation and refractory work including Supply & Application of Final Painting as per rate schedule as detailed in the Tender Specification shall be completed within **14 (Fourteen) months** from the date of commencement of work at site as per the below schedule.
- 1.6.1.2. During the total period of contract, the contractor has to carry out the activities in a phased manner as required by BHEL and the program of milestone events.
- 1.6.1.3. The erection work shall be commenced on the mutually agreed date between the bidder and BHEL engineer and shall be deemed as completed in all respect only when the unit is in operation. The decision of BHEL in this regard shall be final and binding on the contractor. The scope of work under this contract is deemed to be completed only when so certified by the site Engineer.
- 1.6.1.4. The contractor is required to refer Form F15 in Volume-IA Part II for all the instructions to be taken immediately after receipt of fax LOI.

1.6.2. COMMENCEMENT OF CONTRACT PERIOD

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

1.6.3. MOBILISATION FOR ERECTION, TESTING, ASSISTANCE FOR 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:

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A: Major MILESTONES for the project

Milestone Activity	Milestone Month (Tentative)
Start of Boiler Erection	First month
Hydro Test drainable	(5 th month)
Boiler Light Up	(8 th month)
Condenser Erection Start	(2 nd month)
Turbine Erection Start	(3 rd month)
Turbine Box up	(7 th month)
Turbine Oil Flushing	(7 th month)
Barring Gear	(8 th month)
Synchronisation	(9 th Month)
Full Load & Trial Run completion	(10 th Month)
PG Test & Handing over	(10 th Month)
Contractual Completion	(14 th Month)

B: Major Intermediate Milestones (for penalty)

Activity	Unit 5	Milestone
Hydro Test drainable	5 th Month	M1
Synchronisation	9 th Month	M2

Penalty for Intermediate Milestones

- M1 and M2 shall be intermediate Milestones for this work.
- 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.
- 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.
- 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.
- 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.
- Amount required to be withheld on account of slippage of identified intermediate milestone(s) shall be withheld out of respective milestone

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payment and balance amount (if any) shall be withheld @10% of RA Bill amount from subsequent RA bills.

- 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.
- 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.

- 1.6.3.3. 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 for completion of entire work under this scope shall be **14 (Fourteen)** 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 **Twelve Months** shall commence from:-

1. The date of handing over of the Unit to Customer or
2. Six months from the date of first synchronization of the unit, whichever is earlier (Provided all erection, testing, and commissioning works are completed in all respects).

TECHNICAL CONDITIONS OF CONTRACT (TCC)

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1.7 TERMS OF PAYMENT

1.7 Terms of payment:

The progressive payment for erection, testing and commissioning on accepted price / rates of contract value will be released as mentioned below in CI 1.7.1 to 1.7.6.

1.7.1 For Boiler, ESP, SCR, FGD, Rotating Machines, Piping & insulation & Misc Items (**Rate Schedule ID 1 to 5 & 7**), Progressive Payment against monthly running bills will be made up to 85% of the value of the erected tonnage Pro-rata as per CI no 1.1 to 1.21 of the following table.

SL NO	Contract (Main Package) Identification ---->	Boiler/ SCR				Rotating Machine	ESP/ FGD/ Misc		PIPING			INSULATION
	Rate schedule ID Identification ---- --->	Structure	Pressure Parts	Non Pressure Parts (upto ESP inlet Funnel)	Air Pre Heaters (PGMA 52)	1) RM 2) Handling Eqpts	ESP	NPP (ESP outlet Funnel to Chimney) / Misc Items (RS ID 7)	1) CS (HP) 2) CS (LP) 3) SS	Hangers & Supports	Temporary Piping 1) Steam Blowing 2) Chemical Cleaning	1) Castable & Pourable 2) Iron Components 3) Wool mattresses 4) Aluminium sheeting
	PRO RATA PAYMENTS (85%)											
1.1	ON PRE-ASSEMBLY WHEREVER APPLICABLE (IF NOT APPLICABLE, THIS PORTION SHALL BE CLUBBED WITH PLACEMENT IN POSITION)	20	20	25		15	15	15	20	15		--
1.2	PLACEMENT IN POSITION	15	10	10		20	20	10	20	25		50
1.3	ALIGNMENT	15	15	10		20	15	15	10	15		15
1.4	WELDING/BOLTING/FIXING	15	20	15		20	20	30	15	30		20

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1.5	COMPLETION OF NON DESTRUCTIVE EXAMINATION & STRESS RELIEVING/ HEAT TREATMENT (if not applicable, then this portion to be paid along with welding)	5	10	--		--	--	--	5			--
1.6	On Drum/ Steam Water Separator Lifting	0										
1.7	COMPLETION OF ATTACHMENT WELDING, FIN WELDING, SUPPORTS		5									
1.8	COMPLETION OF ROOF SKIN CASING		5									
1.9	INSTALLATION OF TEMPORARY PIPING										60	
1.10	DISMANTLING OF TEMPORARY PIPING, EDGE PREPARATION AND RETURN TO BHEL STORES, AREA CLEANING										25	
1.11	HANGERS & SUPPORTS ETC WHEREVER NECESSARY AS PER DRG		--	25		--	--	15	10			--
1.12	COMPLETION OF FURNACE ALIGNMENT AND FIRE BALL CHECKING	5										
1.13	COMPLETION OF BACK PASS ALIGNMENT	5										
1.14	COMPLETION OF VIBRATION SNUBBERS, MECHANICAL SPACERS, CASSETTE BAFFLES, STEAM COOLED SPACERS	5										
1.15	COMPLETION OF HOPPERS ALONG WITH ALL DOORS, HEATING ELEMENTS, POKING DOORS, ETC		--	0		--	5		--			--
1.16	COMPLETION OF INNER, OUTER ROOF INSULATOR HOUSING, RECTIFIER TRANSFORMERS, PENT HOUSE MONO RAILS, HOISTS ETC		--	--		--	5	--	--			--
1.17	ERECTION OF EMITTING AND COLLECTING RAPPING SYSTEM WITH ALL DRIVES		--	--		--	5	--	--			--

TECHNICAL CONDITIONS OF CONTRACT (TCC)

1.18	EQUIPMENT TRIAL OPERATION					10						
1.19	HYDRAULIC TEST OR PNEUMATIC TEST								3			
1.20	FLOATING OF LINES, FINAL ADJUSTMENT OF SUPPORTS FOR COLD AND HOT VALVES (if not applicable, this portion to be clubbed along with hydraulic test/pneumatic test)								2			
1.21	AIR PRE HEATERS (PG 52)From the total amount payable for the PGMA weight at tonnage rates, payment will be regulated as under:											
1.21.1	Completion of Support steel squareness and levelling, Expansion arrangement, Housing panel erection and alignment, Erection, alignment and welding of pedestals				11							
1.21.2	Completion of Erection, alignment and welding of Support Bearing, Guide Bearing, Rotor post, Bottom and Top centre sections, Hot and cold end connecting plates				14							
1.21.3	Completion of erection and alignment of modules				15							
1.21.4	Completion of erection, alignment and welding of Pin Rack assembly and Drive assembly				12							
1.21.5	Completion of seals setting				17							
1.21.6	Erection, alignment and welding of Lube oil systems, Cleaning Device, Fire sensing device, Deluge and water wash lines, Observation port and lighting assemblies and other accessories				13							
1.21.7	Completion of PGMA				1							
1.21.8	Air preheater Trial Run				2							

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	TOTAL FOR PRO RATA PAYMENTS (TOTAL 85%)	85	85	85	85	85	85	85	85	85	85	85

1.7.2 Further 15 % payment on pro-rata basis common to all PGs of Boiler/ESP/ RM/ Piping/ Insulation & Misc items etc. **(Rate Schedule ID 1 to 5 & 7)** shall be released on achievement of the following stage / milestones events (as per Cl no 2.1 to 2.26 of the following table) for the tonnage erected.

SL NO	Contract (Main Package) Identification ---->	Boiler				Rotating Machine	ESP/ Misc Items		PIPING			INSULATION
	Rate schedule Identification ----- >	Structure	Pressure Parts	Non Pressure Parts (upto ESP inlet Funnel)	Air Pre Heaters (PGMA 52)	1) RM 2) Handling Eqpts	ESP	NPP (ESP outlet Funnel to Chimney) / Misc Items (RS ID 7)	1) CS (HP) 2) CS (LP) 3) SS	Hangers & Supports	Temporary Piping 1) Steam Blowing 2) Chemical Cleaning	1) Castable & Pourable 2) Iron Components 3) Wool mattresses 4) Aluminium sheeting
II	STAGE/MILESTONE PAYMENTS (15%)											
2.1	AIR & GAS TIGHTNESS TEST		--	5		--	1	5	--			--
2.2	GAS DISTRIBUTION TEST		--	--		--	1	--	--			--
2.3	CHARGING OF ESP FIELDS		--	--		--	4	--	--			--
2.4	COMPLETION OF AIR & GAS TIGHTNESS TEST FOR FURNACE		2									
2.5	BOILER HYDRAULIC TEST (DRAINABLE)	0	2									
2.6	BOILER HYDRAULIC TEST (NON DRAINABLE)		1									

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2.7	Reheater Coils Hydraulic Test		2									
2.8	Clean Air Flow test					1						
2.9	Boiler Light Up	0	1		2	1			1	1		1
2.10	ABO		1	1	2	1		1	1	1		1
2.11	Steam Blowing	0		2	1	1			1	1		1
2.12.	SVF		2		2				1	1		1
2.13	Oil Flushing (TG)											
2.14	Barring Gear (TG)											
2.15	Rolling and Synchronisation	0								1		
2.16	Coal Firing			2	2	2	2	2		1		1
2.17	Full Load					1			1	1		1
2.18	Trial Operation of Unit					2	1	2	2	2		2
2.19	Completion of sheet covering for Boiler roof, burner roof, lift shaft cladding, completion of gutters	3										
2.20	Completion of all drains and vents to respective locations and placement of instrument sensors after steam blowing								2			
2.21	Painting	6	0	1	1	2	2	1	2	1		0

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2.22	Area cleaning, temporary structures cutting/removal and return of scrap	1	1	1	1	1	1	1	1	2		3
2.23	Punch List points/pending points liquidation	2	1	1	2	1	1	1	1	1		1
2.24	Submission of 'As Built Drawings'											
2.25	Material Reconciliation	2	1	1	1	1	1	1	1	1	15	2
2.26	Completion of Contractual Obligation	1	1	1	1	1	1	1	1	1		1
	TOTAL FOR STAGE/MILESTONE PAYMENTS (15%)	15	15	15	15	15	15	15	15	15	15	15
	TOTAL of clause 1.7.1 and 1.7.2	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%

1.7.3 The terms of payment for **Steam Turbine, Generator & Aux. (Rate Schedule ID 6)** shall be as below:

	Rate schedule Identification ----->	CND (1)	TUR (2)	GEN (3)	BFP PUMP & AUX (4)	HEATERS AND DEAERATORS (5)	MISCELLANEOUS ITEMS (6)
Sl. No.	Activity/Work Description	%					
I	PRO RATA PAYMENTS (85%)						
1	CONDENSER						
1.1	PREPARATION OF FOUNDATION	2%			--		
1.2	PLACEMENT, ALIGNMENT, ASSEMBLY AND WELDING OF BOTTOM PLATE SEGMENTS, HOT WELL, NDT AND SPRING ELEMENTS PLACEMENT & GROUTING.	10%			--		
1.3	ASSEMBLY AND POSITIONING OF WATER CHAMBER, SIDE PLATES, BOTTOM PLATES, WELDING AND NDT INCLUDING HINGE ASSY	12%		--	--		

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1.4	ASSEMBLY, ALIGNMENT AND WELDING & NDT OF TUBE SUPPORT PLATES AND INTERNALS LIKE BAFFLE PLATES, AIR EVACUATION PIPES ETC.	13%		--	--		
1.5	ASSEMBLY, WELDING & NDT OF DOME WALLS AND DOME STIFFENERS, EXTRACTION PIPING AND STEAM THROW DEVICE, LPH-1 SUPPORT ETC.	10%		--	--		
1.6	INSERTION, EXPANSION, CUTTING ETC. OF CONDENSER TUBES	15%		--	--		
1.9	HYDRO TEST OF STEAM AND WATER SIDE	10%		--	--		
1.10	WELDING OF CONDENSER NECK JOINT AND NDT& COMPLETION OF BALANCE WORKS	10%		--	--		
1.11	ERECTION, COMMISSIONING, LOAD TESTING OF CONDENSER WATER BOX HANDLING SYSTEM	3%		--	--		
	Subtotal for condenser	85%					
2	TURBINE (18 %)						
2.1	PREPARATION OF FOUNDATION, PLACEMENT, ALIGNMENT AND GROUTING OF BASE PLATES OF LPC AND BEARING PEDESTALS	--	7%		--		
2.2	PLACEMENT AND ALIGNMENT OF LP OUTER CASING BOTTOM PORTION AND CENTRE GUIDE KEYS	--	5%		--		
2.3	PLACEMENT OF LP ROTOR AND ALIGNMENT WITH INNER CASING AND CHECKING OF BLADE CLEARANCE	--	9%		--		
2.4	ASSEMBLY, ALIGNMENT & WELDING OF LP OUTER CASING UPPER HALF	--	9%		--		
2.5	PLACEMENT AND ALIGNMENT OF IP TURBINE OUTER CASING AND INNER CASING (LOWER HALVES)	--	2%		--		
2.6	PLACEMENT AND ALIGNMENT OF IP ROTOR WITH LOWER CASING AND BOXING UP OF INNER & OUTER CASING (UPPER HALVES) & ROLL CHECK	--	5%		--		
2.7	FINAL BOX UP OF IP TURBINE	--	0%		--		

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2.8	BOXING UP OF LP INNER-INNER & INNER- OUTER AND ROLL CHECK	--	5%		--		
2.9	PLACEMENT OF HP TURBINE, LOWERING OF HP ROTOR ON BEARINGS AND CHECKING OF CLEARANCES, COUPLING, HP TURBINE SWING CHECKS ETC.	--	5%		--		
2.10	ALIGNMENT OF ALL ROTORS INCLUDING REAMING, HONING AND FIXING OF COUPLING BOLTS		9%				
2.11	ASSEMBLY OF GOVERNING SYSTEM/EQUIPMENT		5%				
2.12	INSTALLATION OF ESVS, IVS, LPBP VALVES, MS STRAINERS (INTERNAL), HRH STRAINERS (INTERNAL)	--	9%		--		
2.13	ERECTION, ALIGNMENT AND WELDING OF CROSS AROUND PIPING	--	5%		--		
2.14	FINAL BOX-UP OF LP TURBINE	--	5%		--		
2.15	ASSEMBLY AND PREPARATION OF HYDRO-TEST, STEAM BLOWING DEVICES AND NORMALISATION ETC.	--	0%		--		
2.16	FINAL BOXING UP OF PEDESTALS AFTER OIL FLUSHING COMPLETION	--	5%		--		
	Subtotal for Steam Turbine		85%				
3	TURBO GENERATOR	--		--	--		
3.1	PREPARATION OF FOUNDATION, LEVELLING, MATCHING AND GROUTING OF FOUNDATION PLATES	--		5%			
3.2	LIFTING, LEVELLING AND ALIGNMENT OF STATOR (including erection and dismantling of portal crane if used for stator lifting)			23%			
3.3	FIXING OF END SHIELDS ON TO FOUNDATION BEAMS	--	--	6%			
3.4	ROTOR INSERTION	--	--	6%			
3.5	BOXING UP OF GENERATOR AND ASSEMBLY OF HYDROGEN SEALS	--	--	11%			

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3.6	ALIGNMENT OF GENERATOR ROTOR WITH LP TURBINE ROTOR, RUN-OUT CHECKS AND REAMING, HONING OF COUPLING HOLES AND FIXING OF COUPLING BOLTS	--	--	9%			
3.7	ERECTION OF EXCITATION EQUIPMENTS & ALIGNMENT OF GEN.-EXCITER ROTORS INCLUDING SWING CHECK AND COMPLETION OF BALANCE WORKS	--	--	10%			
3.8	INSTALLATION OF ENCLOSURES OF GENERATOR/EXCITER WITH ALL AUXILIARIES	--	--	5%			
3.9	GROUTING OF GEN BEARING PEDESTALS AND EXCITOR	--	--	5%			
3.1	FINAL GAS TIGHTNESS TEST OF STATOR WITH COMPLETE SYSTEM	--	--	5%			
	Subtotal for Generator			85%			
4	BFP PUMP AND AUXILIARIES	--	--		--		
4.1	ERECTION / TESTING and commissioning OF ONE BFP, ALONG WITH ALL AUXILIARIES				35%		
4.2	ERECTION / TESTING and commissioning of 2nd BFP, ALONG WITH ALL AUXILIARIES				35%		
4.3	ERECTION, TESTING, GROUTING ETC. OF BOOSTER PUMP	--	--	--	15%		
	Subtotal for pumps and Auxiliaries				85%		
5	HEAT EXCHANGERS AND DEAERATORS						
5.1	ERECTION, TESTING & COMMISSIONING OF ST OIL & STG AIR COOLERS	--	--	--		12%	
5.2	ERECTION, TESTING & COMMISSIONING OF WORKING OIL COOLERS & LUBE OIL COOLERS	--	--	--		5%	
5.3	ERECTION, TESTING & COMMISSIONING OF MAKE UP WATER DE-AERATORS, AND ASSOCIATED APPROACH PLATFORM WITH LADDERS ETC.	--	--	--		40%	

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5.4	ERECTION, TESTING & COMMISSIONING OF FEED WATER DE-AERATORS, AND ASSOCIATED APPROACH PLATFORM WITH LADDERS ETC.	--	--	--		28%	
	Subtotal FOR HEATERS AND DEAERATORS	--	--	--		85%	
6	MISCELLANEOUS ITEMS						
6.1	RE JOINTS, ME BELLOWS, ETC						15%
6.2	BF VALVE &, RELATED ITEMS	--	--	--			28%
6.3	ERECTION, TESTING & COMMISSIONING OF PLATE HEAT EXCHANGER PACKAGE	--	--	--			20%
6.4	ERECTION, TESTING & COMMISSIONING OF MISC. HOISTS & CHAIN PULLEY BLOCKS.						22%
	Subtotal for MISCELLANEOUS ITEMS						85%
	Total for Prorata (85%)	85%	85%	85%	85%	85%	85%
II	STAGE/MILESTONE PAYMENTS (15%)						
1	Boiler Light Up	0%	0%	0%	0%	0%	0%
2	ABO	0%	0%	0%	0%	0%	0%
3	Steam Blowing	0%	0%	0%	0%	0%	0%
4	Safety Valve Floating	0%	0%	0%	0%	0%	0%
5	Oil Flushing (TG)	1%	1%	1%	1%	1%	1%
6	Barring Gear (TG)	1%	1%	1%	1%	1%	1%
7	Rolling and Synchronisation	3%	3%	3%	3%	3%	3%
8	Coal Firing	0%	0%	0%	0%	0%	0%
9	Full Load	2%	2%	2%	2%	2%	2%
10	Trial Operation of Unit	2%	2%	2%	2%	2%	2%

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11	Painting (including arrow marking, nomenclature, etc)	2%	2%	2%	2%	2%	2%
12	Area cleaning, temporary structures cutting/removal and return of scrap	1%	1%	1%	1%	1%	1%
13	Punch List points/pending points liquidation	1%	1%	1%	1%	1%	1%
14	Submission of 'As Built Drawings'						
15	Material Reconciliation	1%	1%	1%	1%	1%	1%
16	Completion of Contractual Obligations	1%	1%	1%	1%	1%	1%
Total for Milestone/Stage payments (15%)		15%	15%	15%	15%	15%	15%
Total of I & II		100%	100%	100%	100%	100%	100%

1.7.4 The terms of payment for **Material Handling (Rate Schedule ID 8)** shall be as below:

SL No	Description of Activity	% of payment
1.7.4.1	Completion of the following activities of the unloaded materials received through trucks / trailers:	
1.7.4.1.a	Shifting to open/ covered stores	5%
1.7.4.1.b	Updation of receipt details, in store material registers / BHEL MM package system	20%
1.7.4.1.c	Stacking and verification	30%
1.7.4.1.d	Updation of verification details in material stock registers, submission of reports as per specified formats for shortage/open delivery, lodging of police report, documents for insurance claims etc, and preparation of material receipt certificates in prescribed formats where ever applicable	20%

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1.7.4.1.e	Identification of material in ready to lift position for issue to BHEL / erection agency, and updation of issue details in stores records	22%
1.7.4.1.f	Completion of contractual obligations	3%
	Total	100%
1.7.4.2	Unloading from railway wagons and collection from transporter godown	
1.7.4.2.a	Unloading from railway wagons / collection from railway station premises or collection from transporter godowns, re-loading, transportation to site and unloading	30%
1.7.4.2.b	Updation of receipt details, in store material registers / BHEL MM package system	15%
1.7.4.2.b	Stacking and verification	15%
1.7.4.2.d	Updation of verification details in material stock registers, submission of reports as per specified formats for shortage / open delivery, lodging of police report, documents for insurance claims etc, and preparation of material receipt certificates in prescribed formats where ever applicable	25%
1.7.4.2.e	Identification of material in ready to lift position for issue to bhel / erection agency, and updation of issue details in stores records	12%
1.7.4.2.f	Completion of contractual obligations	3%
	Total	100%
1.7.4.3	Completion of Preservation painting (paint supply by BHEL)	100%
1.7.4.4	Completion of dispatch to other sites	100%
1.7.4.5	% From every RA bill to be paid only after satisfactory completion otherwise forfeited	
1.7.4.5.a	Removal of grass/weeds and other plant growth in the store area	1%
1.7.4.5.b	Safety + illumination	1%

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1.7.5 The terms of payment for **Civil & Structural Works (Rate Schedule ID 9)** shall be as below:

1.7.5.1 Interim Payment

1.7.5.1.1 Interim bills in the form of monthly running bills prepared by the contractor in soft as well as Hard copies shall be based on the quantities executed and measured.

1.7.5.1.2 95% item rate shall be released after completion of works certification by Engineer in charge.

1.7.5.1.3 5% of the item rate shall be released after submission of the quality check formats as per the quality plan for the quantum of work billed and duly certified by engineer.

1.7.5.1.4 All admissible deductions as per GCC shall be made from the above 95% value.

1.7.5.1.5 BHEL Site Engineer, at discretion, may operate the part rate of the items in line with GCC clause no. 2.23.1 (v). Payment for supply portion (subjected to approval of Engineer In-Charge) shall be made only after receipt of material at site.

1.7.5.2 METHOD OF MEASUREMENT

Mode of measurement shall be as per relevant IS 1200. In case the same is also not available, the standard procedure adopted in CPWD shall be adopted. In case, the same is also not available in CPWD, the measurement of the work done will be based on the mutual agreement between BHEL and contractor. In all the above cases, the interpretation of BHEL will be final and binding to the contractor.

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- 1.7.6 NO CLAIM WHAT SO EVER MAY BE, WILL BE ENTERTAINED UNDER THIS CONTRACT, AFTER DULY SIGNING THE FINAL BILL ALONGWITH MEASUREMENT BOOKS AND ACCEPTED BY BHEL.

Notes to Terms of payment:

1. For Terms of Payments above, if any stage is not applicable for given item, then corresponding payment shall be made with next/ previous stage. Decision of BHEL Engineer at site shall be final in this aspect.
2. The segregation of items in different rate schedules is for tendering purpose only. Site engineer may change the items from One rate schedule ID to another as per actuals. Payment shall be made as per actuals only.
3. For PVC, ORC, RA Bill payment, compensation for Quantity variation, Retention amount, Security Deposit, please refer relevant clauses in TCC and Vol IA Part-II, Chapter-1: Corrections / Revisions in Special Conditions of Contract, General Conditions of Contract and Forms & Procedures of Technical Conditions of Contract (Volume-I, Book-I).
4. Base date for the purpose of calculation of PVC for this contract (in line with clause 2.17.5 of GCC) shall be as follows:
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).

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TAXES AND OTHER DUTIES

1.8.1 Goods and service Tax (GST) & Cess

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

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

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

BHEL GSTN - 21AAACB4146P1ZR
NAME - BHARAT HEAVY ELECTRICALS LIMITED
ADDRESS - BHEL SITE OFFICE, NALCO DAMANJODI ALUMINA REFINERY,
SPP AREA DAMANJODI, KORAPUT, ODISHA - 763008

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.

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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.

TECHNICAL CONDITIONS OF CONTRACT (TCC)

VOLUME-IA PART-I CHAPTER -IX

1.9.0 BILL OF QUANTITY

As mentioned in the Volume II, Price Bid

1.9.1 Weight Schedule –

WEIGHT SCHEDULE – Boiler, Rotating Machines, SCR & Aux.			
Sl. No.	DESCRIPTION	Weight [MT]	Rate Schedule Id
1	BOILER STRUCTURES	2620.33	1.1
2	BOILER - PRESSURE PARTS	699.80	1.2
3	BOILER - NON-PRESSURE PARTS	1775.24	1.3
4	ROTATING EQUIPMENTS	631.74	2.1
5	ROTATING MACHINES HANDLING EQUIPMENTS	15.40	2.2
	TOTAL WEIGHT IN MT (Approximately)	5742.51	

WEIGHT SCHEDULE – ESP , FGD and Auxiliaries			
Sl.No.	DESCRIPTION	WEIGHT [MT]	Rate Schedule Id
1	ESP	1648.00	3.1
2	Non Pressure Parts (ESP outlet funnel to Chimney)	1684.90	3.2
	TOTAL WEIGHT IN MT (Approximately) per unit	3332.90	

WEIGHT SCHEDULE – Piping with associated Fitting & Valves			
Sl.No.	DESCRIPTION	WEIGHT [MT]	Rate Schedule Id
1	AS Piping	198.45	4.1
2	CS HP	145.13	4.2
3	CS LP	1016.05	4.3
4	SS	109.71	4.4

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5	Hangers & Supports	9.50	4.5
6	Steam Blowing Piping (Temporary)	9.00	4.6
7	Chemical cleaning Piping (Temporary)	27.00	4.7
TOTAL WEIGHT IN MT (Approximately) per unit		1514.8	

WEIGHT SCHEDULE – Insulation			
Sl.No.	DESCRIPTION	WEIGHT [MT]	Rate Schedule Id
1	Pourable & castable	65.18	5.1
2	Iron parts	115.43	5.2
3	Al cladding sheet	47.00	5.3
4	Wool mattress	313.00	5.4
TOTAL WEIGHT IN MT (Approximately)		540.61	

WEIGHT SCHEDULE –Steam Turbine, Generator & Aux.			
SI No.	EQUIPMENT / PACKAGE	Weight (MT)	Rate Schedule Id
1	STEAM TURBINE & AUXILIARIES	151.5	6.1
2	TURBO GENERATOR & AUXILIARIES	65.3	6.1
3	CONDENSER & AUXILIARIES	159.98	6.1
4	HEAT EXCHANGERS & DEAERATORS	14.6	6.1
5	BFP PUMPS & MOTORS	59.5	6.1
6	MISC ITEMS		
6.1	RE JOINTS, BF VALVES,	7.94	6.1
6.2	PLATE HEAT EXCHANGERS & LP DOSING SKIDS	8	6.1
TOTAL WEIGHT IN MT (Approximately)		466.82	

WEIGHT SCHEDULE – Misc Items			
Sl.No.	DESCRIPTION	WEIGHT [MT]	Rate Schedule Id
1	Fuel Oil System & Tanks	22.79	7.1
2	Misc Pumps, Cranes, Elec Hoists, Air Dryers & Receivers & Sump Pumps	38.5	7.2

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TOTAL WEIGHT IN MT (Approximately)	61.29	

Detail weight schedule for Various Areas:

Main Boiler, ESP, NPP, Rotating Machines, SCR, FGD, Piping & Insulation etc

PGMA	Description	Size	Weight in MT	Rate Schedule ID
	PRESSURE PARTS			1.2
04	116	Upper Drum + Intl Id 61-71	ID 1676.4 x 100	65.0
04	146	Upper Drum Sspn Id 61-71		7.5
04	210	Lower Drum + Intl Id Upto 36	ID 1067 x 80	23.0
04	xxx	Drum Internals		5.0
	Sub Total		100.5	
05	137	Inlet Front Lower Ww Header	Ø 323.9 x 36	3.0
05	147	Inlet Rear Lower Ww Header	Ø 323.9 x 36	3.0
05	155	Inlet Side Lower Ww Header	Ø 323.9 x 36	6.0
05	175	Outlet Side Upper Ww Header	Ø 219.1 x 32	3.5
	Sub Total		15.5	
06	400	Burner Panel	Ø 63.5 x 4.8	13.5
06	611	Rear Arch Ww Pnl	Ø 63.5 x 4.8	12.5
06	631	Front Upper Ww Pnl	Ø 63.5 x 4.8	18.0
06	637	Waterwall Lower Front Panel	Ø 63.5 x 4.8	13.0
06	647	Rear Lower Ww Pnl	Ø 63.5 x 4.8	13.0
06	651	Side Upper Ww Pnl	Ø 63.5 x 4.8	34.0
06	655	Side Lower Ww Pnl	Ø 63.5 x 4.8	20.0
	Sub Total		124.0	
07	101	Downcomer Piping-Natural Circulation	Ø 273 x 32	30.0
07	200	Furnace Tubes	Ø 63.5 x 4.8	3.5
07	201	Riser Tubes	Ø 114.3 x 6.3	6.8
07	211	Boiler Bank Tubes	Ø 51 x 4.3 , Ø 63.5 x 4.8	54.0
07	212	Boiler Sidewall Tubes	Ø 63.5 x 4.8	2.5
07	222	Furnace Roof Tubes	Ø 63.5 x 4.8	6.8
07	226	Furnace Rear Arch Tubes	Ø 63.5 x 4.8	0.8
07	401	Waterwall Suspension		9.0
07	420	Downcomer Guides		1.0
07	601	Pressure Seals		0.8
07	989	Tools For Tube Expansion		0.8
07	992	Imported Electrodes		0.1
07	993	Consumables & Erection Materials	Ø 63.5 x 6.3	1.0
	Sub Total		117.1	
08	101	Furnace Upper Buckstay		35.0
08	107	Furnace Lower Buckstay		18.0
08	400	Furnace Guide		8.0

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08	900	Furnace Key Buckstay		3.5	1.2
		Sub Total		64.5	
09	001	Seal Boxes For Furnace Opening		3.0	1.2
09	002	Seal Boxes For Instrument Inserts		0.5	1.2
09	003	Material For Instrument Inserts		0.5	1.2
		Sub Total		4.0	
10	174	Vertical Spaced Sh Centre Inlet Header	Ø 323.9 x 32	2.6	1.2
10	178	Vertical Platen Sh 1nlet Header	Ø 273 x 32	2.2	1.2
10	274	Vertical Spaced Sh Centre Outlet Heade	Ø 366.4 x 56.4	5.0	1.2
10	278	Vertical Platen Sh Outlet Header	Ø 323.9 x 37	3.0	1.2
		Sub Total		12.79	
11	274	Sh Vertical Spaced Coil + Attachment	Ø 51.0 x 7.1/4.5	55.0	1.2
11	278	Vert Platen Centre Sh Coil Assy+Attach	Ø 44.5 x 7.1/5.0/4.5	18.5	1.2
		Sub Total		73.5	
12	803	Sh Steam Cooled Spacer Tubes	Ø 51.0 x 6.3	0.3	1.2
12	850	Sh Conn Pipes-Saturated	Ø 127 x 12.5	3.7	1.2
12	852	Sh Desh Links	Ø 323.9 x 32	2.8	1.2
12	900	Sh Desh	Ø 323.9 x 32	0.9	1.2
12	901	Sh Hngr,Suprts,Guides & Ties		3.5	1.2
12	993	Consumables & Erection Materials		0.4	1.2
		Sub Total		11.52	
18	1.0	Furnace Roof Skin Casing	3.15 mm Thk Sheet	3.1	1.2
		Sub Total		3.1	
19	114	Coils And Supports Of Upper P.Tube Ec	Ø 44.5 x 4.5	52.0	1.2
19	124	Coils And Supports Of Lower P.Tube Ec	Ø 44.5 x 4.5	52.0	1.2
19	701	Inlet Eco Headers	Ø 273 x 32	1.8	1.2
19	702	Outlet Eco Headers	Ø 273 x 32	1.9	1.2
19	850	Eco Feed Pipe	Ø 273 x 32	2.6	1.2
19	851	Eco Links To Drum	Ø 273 x 32	2.5	1.2
19	901	Eco. Supports & Suspensions		13.5	1.2
19	903	Eco. Miscellaneous Components		6.5	1.2
19	906	Eco Suprts For Lines & Links		0.2	1.2
19	992	Imported Electrodes		0.1	1.2
		Sub Total		133.0	
21	600	Soot Blower Piping And Fittings	60.3 x 5.54	3.1	1.2
21	601	Sootblower Piping Supports		2.5	1.2
21	700	Bulked Bps Components For Sb Piping		0.5	1.2
		Sub Total		6.13	
24	100	Boiler Trim Piping And Fittings		10.0	1.2
24	101	Boiler Trim Piping Supports		5.0	1.2
24	120	Safety Valve Esc Pipe&Drain - NrH Blr		4.0	1.2
24	125	Silencer Support-Safety Valves		4.5	1.2
24	135	Slncr&Suprt-Starting Vent - NrH Blr		1.5	1.2
24	140	Sample Cooler And Supports		1.5	1.2
24	xxx	Spray Water Piping	60.3x5.5	1.0	1.2
24	xxx	Start-Up Vent Escape Piping	114.3 x 11.13	0.5	1.2
24	xxx	ERV Impulse Piping	33.4x4.55	0.3	1.2
24	175	Headers For Trim Piping		1.5	1.2
24	346	Hnagers and supports of main steam pipin		3.0	1.2

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24	350	Boiler filling Piping		0.5	1.2
24	351	Hanger supports for boiler filling pipin		0.2	1.2
24	700	Bulked Bps Components For Trim Pipes		0.3	1.2
24	955	Lapping Tools For Sv&Erv		0.1	1.2
24	993	Consumables & Erection Materials		0.1	1.2
24	994	Name Plates	Ø 219.1 x 32	0.2	1.2
		Sub Total		34.1	
		TOTAL PRESSURE PARTS		699.8	
		NON PRESSURE PARTS			
20	004	Wall Box Non-Pressurised For Lrsb Mk-1		0.5	1.3
20	204	Wall Box Non Pressurised For Rw5e		0.5	1.3
		Sub Total		1.04	
28	220	DOORS		2.5	1.3
		Sub Total		2.5	
30	103	Seal Plate Assy		2.0	1.3
30	105	Furnace Bottom Enclosure Framing		2.0	1.3
30	211	Furnace Rear Arch Enclosure Framing		1.2	1.3
30	215	Main Boiler		1.5	1.3
30	218	Furnace Roof		0.5	1.3
30	228	Pent House		6.0	1.3
		Sub Total		13.2	
31	010	Skin Casing Comps Welded To Pressure P	3.15 mm Thk Sheet	1.2	1.3
31	104	Furnace Rear Arch Skin Casing	3.15 mm Thk Sheet	0.3	1.3
31	108	Bank Tube Skin Casing	3.15 mm Thk Sheet	2.0	1.3
		Sub Total		3.53	
37	010	Blr Outer Casing Components	1.6 mm Thk Sheet	6.0	1.3
37	810	Blr Outer Casing	1.6 mm Thk Sheet	2.6	1.3
		Sub Total		8.6	
41	390	Oil Gun Vice Assy And Rack		0.6	1.3
		Sub Total		0.6	
42	002	Steam Blow Materials		0.5	1.3
42	005	Instrument Fittings		0.3	1.3
42	152	Piping,Opr'G Floor Lfo		1.2	1.3
42	157	Piping,Opr'G Floor Atm Air		1.0	1.3
42	170	Piping,Oil Burner Fitting		2.3	1.3
42	700	Bps Fasteners		0.2	1.3
42	xxx	Piping,Opr'G FloorHFO		1.2	1.3
42	xxx	Piping,Opr'G Floor Atm Steam		0.5	1.3
42	xxx	LFO Piping From FOPH to Boiler	NB 100, NB 50	3.0	1.3
42	xxx	HFO Piping From FOPH to Boiler	NB 100, NB 50	3.0	1.3
42	xxx	HFO Heaters (2 No.s)		6.5	1.3
42	xxx	HFO Return Line	NB 50	2.5	1.3
42	xxx	LDO Return Line	NB 50	2.5	1.3
		Sub Total		24.71	
43	004	Assy Comp Scanner & Gun Air System		1.5	1.3
43	005	Assy Comp Mill Seal Air System		3.6	1.3
43	104	M/C Comp Scanner & Gun Air System		4.8	1.3
43	105	M/C Comp Mill Seal Air System		15.0	1.3
43	200	Subdel,Ignitor&Scanner Air System		0.5	1.3

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		Sub Total		25.44	
45	180	Wind Box Assembly 18-In Width		29.1	1.3
45	181	Wind Box Support 18-In Width		3.2	1.3
45	xxx	OFA Duct & Dampers		5.0	1.3
		Sub Total		37.2	
47	141	Fuel Piping Supports With 14-In Pipe		4.0	1.3
47	143	Pipe Coupling Orifice & Misc Items		8.0	1.3
47	149	St Pipes & Shop Bends For Rest Of The	406.4 x 12.7	73.0	1.3
		Sub Total		85.0	
48	012	Rect Duct Bet F.D Fan And Airheater	5mm	20.9	1.3
48	014	Expn Piecesbet F.D Fan And Airheater		1.3	1.3
48	015	Supportsetcbet F.D Fan And Airheater		3.0	1.3
48	019	Foundation Materials		0.9	1.3
48	112	Rect Ducts Pri Fan To Airheater Prisd	5mm	12.0	1.3
48	114	Expn Piecespri Fan To Airheater Prisd		1.0	1.3
48	115	Supportsetcpri Fan To Airheater Prisd		2.1	1.3
48	141	Seal Air Hag And Id Fan Outgate		1.4	1.3
48	142	Rect Duct Coldairbus(Temp Air To Mill	5mm	25.0	1.3
48	144	Expn Piecescoldairbus(Temp Air To Mill		1.0	1.3
48	145	Supportsetccoldairbus(Temp Air To Mill		2.0	1.3
48	200	Instrument Tappings On Ducting		2.9	1.3
48	202	Rect Ductsairheater To Windboxduct	5mm	25.0	1.3
48	204	Expn Piecesairheater To Windboxduct		5.2	1.3
48	205	Supportsetcairheater To Windboxduct		1.7	1.3
48	207	Flowmeters For Secondary Air Flow		4.2	1.3
48	212	Wind Box Connecting Ducts - Rectangula	5mm	3.8	1.3
48	214	Expn Pieceswindbox Connecting Duct		1.3	1.3
48	222	Rect Duct-Airheater Prisdetohotair B	5mm	40.0	1.3
48	224	Expn Piecesairheater Prisdetohotair B		2.7	1.3
48	225	Supports For Hot P.A (Ah To Hot Bus)		4.0	1.3
48	232	Rect Ducts Hot Air Busduct(Hotairtomil	5mm	5.0	1.3
48	234	Expn Pieceshot Air Busduct(Hotairtomil		1.5	1.3
48	382	Rect Duct Economiser To Airheater2nop	6mm	55.0	1.3
48	384	Expn Pieceseconomiser To Airheater2nop		8.7	1.3
48	385	Supportsetceconomiser To Airheater2nop		10.2	1.3
48	432	Rect Duct Airheater Boiler Outlet-Gas	6mm	65.0	1.3
48	434	Expn Piecesairheater Boiler Outlet-Gas		4.7	1.3
48	435	Supportsetcairheater Boiler Outlet-Gas		9.0	1.3
48	462	Rect Duct Boiler Outlet To Elec Precp	6mm	63.0	1.3
48	464	Expn Piecesboiler Outlet To Elec Precp		5.2	1.3
48	465	Bof To Ep Ducting Supports		6.0	1.3
48	482	Rect Ducts-Elec Prptr/M.S To Inddraftf	6mm	38.0	1.3
48	484	Expn Pieceselec Prptr/M.S To Inddraftf		5.0	1.3
48	485	Supportsetcelec Prptr/M.S To Inddraftf		6.0	1.3
48	662	Rect Duct Hot Air Bus To Mills	5mm	21.0	1.3
48	665	Supports For Hot Pa To Mills		5.0	1.3
48	667	Venturi-Primary Air Flow		4.5	1.3
48	700	Bulked Bps Components		1.3	1.3
48	993	Erection Materials		7.0	1.3

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48	XXX	Hot Gas Duct- BB Outlet to ECO Inlet	6mm	15.0	1.3
66	000	Raw Coal Bunker (4 No.s)	10 mm Thk Plate	132.0	1.3
		Sub Total		629.529	
50510		STEAM COIL A P H		4	1.3
		Sub Total		4	
57010		GATE-FD FAN OUTLET		7.08	1.3
57033		DAMPER-SA SCAPH INLET		1.5	1.3
57063		DAMPER-SA SCAPH OUTLET		1.95	1.3
57083		DAMPER-SA SCAPH BYPASS		3.1	1.3
57110		GATE-PA FAN OUTLET		6.3	1.3
57141		SEAL AIR HAG AND ID FAN		20	1.3
57143		DAMPER-COLD AIR TO MILL		1.18	1.3
57209		MTG BKT FOR CL DAMPER AI		3.3	1.3
57270		GATE-HOT AIR TO MILLS		6.9	1.3
57363		DAMPER-ECONOMIZER BYPASS		8.4	1.3
57413		DAMPER-ECONOMISER BYPASS		6	1.3
57577		ELECT ACTUATOR FOR GATE,		7.4	1.3
57578		ELECTRICAL ITEMS FOR GAT		0.055	1.3
57603		DAMPER-SCR INLET		13.5	1.3
57613		DAMPER-SCR OUTLET		13.5	1.3
57623		DAMPER-SCR BYPASS		13.5	1.3
57663		DAMPER HOT AIR BUS TO MI		3.5	1.3
57853		DAMPER HOT AIR TO MILL I		6.8	1.3
57863		DAMPER HOT AIR MILL BYPA		6.8	1.3
57873		DAMPER HOT AIR TO ROCKHO		3.4	1.3
57883		DAMPER HOT AIR TO MILL O		7.9	1.3
57988		DUCTS COMMISSIONING SPAR		0.025	1.3
		Sub Total		142.09	
SS901		SCR Supporting Posts and Restraints		37.0	1.3
SS906		SCR Rectifier Truss Arrangement		11.0	1.3
SS907		SCR Cap Truss Arrangement		24.0	1.3
SS908		SCR Bottom Hopper Truss Arrangement		11.0	1.3
SS915		SCR Catalyst Front Casing Wall		19.0	1.3
SS916		SCR Rectifier Front Casing Wall		4.0	1.3
SS917		SCR Cap Top Casing Wall		27.0	1.3
SS918		SCR BOTTOM HOPPER FRONT CASING WALL		5.0	1.3
SS925		SCR Catalyst Rear Casing Wall		19.0	1.3
SS926		SCR Rectifier Rear Casing Wall		4.0	1.3
SS927		SCR Cap Rear Casing Wall		10.0	1.3

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SS928	SCR BOTTOM HOPPER REAR CASING WALL		5.0	1.3
SS935	SCR Catalyst Left Casing Wall		19.0	1.3
SS936	SCR Rectifier Left Casing Wall		4.0	1.3
SS937	SCR Cap Left Casing Wall		10.0	1.3
SS938	SCR BOTTOM HOPPER LEFT CASING WALL		5.0	1.3
SS945	SCR Catalyst Right Casing Wall		19.0	1.3
SS946	SCR Rectifier Right Casing Wall		4.0	1.3
SS947	SCR Cap Right Casing Wall		10.0	1.3
SS948	SCR BOTTOM HOPPER RIGHT CASING WALL		5.0	1.3
SS955	SCR Catalyst Support Arrangement		53.0	1.3
SS965	SCR Catalyst Support Hanger Strap		21.0	1.3
SS975	SCR Catalyst Loading Door		13.0	1.3
SS981	SCR PTFE Bearing Supp App.4 No's/SCR)		1.0	1.3
SS983	SCR Fasteners		3.0	1.3
SS996	SCR Turning vane		16.0	1.3
SS997	SCR Miscellaneous 2		16.0	1.3
SS998	SCR Miscellaneous 3		15.0	1.3
SS999	SCR Temporary Intern. Supp for Erection		10.0	1.3
	Sub Total		400.0	
SD307	SCR Duct Flow Devices		10.0	1.3
SD342	Scr Inlet Ducting		60.0	1.3
SD344	Expjnt-Scr Inlet Ducting		10.0	1.3
SD345	Supports-Scr Inlet Ducting		8.0	1.3
SD352	Scr Outlet Ducting		50.0	1.3
SD354	Expjnt-Scr Outlet Ducting		10.0	1.3
SD355	Supports-Scr Outlet Ducting		8.0	1.3
SD362	Eco Bypass Ducting		20.0	1.3
SD364	Expjnt-Eco Bypass Ducting		6.0	1.3
SD365	Support-Eco Bypass Ducting		10.0	1.3
SD395	CLH/VLH OF SCR DUCTS		2.0	1.3
SD911	SCR DUCT BEARING PLATE		2.0	1.3
SD915	SCR DUCT MANHOLE DOORS		2.0	1.3
SD993	SCR DUCT ERECTION MATERIAL		7.0	1.3
SD386	SCR BYPASS DUCT		30.0	1.3
SD407	LPA Screen		5.0	1.3
	Sub Total		240.0	
SC104	DENOX SYSTEM - FIELD INTERCONNECTING EQPTS		40.0	1.3
SC112	DENOX SYSTEM - PNEUMATIC ACTUATOR IN A&FG SYSTEM		0.3	1.3

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SC116	DENOX SYSTEM -PNEUMATIC TUBINGS FITTINGS & AIR SET		0.3	1.3
SC216	DENOX SYSTEM - LOCAL CONTROL BOXES		0.2	1.3
SC300	DENOX SYSTEM - FIELD GAUGES		0.1	1.3
SC304	DENOX SYSTEM - FIELD SWITCHES		0.1	1.3
SC308	DENOX SYSTEM - FIELD TRANSMITTERS & TEMP. ELEMENTS		0.3	1.3
SC312	DENOX SYSTEM - FLOW MEASURING DEVICES		0.3	1.3
SC316	DENOX SYSTEM -ANALYSERS		0.1	1.3
SC324	DENOX SYSTEM - ERECTION MATERIALS		0.8	1.3
	Sub Total		42.5	
SR010	ANHYDROUS AMMONIA TRUCK UNLOADING SKID		2.0	1.3
SR020	ANHYDROUS AMMONIA FORWARDING PUMP SKID		2.0	1.3
SR050	WASTE AMMONIA DILUTION TANK		3.0	1.3
SR100	ANHYDROUS AMMONIA STORAGE TANK		40.0	1.3
SR103	AMMONIA STORAGE AREA - BHEL VALVES		0.6	1.3
SR106	AMMONIA STORAGE AREA - BOI VALVES		1.2	1.3
SR121	AMMONIA STORAGE AREA- PIPING SUPTS,MISC MATL		1.8	1.3
SR122	AMMONIA STORAGE AREA - DD ITEMS		1.2	1.3
SR150	WASTE AMMONIA HANDLING SYSTEM - SUB DELIVERY		0.9	1.3
SR151	WASTE AMMONIA HANDLING SYSTEM- PIPING SUPTS, MISC		2.0	1.3
SR152	WASTE AMMONIA HANDLING SYSTEM- DD ITEMS		0.8	1.3
SR171	WATER SPRINKLER SYSTEM-PIPING SUPTS, MISC MATL		1.0	1.3
SR172	WATER SPRINKLER SYSTEM - DD ITEMS		0.2	1.3
SR180	AMMONIA STORAGE AREA-SAFETY EQUIPMENT SUB DELIVERY		0.3	1.3
SR181	AMMONIA FARM UTILITY PIPING SUPTS, MISC		0.8	1.3
SR182	AMMONIA FARM UTILITY - DDITEMS		0.1	1.3

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SR200	AMMONIA SYSTEM SCR AREA - SUB DELIVERY		0.3	1.3
SR203	AMMONIA SYSTEM SCR AREA - BHEL VALVES		0.3	1.3
SR206	AMMONIA SYSTEM SCR AREA - BOI VALVES		0.3	1.3
SR207	AMMONIA SYSTEM-FASTENERS		0.3	1.3
SR251	AMMONIA SYSTEM SCR AREA- PIPING SUPT,MISC		0.3	1.3
SR252	AMMONIA SYSTEM SCR AREA - DD ITEMS		0.1	1.3
SR270	AMMONIA INJECTION SKID		0.7	1.3
SR281	AMMONIA SCR UTILITY PIPING SUPTS, MISC		0.3	1.3
SR282	AMMONIA SCR AREA UTILITY - DD ITEMS		0.3	1.3
SR301	DILUTION AIR SUPPLY SYSTEM - PIPING SUPT, MISC		3.0	1.3
SR303	DILUTION AIR SUPPLY SYSTEM - BHEL VALVES		0.8	1.3
SR306	DILUTION AIR SUPPLY SYSTEM - BOI VALVES		0.5	1.3
SR307	DILUTION AIR SUPPLY SYSTEM - FASTENERS		0.5	1.3
SR311	DILUTION AIR HEATER STEAM PIPING, MISC		0.3	1.3
SR312	DILUTION AIR HEATER STEAM PIPING- FITTING		0.1	1.3
SR318	DILUTION AIR HEATER STEAM PIPING - SHOP		0.3	1.3
SR330	DILUTION AIR HEATER -ELECTRIC		2.5	1.3
SR400	SCR - RECTIFIER		12.0	1.3
SR490	SCR-REACTOR SEALING SYSTEM		1.5	1.3
SR500	CATALYST DE- DUSTING SYSTEM		5.0	1.3
SR511	CATALYST DE-DUSTING SYSTEM PIPING SUPPORTS & MISC		0.3	1.3
SR518	CATALYST DE-DUSTING SYSTEM PIPING - SHOP ITEMS		0.5	1.3
SR900	SCR - CATALYST TROLLEY		0.5	1.3
SR988	AMMONIA SYSTEM- COMMISIONING SPARES		0.1	1.3
SR990	SCR-CATALYST HANDLING SYSTEM		3.5	1.3
SR992	AMMONIA SYSTEM-WELDING ELECTRODES		0.1	1.3
SR128	AMMONIA STORAGE AREA - SHOP ITEMS		1.2	1.3

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SR158	WASTE AMMONIA HANDLING SYSTEM -SHOP ITEMS		0.8	1.3
SR178	WATER SPRINKLER SYSTEM - SHOP ITEMS		2.0	1.3
SR188	AMMONIA FARM UTILITY - SHOP ITEMS		0.4	1.3
SR258	AMMONIA SYSTEM SCR AREA - SHOP ITEMS		0.8	1.3
SR288	AMMONIA SCR AREA UTILITY - SHOP ITEMS		0.5	1.3
SR300	DILUTION AIR SUPPLY SYSTEM - SUB DELIVERY		1.3	1.3
SR308	DILUTION AIR SUPPLY SYSTEM - SHOP ITEMS		15.0	1.3
SR503	Catalyst De- Dusting system- BHEL Valves		0.3	1.3
SR506	Catalyst De- Dusting system- BOI Valves		0.3	1.3
SR507	Catalyst De- Dusting system- Fasteners		0.1	1.3
SR512	CATALYST DE-DUSTING SYSTEM PIPING - DD ITEMS		0.3	1.3
	Sub Total		115.3	
	TOTAL NON PRESSURE PARTS Boiler		1775.24	
	STRUCTURES			
34	xxx	Coal Bunker Structure	200.0	1.1
		Sub Total	200.0	
35	010	Foundation Materials-Boiler	2.3	1.1
35	110	Main Columns Left	42.7	1.1
35	120	Main Columns Right	44.2	1.1
35	130	Main Columns Middle	17.0	1.1
35	140	Auxiliary Columns-Left Side	29.4	1.1
35	150	Auxiliary Columns-Rightside	24.3	1.1
35	210	Boiler Ceiling Structure-Fabricated	57.4	1.1
35	220	Boiler Ceiling Structure-Rolled Beams	12.7	1.1
35	230	Boiler Ceiling Structure-Bracings	2.0	1.1
35	310	Horizontal Bracing I Mbl	6.3	1.1
35	320	Horizontal Bracing Ii Mbl	8.8	1.1
35	330	Horizontal Bracing Iii Mbl	16.2	1.1
35	340	Horizondal Bracing Iv Mbl	13.6	1.1
35	380	Landing Platforms	29.0	1.1
35	440	Horizontal Beams	105.2	1.1
35	510	Column Bracings-Front Bracing	11.4	1.1
35	520	Column Bracings-Side Bracing	24.6	1.1
35	530	Column Bracings-Rear Bracing	18.7	1.1
35	610	Boiler Roof Structure	33.1	1.1

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35	611	Boiler Roof Sheetting		15.1	1.1
35	700	Hsfg Fasteners For Pg 35		0.3	1.1
35	810	Temporary Structure For Drum Erection		3.7	1.1
35	811	Floor Grills And Guard Plate		10.2	1.1
35	820	Stairs		8.3	1.1
35	850	Handrails And Posts		7.8	1.1
35	xxx	SCR STRUCTURES		302.0	1.1
35	993	Consumablesanderectionmaterials		4.2	1.1
		Sub Total		850.2	
36	210	Main Floor 1st Level		8.4	1.1
36	220	Main Floor 2 Level		12.2	1.1
36	230	Main Floor 3rd Level		25.5	1.1
36	240	Main Floor 4th Level		9.2	1.1
36	250	Main Floor 5th Level		11.6	1.1
36	260	Main Floor 6th Level		6.0	1.1
36	270	Main Floor 7th Level		10.1	1.1
36	280	Main Floor 8th Level		5.5	1.1
36	290	Main Floor 9th Level		14.2	1.1
36	300	Main Floor 10th Level		9.4	1.1
36	390	Miscellaneous Platforms		29.1	1.1
36	610	Boiler Roof Structure		15.5	1.1
36	810	Floor Grills And Guard Plate		70.3	1.1
36	820	Stairs And Ladders		3.3	1.1
36	xxx	Platforms -SCR		110.3	1.1
36	850	Handrails And Hand Rail Post		9.3	1.1
		Sub Total		350.0	
38	299	Mill Maintanance Plat form		14.9	1.1
38	310	Conn Platforms To Mill Deaerator Bay		4.3	1.1
38	410	Monorail for Mill Handling		16.2	1.1
38	810	Floorgrills And Guard Plate		12.8	1.1
38	850	Hand Rails And Hand Rail Posts		1.9	1.1
		Sub Total		50.1	
39	010	Foundation Materials		3.0	1.1
39	100	Col Frames For Ducting Before Esp		5.2	1.1
39	140	Cols Frames Near I.D.Fan		31.6	1.1
39	150	Col Frames Betn I.D.Fan And Chimney		7.0	1.1
39	300	Platforms - External Structure		11.5	1.1
39	301	Struc And Platform For Fans		1.8	1.1
39	302	Struc For Motor Hood Covering		3.8	1.1
39	303	Monorail Beams For Fans		28.0	1.1
39	700	Hsfg Fasteners For Pg 39		0.2	1.1
39	810	Floor Grill		2.8	1.1
39	820	Stairs		2.6	1.1
39	850	Hand Rail And Hand Rail Posts		2.6	1.1
39	xxx	Elevator Supporting Structure		45.0	1.1
39	xxx	Elevator Cladding Sheet	1.6 mm Thk	5.0	1.1
		Sub Total		150.05	
66	xxx	Bunker Bay Structures		0.0	1.1
66	xxx	Bunker Valley Internal Lining (for 4 Bunkers)	2 mm Thk Sheet	8.0	1.1

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	Sub Total		8.0	
57466	PLATFORMS AND LADDERS		20	1.1
	Sub Total		20.0	
FW260	DUCT STR BYP & BUF/GGH/ABS		48	1.1
FW262	DUCT STR ABS & BYP/STACK		118	1.1
FW280	FOUNDATION MATL FOR DUCT STRUC		10	1.1
FW281	FOUNDATION MATL FOR ABS		7	1.1
FW282	FOUNDATION MATL FOR ELEVATOR		10	1.1
FW283	FOUNDATION MATL RC PUMP SHED		3	1.1
FW285	SUPRTING STR FOR EMERGENCY QWT		2	1.1
FW293	ELEVATOR AND ACCESSORIES		11	1.1
FW297	PLATFORM FOR DUCT		5	1.1
FW298	PLATFORM FOR G&D		5	1.1
FW300	ABSORBER COLUMNS		35	1.1
FW301	ABSORBER BEAMS AND BRACINGS		50	1.1
FW302	ABSORBER LOWER FLOORS		20	1.1
FW303	ABSORBER UPPER FLOORS		20	1.1
FW304	ABSORBER FLOOR GRILLS		18	1.1
FW305	ABSORBER STAIRS & HANDRAILS		8	1.1
FW380	ELEVATOR COLUMN		33	1.1
FW381	ELEVATOR BEAM AND BRACING		20	1.1
FW382	ELEVATOR FLOORS		18	1.1
FW383	ELEVATOR STAIR AND HAND RAIL		6	1.1
FW384	ELEVATOR FLOOR GRILL		10	1.1
FW385	ELEVATOR M/C ROOM & GUIDE ,		5	1.1
FW386	INTER-CONNECTING PLTF TO ABS		5	1.1
FW612	GALLARIES AND RAILINGS FOR DAM		5	1.1
FW613	GALLARIES AND RAILINGS FOR DUC		5	1.1
FW700	SILO STR-BEAM, BRAC & FLOOR		15	1.1
FW711	SHIM PLATE FOR STRUCTURES		2	1.1
FW726	SILO STR-FLOOR GRILLS		15	1.1
FW727	SILO STR-STAIRS & HANDRAILS		15	1.1
FW730	LIMESTONE SILO STRUCTURE		60	1.1
FW740	FOUNDATION MATL FOR TANKS		33	1.1
FW749	ALL TANKS INTERNAL STRUCTURE		5	1.1
FW760	FOUNDATION MATL FOR PIPE RACKS		12	1.1
FW761	STRUCTURE FOR PIPERACKS		35	1.1
FW762	FNDN MATL FOR SILO STRUCTURE		5	1.1
FW763	FNDN MATL SUB PIPE RACK		5	1.1
FW765	STR FOR SUB PIPE RACK		15	1.1
FW766	PLATFORM FOR PIPE RACK		40	1.1

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FW767	PLATFORM SUB PIPE RACK		15	1.1
FW768	TRESTLE FOR MAIN PIPE RACK		80	1.1
FW769	TRESTLE-SUB PIPE RACK		40	1.1
FW787	STRUCTURES INSIDE GDWB & BMB		25	1.1
FW871	PIPING SUPPORT STR.		18	1.1
	Subtotal		912	
SS990	Ammonia Storage Structure Columns		20.0	1.1
SS991	Ammonia Storage Struct Beams & Bracings		20.0	1.1
SS992	Ammonia Storage Floor Steel Arrangement		10.0	1.1
SS993	Ammonia Storage Handling Arrangement		10.0	1.1
SS994	Ammonia Storage Roof Structure		15.0	1.1
SS995	Ammonia Storage Roof Sheet		5.0	1.1
	Sub Total		80.0	
	TOTAL STRUCTURES		2620.33	
	ROTATING MACHNIES			
65	724	24" Gravimetric Feeders (4No.s)	16.5	2.1
	Sub Total		16.5	
67	252	Coal Gate at Bunker Outlet	2.6	2.1
67	256	Coal Gate at Feeder Inlet	2.6	2.1
67	283	Feeder Outlet Iso Gate	4.8	2.1
67	801	Down Spout	11.0	2.1
67	802	Bunker Emptying Chute	5.0	2.1
67	803	Feed Pipe to Mill	5.0	2.1
	Sub Total		31.0	
52000	SPECIAL TOOLS/CONTRA		0.43	2.1
52010	LARG AH-ROTOR ASSY		141	2.1
52011	LARG AH-ROTOR POST		7.65	2.1
52012	LARG AH-ROTORPINRACK		2	2.1
52013	LARG AH-ROTORSEALS		2.3	2.1
52030	LARG AH-ROTORHOUSING		17.5	2.1
52041	HOT END CONN PLATE		20	2.1
52042	COLD END CONN PLATE		30.2	2.1
52054	LARG AH-AXIAL SEAL		0.25	2.1
52055	LARG AH-BY PASS SEAL		0.45	2.1
52100	LARGE AH ROTOR DRIVE		2.52	2.1
52211	LARG AH-AIRSEAL PIPE		0.39	2.1
52220	LARG AH-GENS DETAILS		3.6	2.1
52261	LARG AH-GUIDE BEARNG		1.47	2.1
52262	LARG AH-SUPRT BEARNG		2.13	2.1
52271	OIL PIPING GUIDE BRG		0.255	2.1
52272	OIL PIPING SUPRT BRG		0.28	2.1
52274	LUB OIL CIRCULATION UNIT		0.56	2.1
52275	LARGE AIR HEATER-LUBRICA		0.25	2.1

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52301	WASH MANIFLD GAS INL		0.3	2.1
52302	WASH MANIFLD GAS OUT		0.285	2.1
52325	LARG AH-CLEANG EQPT		0.69	2.1
52338	LARGE AH-MULTIMEDI CLNG		0.85	2.1
52600	LARGE AH E,C&I COMPONENTE		0.1	2.1
52988	LARG AH COMMISSIONING SP		0.29	2.1
Sub Total			235.75	
56000	FAN TOOLS & FIXTURES		0.4	2.1
56011	FD FAN FIX MATLS		1	2.1
56015	FD FAN CPLNG GUARD		0.03	2.1
56017	FD FAN C&I ITEMS		0.02	2.1
56021	ID FAN FIX MATLS		1.2	2.1
56025	ID FAN CPLNG GUARD		0.05	2.1
56027	ID FAN C&I ITEMS		0.03	2.1
56031	PA FAN FIX MATLS		0.9	2.1
56035	PA FAN CPLNG GUARD		0.04	2.1
56037	PA FAN C&I ITEMS		0.02	2.1
56075	SA FAN CPLNG GUARD		0.03	2.1
56077	SA FAN C&I ITEMS		0.02	2.1
56079	SA FAN MTR CANOPY		0.22	2.1
56091	FIRST FILL LUBRICANT		7.56	2.1
56114	FD FAN ROTOR		2.05	2.1
56135	PA FAN ROTOR		3.2	2.1
56171	SA FAN ROTOR		0.55	2.1
56226	ID FAN ROTOR		12	2.1
56310	FD BEARING HSG & ACC		0.26	2.1
56320	ID BEARING HSG & ACC		1.1	2.1
56330	PA BEARING HSG & ACC		1.27	2.1
56370	SA BEARING HSG & ACC		0.06	2.1
56414	RADIAL FD FAN STATOR		10.25	2.1
56435	PA FAN STATOR		9	2.1
56471	SA FAN STATOR		2.6	2.1
56510	FD FAN EXPN JOINTS		0.8	2.1
56526	ID FAN STATOR		32	2.1
56530	PA FAN EXPN JOINTS		0.55	2.1
56670	RADIAL SEAL AIR FAN MOTO		2.3	2.1
56810	RADL FDFAN COUPLING		0.04	2.1
56820	RADL IDFAN COUPLING		12.3	2.1
56830	RADL PAFAN COUPLING		0.11	2.1
56870	SEAL AIR FAN COUPLING(RA		0.03	2.1
56910	RAD FDFAN ACCESSORY		3.2	2.1
56911	FD FAN SILENCER		16	2.1
56920	RADIAL ID FAN LUBE OIL S		3.5	2.1
56930	RAD PAFAN ACCESSORY		3.5	2.1
56931	PA FAN SILENCER		12.5	2.1

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XX	ID Fan motor		8	2.1
XX	FD Fan motor		8	2.1
XX	PA Fan motor		12	2.1
	Sub Total		168.69	
Mills				
PGMA	Description	Dimensions	Wt MT	
NA	Mill body (in one piece)	Dia 3700x6200	70	2.1
NA	Hot air box	2700x2800x1200	4.8	2.1
NA	Trunnion	Dia 1400 x 1200	16	2.1
NA	Spur Girth gear (in two pieces)	Dia 5370 x 450 x 2500	8	2.1
NA	Main Reducer gear box	1500x1400x550	10	2.1
NA	Inching Device	1200x1000x500	6	2.1
NA	Mill lube oil unit	2000x1000x1000	5	2.1
NA	Lifting cradle	2100x500x700	4	2.1
NA	Classifier	Dia 2100 x 2400	18	2.1
NA	Ball feeding device	1000x500x500	4	2.1
NA	Conveyor Body	2500x1500x800	8	2.1
NA	Screw Conveyor	Dia 1200x1800	6	2.1
NA	Main mill motor	2000x1000x1200	17	2.1
NA	DP Level Cubicle	2000x1600x550	3	2.1
	Sub Total		179.8	
	TOTAL ROTATING MACHINES		631.74	
ROTATING MACHINES HANDLING EQUIPMENT				
99	100	Fan Handling Equipment	4.8	2.2
99	400	Airheater, Steamcoil Airheater Handlg E	0.6	2.2
99	xxx	Furnace maintenance platform	10.0	2.2
	Sub Total		15.4	
	TOTAL ROTATING MACHINES HANDLING EQUIPMENT		15.4	
ESP				
78401	ROLL/SLIDE SUPPORTS		5.5	3.1
78405	ESP-SUB-DELIVERY COMPONE		0.125	3.1
78406	INSULATOR HOUSING AS		11.25	3.1
78408	GAS DIST. ASSY		29	3.1
78409	GD-RAPPING MECHANISM		4.8	3.1
78410	GD_DRIVE ARRANGEMENT		0.215	3.1
78411	GAS SCREEN-EP		5.375	3.1
78413	EMIT SYST SUSPENSION		3.85	3.1
78414	SUPPORT INSULATORS		3.3	3.1
78415	EMITTING ELECTRODES		6.05	3.1
78416	EMIT ELECT RAPP MECH		16.75	3.1
78417	DRIVE ARGT. FOR EMIT. SY		8.5	3.1
78419	COL ELEC SUSPENSION		33	3.1
78420	COLLECTING ELECTRODE		273	3.1
78421	EMIT SYS FRAME-TOP		34	3.1

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78422	EMIT SYS FRAME BOTOM		47	3.1
78423	INSPECTION DOORS		2.6	3.1
78424	SHOCK BARS		21	3.1
78425	COLL ELECT RAPP MECH		22.86	3.1
78426	COLL ELEC RAPP DRIVE		1.6	3.1
78428	ESP ROOF BEAM		43	3.1
78430	ELECTRICAL SD COMPTS		3.6	3.1
78431	GEARED MOTORS FOR RAPPIN		4	3.1
78432	EMIT SYS FRAME-MIDLE		52.38	3.1
78437	JUNCTION BOX & PUSH BUTT		0.5	3.1
78441	ELECTRICAL MISCELLANEOUS		0.1	3.1
78442	OUTER ROOF-EP		60	3.1
78443	HOPPER RIDGES		14	3.1
78444	HOPPER UPPER PART		78	3.1
78445	HOP MLD&LOWER PART		117	3.1
78446	INSULATOR SUPP PANEL		34	3.1
78447	ROOF PANEL ASSY		37	3.1
78448	CASING STRUCTURE		133	3.1
78449	CASING SHELL/PANEL		201	3.1
78450	INLET-OUTLET FUNNEL		58	3.1
78455	PENT HOUSE FOR E P		40	3.1
78457	SPLITTER&GUIDE VANES		6.5	3.1
78460	CABLE-CABLE RACKS		33.754	3.1
78461	EP PERF TEST EQUIPT		0.2	3.1
78463	ASH LEVEL INDICATOR		0.3	3.1
78464	MISCELLANEOUS ITEMS		2	3.1
78465	APP PLATFORM-HOPPER		22.25	3.1
78466	WATER WASHING SYSTEM		1.5	3.1
78472	INTERLOCKS-EP		0.35	3.1
78473	ELECTRICALLY OPERTD HOIS		1.6	3.1
78474	OPACITY MONITOR & ACCESS		0.5	3.1
78477	LT SWITCH BOARD/ESP SWTI		10	3.1
78478	BAPCON & ACCESSORIES		0.25	3.1
78480	FOUNDATION MATLS FOR ESP		2.8	3.1
78481	SUPPOTING STRUCTURES FOR		119.041	3.1
78489	GUIDE PLATE/VANE EP INLE		1	3.1
78490	HEATING ELEMENTS		0.9	3.1
78495	IOS PANEL		0.2	3.1
78988	COMMISSIONING SPARES		0.3	3.1
78996	TOOLS & TACKLES		0.3	3.1
	Sub Total		1609.1	
89610	EP GALLERIES&STAIRS		12	3.1
89611	ESP ROOF HANDRAILS		2	3.1
89612	FLOOR GRILL AND STEP TRE		6.4	3.1
89613	FLOOR GRILL AND MOBILE L		9	3.1
89614	PENT HOUSE ROOFING SHEET		9.5	3.1

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		Sub Total		38.9	
		TOTAL ESP		1648	
		NON PRESSURE PARTS - ESP			
48	492	Rect Duct Ind Draft Fan To Chimney	6mm	35.0	3.2
48	494	Expn Pieces ind Draft Fan To Chimney		5.0	3.2
48	495	I.D.System Duct Supports		8.0	3.2
		Sub Total		48.0	
57460		GATE-ESP INLET		9.6	3.2
57466		PLATFORMS AND LADDERS		15	3.2
57470		GATE-ESP OUTLET		9.6	3.2
57480		GATE-ID FAN INLET		9.8	3.2
57490		GATE-ID FAN OUTLET		9.8	3.2
57491		BLOWER WITH MOTOR		14	3.2
57497		KNIFE GATE VALVE		12	3.2
57560		GATE-FGD INLET		11.8	3.2
57566		PLATFORMS AND LADDERS-FG		16	3.2
57570		GATE-FGD OUTLET		12.4	3.2
57583		DAMPER FGD BYPASS		11.2	3.2
		Sub Total		131.2	
FW201		ABSORB. RC PUMP NOZZLE		2	3.2
FW202		ABS NOZL NB 300 & ABOVE		2	3.2
FW203		NOZZLE NB25 TO NB250		2	3.2
FW207		OUTLET GUIDE VANE		5	3.2
FW209		MAN HOLE DOOR FOR ABSORBER		2	3.2
FW212		SLURRY RECIRCULATION PUMP SYST		36	3.2
FW213		ABSORBER SYSTEM INTERNALS		3.6	3.2
FW214		ABS BAFFLE GRATING		2	3.2
FW215		MIST ELIMINATOR & ACCESSORIES		4.4	3.2
FW216		ABS BAFFLE GRATING SUPP		10	3.2
FW217		ABS ME SUPPORT		10	3.2
FW218		ABS SPRAY PIPE SUPP		10	3.2
FW219		ABSORBER SYSTEM-BASE		2.8	3.2
FW221		ABSORBER SYSTEM-CASING BOTTOM		50	3.2
FW222		ABSORBER SYSTEM-CASING TOP		50	3.2
FW225		ABSORBER SYSTEM-RUBBER LINING		2	3.2
FW226		EMERGENCY QUENCH WATER TANK		10	3.2
FW227		EMERGENCY QUENCH SYSTEM		3	3.2
FW228		ABSORBER-W/D INTERFACE		8	3.2
FW229		W/D WASH SYSTEM		2	3.2
FW230		OXIDATION BLOWER & ACC		25	3.2
FW231		ABSORBER SHEAR PLATE		7	3.2
FW232		DUCT SUP BYP & BUF/GGH		10	3.2

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FW234	DUCT SUP ABS & STACK/BYP		15	3.2
FW236	STRUCTURES FOR RC PUMP HOUSE		80	3.2
FW239	VIEWING PORTS		1	3.2
FW241	ABSORBER AGITATOR		2.2	3.2
FW251	EXPNSN JNT METALLIC		4	3.2
FW253	EXPANSION JOINT BETWEEN SCRUBR		3	3.2
FW255	DUCT BYP & BUF/GGH/ABS		50	3.2
FW257	DUCT ABS & BYP/STACK		100	3.2
FW306	ABSORBER HSFG FASTNERS		2	3.2
FW307	ABSORBER MISCELLANEOUS		2	3.2
FW322	ABSORBER SYSTEM-CASING INTERM		20	3.2
FW328	W/D INTERFACE (CARBON STEEL)		10	3.2
FW701	SLURRY PUMPS & ACCESSORIES		20	3.2
FW702	WATER PUMPS & ACCESSORIES		5	3.2
FW709	TRENCH COVER PLATE		5	3.2
FW710	MONORAIL FOR HOIST & CRANES		45	3.2
FW713	CHAIN PULLEYS		75	3.2
FW714	HOISTS		75	3.2
FW717	MAN HOLE DOOR		10	3.2
FW718	ROOF SHEETING		5	3.2
FW719	LIME DOSING SYSTEM		4	3.2
FW720	AGITATORS		20	3.2
FW721	AGITATOR SUPPORT		40	3.2
FW722	GALLERIES & RAILINGS FOR TANK		36	3.2
FW723	AIR CANNON-SILO		1	3.2
FW724	BAGFILTER & FAN ASSY SILO		1	3.2
FW728	SILLO PENTHOUSE		19	3.2
FW729	LIMESTONE SILO-SS 304 LINING		3	3.2
FW731	LIMESTONE SILO		28	3.2
FW734	LIMESTONE MILL		198	3.2
FW738	GYPSSUM BELT FILTER AND ACCESS		72	3.2
FW741	LINING FOR TANK AND SUMPS COMM		20	3.2
FW742	LIMESTONE SLURRY STORAGE TANK		28	3.2
FW743	AUXILIARY ABSORBER TANK		40	3.2
FW744	FILTRATE TANK		14	3.2
FW745	WASTE WATER TANK		10	3.2
FW747	HYDROCLONE WASTE WATER TANK		8	3.2
FW748	PROCESS WATER TANK		44	3.2
FW781	START STOP PUSH BUTTON		0.5	3.2
FW785	BELT FILTER WASHING TANK		12	3.2
FW789	TEMPLATE-MISC		2	3.2

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	FW798	AIR RECEIVERS		5	3.2
	FW806	CONTROL JUNCTION BOX		0.7	3.2
	FW807	POWER JUNCTION BOX		0.5	3.2
	FW815	RC PUMP INLT & OUTLT VALVE		21	3.2
	FW816	MANL BTRFLY VALV- UTLTY		2	3.2
	FW817	MOTOR BTRFL VALV-UTLTY		1	3.2
	FW818	PNEM BTRFLY VALV-UTLTY		1	3.2
	FW819	MAN BTRFLY VALV-LS SLRY		3	3.2
	FW820	MOTOR BTRFLY VALV-LS SLRY		5	3.2
	FW821	PNEUM BTRFLY VALV-LS SLRY		1	3.2
	FW822	MAN BTRFLY VALV-GYP SLRY		3	3.2
	FW823	MOTOR BTRFLY VALV -GYP SLRY		5	3.2
	FW824	PNEUM BTRFLY VALV-GYP SLRY		1	3.2
	FW825	MAN BTRFLY VALV-AIR		1	3.2
	FW826	MOTOR BTRFLY VALV-AIR		1	3.2
	FW827	PNEUM BTRFLY VALV-AIR		1	3.2
	FW828	MAN GATE VALV-UTLTY		7	3.2
	FW829	MOTOR GATE VALV-UTLTY		1	3.2
	FW830	PNEUM GATE VALVE-UTLTY		1	3.2
	FW834	MAIN GLOBE VALV-UTLTY		2	3.2
	FW840	CERAMIV VALVES		1	3.2
	FW841	CONTROL VALVES		1	3.2
	FW842	MAN PINCH VALV-GYP SLRY		1	3.2
	FW845	BALL VALVES- WATER		1	3.2
	FW848	CHECK VALVES- WATER		1	3.2
	FW851	DIAPHRAGM VALV-SLURRY		1	3.2
	FW854	ROOT VALV INSTRMNTN		2	3.2
	FW866	FASTENERS CS & SS		18	3.2
	FW867	RUBBER GASKET, SHEET		3	3.2
	FW868	U-BOLTS		5	3.2
	FW869	RUBBER EXP. BELLOWS		3	3.2
	FW988	COMMISSIONING SPARES		10	3.2
	FW991	SPECIAL WELDING ELECTRODE		2	3.2
	XXX	RC PUMP Motor		5	3.2
		Subtotal		1505.7	
		TOTAL NON PRESSURE PARTS - ESP		1684.90	
		PIPING			
24	345	MS Piping from super heater outlet	406.4 x 25.4	3.0	4.1
		Sub Total		3.0	
80	340	Aux Steram Header	114.3 x 12.7	0.3	4.3
80	342	Aux Steam To SCAPH	60.3 x 4.5	0.2	4.3
80	351	Aux. Steam Piping (Internal)	60.3 x 4.5	2.0	4.3
80	355	HFO Tracing Line	NB 80	2.0	4.3
80	366	IBD Vent to Deaerator	NB 25	0.2	4.3
80	450	Cbd And Emergency Drum Drain		0.0	4.3
80	451	Boiler Integral Piping Drains		0.0	4.3

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80	453	Lp Piping Drains-Sg Scope		0.0	4.3
80	460	Sg Aux Cooling Water Unit System	NB 50	5.0	4.3
80	471	Boiler Wash Water To & From Unit	NB 50	5.0	4.3
80	600	Hp Dozing	NB 50	0.5	4.4
80	612	Service Air For Unit	NB 50	3.0	4.3
		Sub Total		18.2	
	FW861	CSRL PIPE-1 (GS,LS)		80	4.3
	FW862	CSRL PIPE-2 (GS,LS)		120	4.3
	FW863	CS PIPING (PW,CW,SW)		65	4.3
	FW864	SS PIPING (W/D)		40	4.4
	FW865	GI PIPING (IA, DW)		25	4.3
	FW870	PIPING ACC.		1	4.3
		Subtotal		331	
		PC SUPPLY			
NA		VHP SYSTEM		39.6	4.2
NA		HP SYSTEM		13.23	4.2
NA		MP SYSTEM		82.8	4.2
NA		LP SYSTEM		152.2	4.3
NA		AUX STEAM TO DEAERATING HEATER		5.4	4.3
NA		STEAM FROM PROCESS BLR		11.25	4.3
NA		BOILER FEED PUMP RECIRCULATION		41.4	4.3
NA		BOILER FEED PUMP TO HPH INCLUDING BYPASS		3.6	4.3
NA		BFD BETWEEN HTRS AND GROUP PROTECTION		18.9	4.3
NA		BFD FROM FINAL HPH TO SG TP		11.88	4.3
NA		SPRAY WATER TO AUX PRDS		7.29	4.3
NA		HP PIPING DRAINS - SG SCOPE		7.74	4.3
NA		MS HEADER TO AUX PRDS		1.89	4.3
NA		MS DUMP TO CONDENSER		7.56	4.3
NA		H AND S FOR HYDRO TEST		1.5	4.5
NA		VLH AND CLH for MS PPG UPTO MSV -HERP		0.9	4.3
NA		WELDING ELECTRODES-1		0.025	4.3
NA		AUX STEAM TO SCAPH		1.85	4.3
NA		AUX STEAM TO AH SOOT BLOWERS		0.1	4.3
NA		AUX STEAM TO FO SYSTEM TP		15.8	4.3
NA		STEAM TRACING PIPING		4.65	4.3
NA		IBD TANK VENT TO ATMOSPHERE		4.4	4.3
NA		AUX STEAM TO FUEL OIL ATOMISING		0.5	4.3
NA		ERECTION MATERIALS FOR INSTRUMENTS		0.025	4.3
NA		CBD AND EMERGENCY DRUM DRAIN		3	4.3

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NA	BOILER INTEGRAL PIPING DRAINS		0.65	4.3
NA	SCAPH DRAINS		0.85	4.3
NA	SG AUX COOLING WATER UNIT SYSTEM		25.5	4.3
NA	BOILER WATER WASH TO AND FROM UNIT		6.3	4.3
NA	SERVICE WATER PIPING		20.7	4.3
NA	DRINKING WATER PIPING		7.7	4.3
NA	FIRE WATER-OTHER AREAS		7	4.3
NA	HIGH PRESSURE DOSING PIPING		0.5	4.4
NA	ACID CLEANING PIPING-TEMPORARY		27	4.7
NA	SCR -AMMONIA PIPING		9.5	4.2
NA	SERVICE AIR FOR INDIVIDUAL UNITS		1.085	4.3
NA	INSTRUMENT AIR FOR INDIVIDUAL UNIT		5	4.3
NA	FUEL OIL SUPPLY AND RETURN PIPING		12.9	4.3
NA	SUB DELIVERY VALVES FOR LIGHT UP		0.95	4.3
NA	H AND S FOR LIGHT UP - NON STEAM LINES		8	4.5
NA	CONTINUOUS BLOW DOWN EXPANDER-D1500 MM		2.3	4.3
NA	INTERMITTENT BLOW DOWN EXPANDER-D2000 MM		5	4.3
NA	HIGH PRESSURE DOSING SYSTEM		3	4.4
NA	DIRECT GAUGES FOR STEAM LINES		0.7	4.3
NA	DIRECT GAUGES FOR NON-STEAM LINES		0.6	4.3
NA	STEAM BLOWING PIPING-TEMPORARY		9	4.6
NA	AUX STEAM TO UNLISTED USERS - SG SCOPE		4.1	4.3
NA	CBD TANK VENT TO SYSTEM		0.3	4.3
NA	CBD TANK VENT/SV EXHAUST TO ATMOSPHERE		0.1	4.3
NA	Piping AS		80.55	4.1
	Sub total		676.225	
NA	Valves AS		114.5	4.1
NA	Valves CS		101.25	4.3
	PESD Supply			
NA	Piping CS		181.36	4.3
NA	Fittings CS		11.27	4.3
NA	Valves CS		11.81	4.3

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NA		Piping SS		57.88	4.4
NA		Fittings SS		2.07	4.4
NA		Valves SS		5.76	4.4
		TOTAL PIPING		1514.8	
		INSULATION			
32	010	Fixing Comp For Blr Pr Parts Insul	1.6mm Thk Sheet	2.0	5.2
32	110	Fixing Comp For Blr Mountings Insul	1.6mm Thk Sheet	1.5	5.2
32	120	Fixing Comp For Sb Pipes Insul	1.6mm Thk Sheet	0.5	5.2
32	310	Fixing Comp For Air Ducts Insul	1.6mm Thk Sheet	14.5	5.2
32	410	Fixing Comp For Ah And Gas Ducts Insul	1.6mm Thk Sheet	18.0	5.2
32	510	Fixing Comp For Id Ducts Insul	1.6mm Thk Sheet	15.0	5.2
32	520	Fixing Comp For Fans And Ep Insul	1.6mm Thk Sheet	38.0	5.2
		Sub Total		89.5	
33	021	Blr Pr Parts Mineral Wool		25.0	5.4
33	121	Blr Mountings Mineral Wool		3.5	5.4
33	126	Sb Pipes Mineral Wool		1.5	5.4
33	201	Main Blr Formed Refractory Is8		8.5	5.1
33	212	Main Blr Castable Refractory Gr C		52.0	5.1
33	321	Air Ducts Mineral Wool		40.0	5.4
33	421	Air Heater And Gas Ducts Mineral Wool		35.0	5.4
33	521	Id Ducts Mineral Wool		9.0	5.4
33	526	Fans And Ep Mineral Wool		38.0	5.4
33	970	Misc Eqpts Expanded Metal		1.5	5.2
33	971	Misc Eqpts Woven Wire Cloth		0.8	5.2
33	975	Misc Eqpts Sealing Compound		0.1	5.1
		Sub Total		214.9	
	56919	RADIAL FD FAN INSULATION		3.2	5.4
	56939	PA FAN INSULATION WOOL		3.8	5.4
	78467	MIN WOOL FOR ESP INSULAT		45	5.4
	78468	FIXING COMP. FOR ESP INS		12	5.2
	89615	INSULATION CLADDING SH F		16	5.3
		Subtotal		80	
	FW267	INSULATION MATERIALS FOR DUCT		14	5.4
	FW268	FIXING COMP FOR DUCT		8	5.2
	FW269	CLADDING SHEET FOR DUCT		8	5.3
		Subtotal		30	
	SL021	Mineral Wool for SCR System		91.0	5.4
	SL210	Fixing Components for SCR System		2.6	5.2
	SL700	Bulked DD components for SCR System		4.6	5.1
	SL701	BPS Fasteners for SCR System		0.3	5.2
	SL810	Al Outer Casing for SCR System		20.0	5.3
		Sub Total		118.5	
		PC Supply			
	NA	MINERAL WOOL MATTRESS		4	5.4

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	NA	ALUMINIUM CLADDING FOR INSULATION		3	5.3
	NA	FIX COM FOR MISCELLANEOUS PPG INSULATION		0.75	5.2
		Sub Total		7.75	
		TOTAL INSULATION		540.61	

WEIGHTS & DIMENSION SCHEDULE (STEAM TURBINE, GENERATOR & AUXILIARIES)

SL.No.	ITEM DESCRIPTION	QTY	Wt MT	DIMENSIONS (mm) LxWxH (Approximate)	Rate Schedule ID
1.	Outer Casing Upper part	1	16.50	2600x4500x2550	6.1
2.	Outer Casing Lower part	1	7.50	3100x2000x1500	6.1
3.	Steam chamber	1	1.05	450x1100x1080	6.1
4.	Guide Blade Carrier-1	1	0.60	400x1100x1080	6.1
5.	Guide Blade Carrier-2	1	1.00	335x1100x1080	6.1
6.	Guide Blade Carrier-3	1	1.00	400x1230x1200	6.1
7.	LP Guide Blade Carrier	1	3.10	900X1850X1850	6.1
8.	Intermediate gland-I	1	0.50	200X950X950	6.1
9.	Intermediate gland-II	1	0.70	250x1100x1080	6.1
10.	Exhaust Hood Upper Part	1	5.50	1600x3300x1190	6.1
11.	Exhaust Hood Lower Part	1	11.00	1800x4500x1700	6.1
12.	Rear Bearing Housing Assembly	1	2.00	1000x1220x1365	6.1
13.	Front Bearing Housing Assembly	1	2.50	1100x2300x1050	6.1
14.	Rotor Assembly	1	6.30	5000X1350x1350	6.1
15.	Upper Part of Outer Casing & Exhaust Hood	1	22.00	4200x4500x2550	6.1
16.	Lower Part of Outer Casing & Exhaust Hood	1	18.50	4900x4500x1700	6.1
17.	IP CONTROL VALVE ASSEMBLY	2	1.30	1250X650X1250 for one valve assy	6.1

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18.	LP CONTROL VALVE ASSEMBLY	2	1.30	1250X650X1250 for one valve assy	6.1
19.	GOVERNING CONSOLE	1	0.80	1500X1500X2000	6.1
20.	Lube Oil Pump assembly	2	3.40	2500x950x1000	6.1
21.	Emergency oil pump assembly	1	1.40	2150x915x800	6.1
22.	Jacking oil pump assembly	1	0.45	2000X1000X600	6.1
23.	Oil purification unit	2	2.40	1400x1400x1600	6.1
24.	Oil accumulators	2	0.80	1350X450X1500	6.1
25.	Turbine enclosure	1	10.00	15300X7500X4500	6.1
26.	Lube Oil Tank	1	5.50	3400X2500X3200	6.1
27.	Overhead Oil Tank	1	3.00	2650X2650X2450	6.1
28.	Control Valves	20	14		6.1
29	De-Superheater	8	4		6.1
30	Turbine Bypass Valve	1	1.5		6.1
31	Pneumatic on off ball valve	5	0.4		6.1
32	Atmospheric Flash Tank	1	1.5		6.1
	Total Weight		151.50		
Generator Package					
1	"GENERATOR PACKAGE (without Transport Frame)"	1	45.8	5800 X 3500 X 3200	6.1
2	"GENERATOR COOLER (Total 6 nos. loose)"	1	4.50	4200 X 620 X 420	6.1
3	FOUNDATION ITEMS & ACCESSORIES	1	3	Loose items	6.1
4	Gearbox for STG	1	12	3 m X 2.5 m X 2.7 m	6.1
	Total Weight		65.30		
Condenser					
1	Condenser Complete Assembly	1	46	L 10000 x W 3300 x H 5600	6.1

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2	Steam Jet Air Ejector Complete Assembly	1	7.1	L 6100 x W 1900 x H 2600	6.1
3	Gland Steam Condenser Complete Assembly	1	1.6	L 4700 x W 1200 x H 1500	6.1
	Total Weight		54.7		
Heat Exchangers & Deaerators					
1	Makeup Water Deaerator				
1.1	Heater Assly.	1	45	L 6800x W 2500 x H 2900	6.1
1.2	Storage Tank Assly.	1		L 22300x W 3700 x H 4055	6.1
2	Makeup Water Deaerator				
2.1	Heater Assly.	1	60.278	L 6800 x W 2500 x H 2900	6.1
2.2	Storage Tank Assly.	1		L 23600 x W 4250 x H 4500	6.1
3	ST Oil Cooler (Vertical) Complete Assembly	2	8	Dia. 700 x H 4500	6.1
4	STG Air Cooler (Cooler Elements)	6	4.5	L 4200 x W 650 x H 450	6.1
5	Double working oil coolers	1	1.4	3657x1250x600	6.1
6	Double lube oil coolers	1	0.7	3059x1250x600	6.1
	Total Weight		119.878		
BFP Pumps & Motors					
1	BFP		11.54	2238X 2200X3000	6.1
2	BP		2.7	1645X1310x1400	6.1
3	BFP Motor		23.7	3014x2550x1790	6.1
4	Hydraulic Coupling		3.56	1810X1720X1720	6.1
5	BFP Grillage		18	9336x2140x 370	6.1
	Total Weight		59.5		
MISC ITEMS (Part of STG)					
RE Joints & BF Valve					
1	BF Valve assembly (700 NB – electrical operated)	4	5.24	1600 X 1100 X 400 mm	6.1
2	700 NB Compensating type RE Joint assy(Piping Side)	1	1.6	OD:1500mm, Length:600mm	6.1
3	700 NB Compensating type RE Joint assy(Water box Side):	1	1.1	OD:1500mm, Length:600mm	6.1
PHE & LP Dosing Skid					
1	PLATE HEAT EXCHANGER	2	3	2.5 x 0.7 x 2	6.1

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2	LP dosing skids	2	5	4 x 3 x 3	6.1
	Total Weight		15.94		
	Total TG & Aux		466.82		

Misc Items

S. No.	Equipment /Package Description	Qty. in No.	Weight (each)	Dimension (each) Dia X Height in meters	Rate Schedule ID
			MT		
	Fuel Oil System & Tanks				
1	Fabrication & Erection - Heavy Fuel oil	1	13.5	4.5x6.6	7.1
2	Fabrication & Erection - Light Diesel oil	1	4.58	3x4.5	7.1
3	Clean Oil Tank	1	2.17	2.5x3.5	7.1
4	Dirty oil Tank	1	2.17	2.5x3.5	7.1
5	Condenser cooling water tank	1	0.365	1.2x1.5	7.1
	Total		22.785		
	Misc Pumps, Cranes, Elec Hoists, Air Dryers & Receivers & Sump Pumps				
1	Condensate Extraction Pump	2	5	1.5X1.5X3.5(D)	7.2
2	Make Up Water Transfer Pump	2	5	3.0X1.75X2.0	7.2
3	DMCW Pump	2	2	2.5X1.5X1.5	7.2
4	Lube Oil Transfer Pump	2	1	1.5X1.0X1.0	7.2
5	Air Dryer	2	5	4.0 x 4.0 x 3.0	7.2
6	Instrument Air Receiver	1	10	2.0 m(Dia.) x 3.5 m(H)	7.2
7	Plant Air Receiver	1	5	1.75 m(Dia.) x 2.75 m(H)	7.2
8	Electric wire rope hoist for Chiller building & ESP control room	10	5	1.5X1.5X1.5	7.2
9	Sump Pumps	5	0.5	0.5X0.5X0.5	7.2
	Total		38.5		
	Total Misc Items		61.29		

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1.9.2 Weight Schedule to be considered for Material Handling:

1.9.2.1 Weight Schedule

Sl. No.	UNIT	DESCRIPTION OF SUPPLIES	APPROX WEIGHT (MT)
1	HPVP Vizag	SG & Auxiliaries etc.	3575.94
2	TRICHY	SCR & Valves	1216.30
3	RANIPET	ESP & FGD	5180.43
4	PIPING CENTRE	PCP, SG Piping, LP Piping etc.	683.98
5	HYDERABAD	Mills, Pumps, TDBFP, FST Heaters etc.	609.28
6	BHOPAL	Transformers, SWGRs Motors etc.	79.94
7	PESD Hyd	BOP, Pumps, Valves etc.	513.34
8	PSSR	T & Ps, Consumables, Furniture etc.	50.00
9	PSSR	Structural Steel	2004
		Total Weight	13913.20

1.9.2.2 Tetative list of ODC/ Heavy Items Details:

S.No.	Component Description	Size in mm	Weight (MT) Approx.
1	Boiler Upper Drum	Max Length: ~12,500 mm, Max width: ~2,500 mm,	60
2	Boiler Lower Drum	Max Length: ~10,500 mm, Max width: ~1,800 mm,	30
3	Upper Part of Outer Casing & Exhaust Hood	4200x4500x2550	22
4	Lower Part of Outer Casing & Exhaust Hood	4900x4500x1700	18.5
5	Mill body (in one piece)	Dia 3700x6200	35
6	Condenser Complete Assembly	L 10000 x W 3300 x H 5600	46
7	Generator Assembly	L 5800 X W 3500 X H 3200	46

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1.9.3 Weight Schedule for Civil/ Structural Works:

For BOQ for Civil works & structural, please refer Rate Schedule (**Rate Schedule ID 9**).

Note to clause 1.9.1 above:

1. The weights mentioned above are approximate and liable to vary as per design consideration. There will be change in PG, weight, description etc. However, payments will be made for the tonnage actually erected at the quoted rate. Quantity Variation will be dealt as per clause 2.14 of General Conditions of Contract (Volume I Book II).
2. Besides PG / PGMA indicated in the weight schedule, there is likelihood of addition of product groups integral to Boiler, SCR, ESP, STG and its auxiliaries. The quoted rates shall be applicable for such product groups also.
3. The erection & dismantling of temporary piping, pumps, tanks, dummy plates & other miscellaneous equipment etc. for pre-commissioning and commissioning activities like hydraulic test, chemical cleaning, steam blowing, gas tightness test etc. are covered in this contract and shall be carried out as a part of work. There will not be any separate payment for these works.
4. The Erection of HT MOTORS are covered in this scope of contract.
5. The erection and dismantling of air blowers and connecting pipes and ducts, providing blanks / dummies at the required locations and conducting gas tightness test is in the scope of the contract and shall be carried out within the quoted rate.
6. Imported electrodes / TIG welding wires released by manufacturing Units will be supplied by BHEL. All other electrodes / TIG welding wires are to be supplied by contractor under his scope.
7. Also, refer welding schedule in Part II of Technical Conditions of Contract

Note to clause 1.9.2 above:

The weight indicated in the rate schedule (Price Bid) from SI.No.8.4 to SI.No. 8.8 is not covered in the above weight schedule.

Bidders shall refer Part –A in Price Bid for Instructions on the rate schedule.

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VOLUME-IA PART-I CHAPTER -X GENERAL

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

1.10.1 Bidders 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 (As applicable).
- II. Unqualified Acceptance for Detailed LOI/ Work Order.
- III. Rs.100/- Stamp Paper for preparation of Contract Agreement.

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

- I. PF Regn No.
- II. Labour License No.
- III. Workmen Insurance Policy No.

1.10.3 BOCW Act & BOCW Welfare Cess Act

1.10.3.1 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.

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

1.10.3.3 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.,

1.10.3.4 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.

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1.10.3.5 Contractor shall make remittance of the BOCW cess as per 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.

1.10.3.6 Non-compliance to provisions of the BOCW act and BOCW welfare Cess act is not acceptable. In case of any non-compliance, BHEL reserves the right to withhold any sum 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.

1.10.4 PROVIDENT FUND

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

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

1.10.5 Employees State Insurance Act

(i) The Bidder agrees to and does hereby accept full and exclusive liability for the compliance with all obligations imposed by the Employee State Insurance Act 1948 and the Bidder further agrees to defend, indemnify and hold BHEL & Owner harmless for any liability or penalty which may be imposed by the Central, State or Local authority by reasons of any asserted violation by Bidder or his sub-contractor of the Employees' State Insurance Act, 1948 and also from all claims, suits or proceeding that may be brought against the BHEL & Owner arising under, growing out of or by reasons of the work provided for by this Bidder, whether brought by employees of the Bidder, by third parties or by Central or State Government authority or any political sub-division thereof.

(ii) The Bidder agrees to fill in with the Employee's State Insurance Corporation, the

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Declaration forms, and all forms which may be required in respect of the Bidder's or his sub-contractor's employees, who are employed in the WORK provided for or those covered by ESI from time to time under the Agreement. The Bidder shall deduct and secure the agreement of his sub-contractor to deduct the employee's contribution as per the first schedule of the Employee's State Insurance Act from wages and affix the Employees Contribution Card at wages payment intervals. The Bidder shall remit and secure the agreement of his sub-contractor to remit the State Bank of India, Employee's State Insurance Corporation account the Employees contribution as required by the Act. The Bidder agrees to maintain all Cards and Records as required under the Act in respect of employees and payments and the Bidder shall secure the agreement of his sub-contractor to maintain such records. Any expenses incurred for the contributions; making contributions or maintaining records shall be to the Bidder's or his sub-contractor's account.

(iii) BHEL shall retain such sum as may be necessary from the total value of contract until the Bidder shall furnish satisfactory proof that all contributions as required by the Employees State Insurance Act, 1948 have been paid. This will be pending on the bidder when the ESI Act is extended to the place of work.

1.10.6 OTHER STATUTORY REQUIREMENTS

- 1.10.6.1 The Contractor shall submit a copy of Labour License obtained from the Licensing Officer (Form VI) u/r25 read with u/s 12 of Contract Labour (R&A) Act 1970 & rules and Valid WC Insurance copy or ESI Code (if applicable) and PF code no along with the first running bill.
- 1.10.6.2 The contractor 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.
- 1.10.6.3 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 contractor, BHEL will reserve its right to pay the workmen under the orders of Appropriate authority at the risk and cost of the Contractor.
- 1.10.6.4 Wages paid to the workmen by the Bidder should not be less than the rates specified by the Central Govt. as per Minimum Wages Act, 1948 and as adopted by NALCO from time to time.

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- 1.10.6.5 Wages to the workmen should be paid on or before the 7th of the subsequent month. If 7th falls on a holiday or weekly off day, the payment should be made one day prior to that.
- 1.10.6.6 Where the Minimum wages notified by the concerned State Government are higher than the rates notified by the Central Government, the states Government rates should apply in concerned scheduled employment as long as the same remains higher than the Central Government rates. The classification on workers in different categories will be as per the notification issued by the Central Govt. fixing the minimum wages for the above scheduled appointment.
- 1.10.6.7 The Contractor shall submit copies of Final Settlement statement of disbursal of retrenchment benefits on retrenchment of each workman 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.
- 1.10.6.8 In case of any dispute pending before the appropriate authority under I D act 1948, WC Act 1923 or ESI Act 1948 and PF Act 1952, BHEL reserve the right to hold such amounts from the final bills of the Contractor which will be released on submission of proof of settlement of issues from the appropriate authority under the act.
- 1.10.6.9 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.
- 1.10.7 Comprehensive General Liability Insurance**
- 1.10.7.1 This insurance shall protect the Bidder against all claims arising from injuries, disabilities, disease or death of members of public or damage to property of others, due to any act or omission on the part of the Bidder, his agents, his employees, his representative and sub-contractors or from riots, strikes and civil commotion. This insurance shall cover all the liabilities of the Bidder arising out of the relevant clauses of enquiry documents.
- 1.10.7.2 The hazards to be covered will pertain to all the works which and areas where, the Bidder, his Sub-contractors, his agents and his employees have to perform work pursuant to the contract.
- 1.10.7.3 The above are only illustrative list of insurance covers normally required and it will be the responsibility of the Bidder to maintain all necessary insurance coverage to the extent both in time and amount to take care of all his liabilities either direct or indirect, in pursuance of the contract.

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1.10.8 Liability for Accident and damage

The Contractor shall Indemnify the Purchaser against any claims which may be made under the workman's Compensation Act, 1923, or any statutory modification thereof or otherwise for or in respect of any damages under the workman's Compensation Act, 1923, or any statutory modification thereof or otherwise for or in respect of any damages or compensation payable in consequence of any accident or injury sustained by any workman or other person whether in the employment of the Contractor or not.

1.10.9 Declaration stating that the bidder has un-blemished reputation and has not been penalised by NALCO or other Govt. organisation in the past is to be submitted along with the offer documents.

1.10.10 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.

1.10.11 GENERAL

1.10.11.1 E way Bills to be arranged by contractor whenever required.

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

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engineer, depending upon the availability of materials, fronts etc., will decide the sequence of erection and methodology. No claims for extra payment from the contractor will be entertained on the grounds of deviation from the method of erection adopted in erection of similar jobs in other projects or for any reason whatsoever.

- 1.10.11.3 Contractor has to work in close co-ordination with other erection agencies at site. BHEL engineer will co-ordinate area clearance. In a project of such magnitude, it is possible that the area clearance may be less / more at a particular given time. Activities and erection program have to be planned in such a way that the milestones are achieved as per schedule / plans. Contractor shall arrange & augment the resources accordingly
- 1.10.11.4 All works shall be carried out in proper workmen like manner. Items of works covered by the following specification shall be carried out as per the best practices and according to the direction of the Engineer In-charge / BHEL, Site Engineer and to his satisfaction.
- 1.10.11.5 Bidders may take note of the following points for material supply in their scope, while sending their offers:
- i) The quoted prices shall include transit freight (for materials supplied new), handling at site, assembly and erection. Also refer the clauses mentioned in Volume-IA- Part I Chapter-VIII- Taxes and Other Duties.
 - ii) The materials and workmanship must be of good quality and accepted standards and specifications. The site engineer reserves the right to reject any material not up to the specification. All taxes, levies and duties on construction materials will be on bidder's account. After completion of work, the building and areas around them should be cleared of all rubbish, debris etc. and handed over in fit condition for occupation.
- 1.10.11.6 Bidders are requested to visit site to see the site condition, prevailing local laws etc. No claim shall be entertained to lack of knowledge of site condition.
- 1.10.11.7 Scope of work covered under this specification requires quality workmanship, engineering and construction management. 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.
- 1.10.11.8 It is not the intent to specify herein all details of material. Any item related to this work not covered in the specification but necessary to complete the system will be deemed to have been included in the scope of the work.

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- 1.10.11.9 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.
- 1.10.11.10 The work shall be executed under the usual conditions without affecting the plant construction 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.
- 1.10.11.11 The Contractor may have to execute work in such a place and condition where other agencies also will be under such circumstances. The contractor shall co-operate with other contractors and agencies so that various activities can be carried out simultaneously in order to achieve an early completion.
- 1.10.11.12 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.
- 1.10.11.13 The contractor will be responsible for the safe custody and proper accounting of all materials in connection with the work.
- 1.10.11.14 No temporary supports shall be welded on the pressure parts of piping. Welding of temporary supports, cleats, etc. on the boiler columns shall be avoided. In case of absolute necessity contractor shall take prior approval from BHEL Engineer. Further, any cutting or alternation of member of the structure of platform or other equipment shall not be done without specific prior approval of BHEL Engineer.
- 1.10.11.15 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.
- 1.10.11.16 Contractor should obtain the formal statutory clearance from Chief Inspector of Boilers to carry out erection & Welding of piping under IBR purview. Arrangement for the visit of Boiler inspector for field inspection, hydraulic test etc., is in the scope of contractor, and necessary drawing / details only will be given by BHEL.
- 1.10.11.17 Contractor shall arrange the necessary clearance from statutory authorities like IBR, Electrical Inspectorate, Explosive, etc. including the load test on Hoists/Handling as required for installation of the plant and equipment and render all assistance, service required in this regard.
- 1.10.11.18 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.
- 1.10.11.19 Contractor shall submit a copy of license to undertake construction / repair of Boilers & Piping issued by Boiler inspectorate before commencement of Pressure Parts /

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Piping Erection.

1.10.11.20 Gate Pass for Bidder's Labour:

The Bidder shall arrange to obtain from the Owner the required gate pass for entry to the Owner's Works for each one of his workmen and staff as per the Owner's prescribed procedure and format. Each gate pass shall contain the photograph of the person concerned. In the event of loss and/or damage to the gate pass the Bidder shall pay to the Owner the prescribed penalty before a new gate pass can be issued.

All gate passes, for the entry of labour inside the Works, engaged by or through the Bidder and all material gate passes will be issued only in the name of the Bidder, and he will be directly responsible for the same. All gate passes issued as aforesaid to the Bidder shall be returned by the Bidder to the Owner on completion of the Works or on termination of the Contract.

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

1.10.11.22 Contractor shall retain all T&Ps, Material handling equipments 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.

1.10.11.23 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.

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

1.10.11.25 Contractor has to work in close co-ordination with other erection agency at site. BHEL engineer will co-ordinate area clearance. In a project of such magnitude, it is possible that the area clearance may be less / more at a particular given time. Activities and erection program have to be planned in such a way that the milestones are achieved as per schedule/ plans. Contractor shall arrange & augment the resources accordingly.

1.10.11.26 Contractor shall remove all scrap materials periodically generated from his working area in and around power station and collect the same at one place earmarked for the same. 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. All the package materials,

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including special transporting frames, etc. shall be returned to the BHEL stores by the contractor.

- 1.10.11.27 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.
- 1.10.11.28 No member of the already erected structure / platform, pipes, grills, platform, other component and auxiliaries should be cut without specific approval of BHEL engineer.
- 1.10.11.29 Contractors shall ensure that all their Staff / Employees are exposed to periodical training programme conducted by qualified agencies/ personnel on ISO 9001 – 2015 Standards.
- 1.10.11.30 Crane operators deployed by the contractor shall be tested by BHEL before he is allowed to operate the cranes.
- 1.10.11.31 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.
- 1.10.11.32 During the course of erection, if the progress is found unsatisfactory, or if the target dates fixed from time to time for every milestone are to be advanced, or in the opinion of BHEL, if it is found that the skilled workmen like fitters, operators, technicians employed are not sufficient, BHEL will induct required additional workmen to improve the progress and recover all charges incurred on this account including all expenses together with BHEL overheads from contractor's bills.
- 1.10.11.33 It is the responsibility of the contractor to do the alignment, checking, etc. if necessary, repeatedly to satisfy BHEL Engineer with all the necessary tools and tackles, manpower etc. without any extra cost. Also the contractor should ensure that the alignment is not disturbed afterwards.
- 1.10.11.34 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.

1.10.12 UTILITY POINTS

- 1.10.12.1 Number of utility points (Service / plant air, service / plant water, service / washing

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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 'BILL OF MATERIAL' to BHEL for approval.

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

1.10.13 SITE INSPECTION

- 1.10.13.1 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.
- 1.10.13.2 BHEL 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 BHEL.
- 1.10.13.3 Wherever the performance of work by the contractor is not satisfactory in respect of workmanship, deployment of sufficient labour or equipment, delay in execution of work or any other matter, BHEL shall have the right to engage labour at normal ruling rates and get the work executed through other agency and debit the cost to the contractor and the contractor shall have no right to claim compensation thereof. In such a case, BHEL shall have the right to utilize the materials and tools brought by the contractors for the same work.

1.10.14 DOCUMENTATION

- 1.10.14.1 As built drawings:
- 1.10.14.2 After successful completion of installation work, drawings / documents shall be updated in line with the actual work carried out and as built drawings / documents shall be submitted by the contractor.
- 1.10.14.3 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.

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1.10.14.4 Other documents as specified in PROGRESS OF WORK (VOLUME-IA PART- I CHAPTER-XI)

1.10.15 Social Accountability 8000 (SA 8000)

The Bidders may be aware that NALCO are installing and implementing Social Accountability 8000 (SA 8000). As a part of Implementation, it is necessary that all bidders, sub-contractors of NALCO make a written commitment to conform all requirements of SA 8000. Bidder to submit / upload with his Part-I bid details of SA 8000 as per Appendix – 1 in Part II of specification.

1.10.16 The bidder to follow NALCO's occupational health & safety policy. The bidder has to ensure attendance in a training programme for all his contract workers conducted by safety department and obtain a certificate before putting the workers to work front. The bidder has to adhere to "NALCO's safety code for contractors" while executing the work and the same has to be collected from NALCO's T & C department.

Medical Check-up: The bidder will have to submit medical certificate from a Govt. Hospital or registered medical practitioner in the prescribed format for the workmen engaged by him along with application for gate pass and for annual renewal. No gate pass will be issued / renewed unless the medical certificate is enclosed along with the application.

1.10.17 No female labour shall be employed during dark hours.

1.10.18 The Engineer in-charge executing the contract upon his satisfaction that the bidder is not performing as per the safety requirements may direct stoppage of work. The bidder shall not proceed with the work until he has complied with such directions to the satisfaction of concerned Engineer in-charge.

Without prejudice to the right conferred by the 1.10.18 above for stoppage of work for violating of safety requirements, the bidder shall be liable for penalty up to Rs. 3,000/- for the first violation and up to Rs. 5,000/- for the second violation. For the third violation, he shall be liable to be debarred from further contracts up to a period of one-year minimum from the date of completion of jobs in hand.

NON-COMPLIANCE OF THE SHE AND SAFETY NORMS

Penalty may be imposed on successful bidder and their sub-contractors/subvendors working in the Project for non-compliance to the SHE (Safety, Health & Environment)

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requirements working in the Project as per The National Aluminium Company Limited (NALCO)'s norms.

ENVIRONMENTAL CLAUSE (ISO-14000)

In line with the requirement of ISO – 14001, all Bidders shall comply with the following:

- i) Each and every Bidder engaged inside the Works shall maintain the upto-date training certificate of their employees of Environment. The training shall be provided during safety & Environment training prior to start of the job.
- ii) Any earth excavated during the job shall be disposed off in a preassigned area. The Bidder shall take preventive steps to avoid spillage of earth/debris during transport/dumping.
- iii) Maintain a clear work area in and around the work place.
- iv) Ensure optimum use of water and avoid misuse/ wastage.
- v) Ensure that the vehicles used by them meet the emission norms. These are being checked by Owner's Safety department.

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VOLUME-IA PART – I CHAPTER - XI

1.11.0 PROGRESS OF WORK

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

- 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.
- 1.11.2 Contractor is required to draw mutually agreed monthly erection programs in consultation with BHEL well in advance. Contractor shall ensure achievement of agreed program and shall also timely arrange additional resources considered necessary at no extra cost to BHEL.
- 1.11.3 Progress review meetings will be held at site during which actual progress during the week vis-a-vis scheduled program shall be discussed for actions to be taken for achieving targets. Contractor shall also present the program for subsequent week. The contractor shall constantly update / revise his work program to meet the overall requirement. All quality problems shall also be discussed during above review meetings. Necessary preventive and corrective action shall be discussed and decided upon in such review meetings and shall be implemented by the contractor in time bound manner so as to eliminate the cause of nonconformities.
- 1.11.4 Tenderers have to furnish a list of Tools and Plants including cranes, Tractor / Trailers etc., which they propose to deploy for this work.
- 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 contractor shall submit weekly / fortnightly / monthly statement report regarding consumption of all consumables for cost analysis purposes.
- 1.11.7 The contractor shall submit a report of any damage, shortage, discrepancy etc., every week detailing in this regard.
- 1.11.8 The manpower reports shall clearly indicate the manpower deployed, category wise specifying also the activities in which they are engaged.
- 1.11.9 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.

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- 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 operators and helpers. Data shall be split up under the work areas like Boiler (pressure parts, structures), ESP, Aux Boiler, Rotating machines, SCR, 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.

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VOLUME-IA PART- I CHAPTER-XII

1.12.0 Foundations and Grouting

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

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

- 1.12.1 Foundation for the equipments to be erected shall be provided by BHEL / clients of BHEL. The dimensions of the foundations and anchor bolt pits shall be checked by the contractor for their correctness as per drawings. Further, top elevation of foundations shall be checked with respect to bench mark etc. All adjustments of foundations surfaces, enlarging the pockets in foundations etc. as may be required for the erection of equipments / plants shall be carried out by the contractor.
- 1.12.2 Cleaning of foundation surfaces, pocket holes and anchor bolt pits etc., dewatering, making them free of oil, grease, sand and other foreign materials by soda wash, water wash, compressed air or any other approved methods etc., form / shuttering work are within the scope this work.
- 1.12.3 It shall be contractor's responsibility to check the various equipment foundations for their correctness with respect to level, orientation, dimensions etc., and ascertained dimensions shall be measured and submitted to BHEL for approval before erection. Also minor chipping, dressing of foundations up to 30 mm for obtaining proper face for packer plates / shims, as 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. Packer plates should not only be blue matched with foundation but also inter-packer contact surfaces between the packers and foundation frame etc., shall also be blue matched by Prussian Blue match checks and required percentage contact shall be achieved by chipping and scrapping as per BHEL Engineer's instructions.

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- 1.12.7 Total grouting of the columns / equipments including pocket grouting, grouting at the gap between foundation and base plates top surface of column / equipments is in the scope of the contractor. All the grouting should be carried out by non-shrink cement like conbextra GPI / Conbextra GP II / Shrinkkomp or its equivalent etc. This special non-shrink cement shall be arranged by the contractor at his cost. The quoted rate shall be inclusive of the same.
- 1.12.8 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.
- 1.12.9 All equipment bases and structural steel bases and foundations pockets shall be grouted and finished as per these specifications after surface preparation unless otherwise recommended by the equipment manufacturers. The surface preparation includes soda washing of the foundations to remove oil, grease etc. to ensure proper grouting.
- 1.12.10 The certificates of the grout are to be submitted BHEL. If necessary, test cubes are to be made and tested at site to ensure the quality of the grout as per relevant IS standards. In case grouting with Portland cement is approved, necessary cement, sand etc. to be arranged by the contractor including the fine aggregates.
- 1.12.11 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.
- 1.12.12 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.
- 1.12.13 **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.

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VOLUME-IA PART –I CHAPTER -XIII

1.13 TRANSPORTATION AND 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 Scope includes receipt, unloading & material handling from trucks/ trailers etc., transportation to site/ site stores & storage yard, reshifting of materials, verification, stacking, tracking location of materials along with associated documentation in the computerized MM/ SCMS package with BHEL and manual registers and preservation of materials/ components of boiler, TG, etc. and their auxiliaries, steel materials like TMT bars, structural steels, plates, reinforcement, tools and plants, office furniture, miscellaneous items etc
- 1.13.2 Loading at BHEL / Customer stores and storage yard, transport to site, unloading at site / working area of equipment, placement on respective foundation / location, fabrication yard, pre-assembly bay or at working area are in the scope of work. The scope includes taking materials / Equipments from customer stores / storage yard also. Contractors Quoted / Accepted rate shall be inclusive of the same. Required cranes, tractors, trailer or trucks/ slings/ tools and tackles / labour including operators, fuel, lubricants etc. for loading & unloading of materials will be in the scope of contractor.
- 1.13.3 Loading at storage yard and transporting to site, unloading at site / pre assembly area or at working area, is in the scope of work. Required cranes for loading & unloading of materials, trailer shall be in the scope of contractor. The contractor shall provide any fixtures, concrete blocks & wooden sleepers, sandbags which are required for temporary supporting of the components at site. Store / storage yards are located approx. 5 kms from site of erection which are within and outside the plant premises adjacent to the plant boundary.
- 1.13.4 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.
- 1.13.5 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.
- 1.13.6 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.

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- 1.13.7 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.
- 1.13.8 All pipe and tube ends shall be covered with plastic caps or will be closed with wooden plugs as the case may be.
- 1.13.9 The contractor shall provide any fixtures, concrete blocks & wooden sleepers, which are required for temporary supporting of the components at site.
- 1.13.10 The contractor shall take necessary measures to see that all the machined surfaces are preserved and covered.

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VOLUME-IA PART-I CHAPTER- XIV

1.14 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.)

Relevant points of this chapter as applicable for the scope of work for this contract shall be complied with.

1.14.1 Erection

- 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 Brief list of System / sub-system to be erected by the contractor & approximate weight of individual PGMA's and number of welding joints are given in this tender elsewhere and are meant for giving general idea to the tender only about magnitude of the work involved. This should not be taken for billing or any other claims. All weights for such purposes will have to be taken from design documents only (shipping list). This section also gives general idea about various components to be erected with expected accuracy level. However, the contractor is requested to get the correct details from the engineer to avoid mistakes and rework.
- 1.14.1.3 In case of any class of work for which there is no such specifications as laid down in the contract such as blue matching, welding of stainless steel parts etc., the work shall be carried out in accordance with instructions and requirements of the BHEL engineer at the quoted rates only.
- 1.14.1.4 The contractor is strictly prohibited in using any of the Boiler components like angles, channels, hand-rails, etc for any temporary supporting or scaffolding work. In case of such misuse, a sum as determined by BHEL shall be recovered from contractor's bills. Also the contractor will be responsible for the safe custody and proper accounting of all materials in connection with the work. If the contractor has drawn materials in excess of design requirements, recoveries will be effected for such excess draws at the rate prescribed by manufacturing units.
- 1.14.1.5 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.
- 1.14.1.6 All welded joints shall be subjected to acceptance by BHEL Engineer.

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- 1.14.1.7 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.
- 1.14.1.8 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.
- 1.14.1.9 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.
- 1.14.1.10 All pipe and tube ends shall be covered with plastic caps or will be closed with wooden plugs as the case may be.
- 1.14.1.11 Contractor has to arrange required fire proof tarpaulins to protect the machined components / assembled parts drawn from BHEL before and after erection at their cost.
- 1.14.1.12 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 shall be arranged by the contractor at his cost.
- 1.14.1.13 In the case of structural members / ducts in certain cases, the raw material will be supplied in random lengths and the contractor will have to make up the length / prepare the edges to suit the matching profiles, weld / bolt connects the joints at no extra cost.
- 1.14.1.14 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. There is a possibility of slight change in routing the above pipelines when after completion, to suit the site conditions. The contractor should absorb this cost in his quoted rate.
- 1.14.1.15 All welded joints should be painted with anti-corrosive primer, once NDE works are over.
- 1.14.1.16 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.
- 1.14.1.17 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

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on the column and should be pre-fabricated clamping type ladders. No temporary welding on any structural member is permitted except under special circumstances with the approval of BHEL.

- 1.14.1.18 The temporary structures / items welded to permanent members / pipes, temporary lugs / structures meant for transportation are to be cut and removed without any damage. In case of any damage, the same has to be made good by the contractor at his cost.
- 1.14.1.19 Contractor has to arrange required fire retardant covering material at their cost to protect the machined components / assembled parts drawn from BHEL before and after erection.
- 1.14.1.20 The contractor shall provide any fixtures, concrete blocks / wooden sleepers, steel structures etc., which are required for temporary supporting for checking / welding / lifting / handling / preassembly of the components at site.
- 1.14.1.21 Prior to erection of any components inspection to be done for any foreign materials and damages and they are to be attended as per directions of BHEL engineer.
- 1.14.1.22 Before lifting the heavy components, soft materials like gunny bags to be used while lashing the rope to avoid dents, rubbing marks etc. The capacity, number of sheave pulleys, size of the rope, guide pulley locations are to be decided at site with respect to the capacity and positioning of the winch.
- 1.14.1.23 The end caps provided at shop for various stubs are to be removed during final fit up only.
- 1.14.1.24 For other agencies, such as electrical, cabling, instrumentation, civil works etc., to commence their work from / on the equipments coming under this scope, Contractor has to clear the front, expeditiously and promptly as instructed by BHEL Engineer. Some time it may be required to re-schedule the activities to enable other agencies to commence / continue the work so as to keep the overall project schedule.
- 1.14.1.25 The contractor shall conduct non-destructive tests like Radiography, Ultrasonic, Dye penetrant, Magnetic particle tests, Kerosene Leak Test etc. on welds, castings, valve bodies & other equipments etc. and Ultrasonic test for finding thickness of materials as per BHEL Engineer's instructions within the quoted rate.
- 1.14.1.26 The contractor has to fabricate stainless steel orifice plate within the quoted rate. No extra payment will be made for fabrication of above orifice plates. The required stainless steel plate will be supplied by BHEL.
- 1.14.1.27 All welded joints should be painted with anti-corrosive paint, once radiography and stress relieving works are over.

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- 1.14.1.28 It is the responsibility of the contractor to do the alignment, checking, etc. if necessary, repeatedly to satisfy BHEL Engineer / Customer Engineers with all the necessary tools and tackles, manpower etc. without any extra cost. The alignment will be completed only when jointly certified so, by the BHEL Engineer & Customer. Also the contractor should ensure that the alignment is not disturbed afterwards.
- 1.14.1.29 Some of the packages may be sent in parts to suit the site condition / transportation, the same is to be assembled at site without any extra cost. Likewise, the package may be assembled together and sent as a single assembly. Contractor may have to dismantle and erect (or) erect as single assembly as per the instruction of BHEL Engineers within the quoted rates / prices.
- 1.14.1.30 Erection of flow switches, filters, flow meters, other metering elements, flow orifices, flow indicators, control valves supplied either by BHEL or customer forming part of the system is in the scope of work. This will include collecting from BHEL/Customer stores, transport to site, suitably cutting the erected piping, cleaning, erection, welding, radiography and stress relieving and commissioning.
- 1.14.1.31 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.
- 1.14.1.32 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.
- 1.14.1.33 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.
- 1.14.1.34 Wherever hanger and support materials are not received from manufacturing unit in time to suit the erection schedule, contractor shall erect the system on temporary supports to ensure the progress of work. The required structural steel materials will be issued on free of charges by BHEL, either from scrap/spare materials. The same shall be removed and returned to BHEL store after erection of permanent supports. The erection of temporary support is in the scope of contractor at no extra cost.
- 1.14.1.35 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 is within the quoted / accepted rate.
- 1.14.1.36 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

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necessary and paint inside surfaces of the equipments like coolers, oil tanks, Rubber expansion joints assemblies and other components as per instruction of BHEL Engineer during erection at the quoted rate.

- 1.14.1.37 Contractor shall cut / open works if needed, as per BHEL Engineer's instructions during commissioning for inspection, checking and make good the works after inspection is over. This contingency shall be included within the quoted value. During commissioning opening of valves, changing of gaskets, attending to leakages, minor modification, rectification works may arise. The contractor has to carry out these works at his cost by providing required manpower with T & Ps in all the three shifts. In case any rework is required because of contractor's faulty erection and which is noticed during commissioning, the same has to be rectified by the contractor at his cost.
- 1.14.1.38 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.
- 1.14.1.39 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.
- 1.14.1.40 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 BHEL engineer.
- 1.14.1.41 Field Quality Assurance Formats: -

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

1.14.2 ERECTION OF BOILER & ITS AUXILIARIES, SCR AND ROTATING MACHINES

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

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- b) Machine / flame / electric cutting, grinding, welding, radiography and stress relieving.
- c) Fitting, fettling, filing, straightening, chamfering chipping, scrapping, reaming, cleaning, checking, leveling, blue matching, aligning and assembly.
- d) Machining, surface grinding, drilling, doweling, shaping
- e) Temporary erections for alignment, dismantling of certain equipment for checking, cleaning, servicing and site fabrication
- f) The contractor should get the formal approval from the Boiler inspectorate to take up the boiler erection work (mainly pressure parts, piping etc.). Necessary assistance will be extended by BHEL for the same

1.14.2.2 Preparation of preassembly bed is very much essential for preassembly of MBLs, columns, ceiling girders, panels, coils etc. on consolidated ground and to avoid sagging and shrinking the temporary supports are to be provided. The preassembled component should have minimum three supports to avoid sagging. No separate payment will be made. The column and girder pieces are to be measured individually to check for camber, sweep etc. The level markings on the columns to be checked before erection. The verticality stickers are to be fixed over individual column pieces on both the flanges (90° apart in two places). These stickers are to be arranged by the contractor within the quoted rates.

1.14.2.3 Tier by tier erection method is to be followed. Columns are to be tied up with horizontal and diagonal bracing in each tier before proceeding to next level. Log sheets are to be maintained in line with log sheets which are available with BHEL. Before erection of top column piece the girder pin connection matching and welding of support plates with column top shall be completed. Necessary lubricant for the girder pin assembly should be applied as per drawing within the quoted rates.

1.14.2.4 Detailed procedure available with BHEL site office should be collected before taking up the job by the contractor for preassembly of ceiling girders. CEILING GIRDERS ARE TO BE PRE-ASSEMBLED AT SITE AND WELDING, NDT TESTS AND STRESS RELIEVING AS APPLICABLE ARE TO BE CARRIED OUT, INCLUDING 100% RADIOGRAPHY FOR THE WELDED JOINTS IN CEILING GIRDERS.

(Please check for the correct dimensions / measurements including weight before taking up the work and plan for the resources)

Camber, sweep and twist are to be checked. Major deviation if any observed should be intimated to BHEL for getting the resolution before proceeding further. The tolerances for individual piece camber and sweep, individual length, level of girder assembly, flatness of the web, out of squareness of assembly, overall length of the

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assembly etc. to be ensured before taking up the job. The preheating and post heating operations to be done in line with the guidelines issued by BHEL. Any additional clarifications if required are to be obtained. The sequence of welding of girder joints for the flange and web is to be followed strictly as per the procedure issued by BHEL. Suitable crane to be used for handling /lifting the ceiling girder. Positioning of the crane inside the boiler cavity is to be decided in consultation with BHEL.

- 1.14.2.5 The tightening procedures for HSFG bolts are to be obtained from BHEL at site before taking up the work. Normally it is done by turn of nut method. Torque wrenches also can be used. The bolted joints will be checked jointly by BHEL/Customer engineers for required tightness and retightening is to be done as per requirement. The tightened bolts will be marked with colour paints. Facility for random checking by torque wrench will have to be done. The required calibrated torque wrench will be provided by the contractor.
- 1.14.2.6 Some platform materials in PG 36 and PG 38, approach ladders, suspension materials etc. will be supplied in running meters. The contractor has to modify these materials wherever they are supplied in running meters to the required size / shape, to be welded and erect them within the quoted rates.
- 1.14.2.7 It shall be the responsibility of the contractor to provide ladders on column for initial works till such time stairways are completed. For this the ladder should not be welded on the column and should be fabricated clamping type ladders. No temporary welding on any structural members is permitted except under special circumstances with the approval of BHEL. The necessary materials for the ladders are to be arranged by bidder within quoted rate. Any ladder supplied by the manufacturing unit for this purpose will be issued to contractor free of cost and the same is to be returned once the platforms are completed.
- 1.14.2.8 Scrap disposing chutes are to be provided by the contractor within the quoted rate at different areas like along the boiler column, bunker structure and duct supporting structures. Material for the scarp chute will be provided by BHEL.
- 1.14.2.9 Certain adjustments in length of steel /pipe/tube members may be necessary while erecting high pressure pipelines of boiler and piping (pre-fabricated lines) and the contractor should remove the extra lengths to suit the final layout after preparing edges afresh and adopting specified heat treatment procedures at no extra cost, wherever indicated. Depending upon the type of deviation BHEL will consider the reimbursement at man hour rates. If the drawing provides for erection allowance, then it becomes part of the work and no compensation is payable. The prepared edges in pressure parts shall be preserved by applying with weldable primer as preservation and supply of the primer is in contractor scope.

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- 1.14.2.10 Ducts / expansion pieces are dispatched to site in loose walls / plates and these are to be assembled at site before erection. (Walls with stiffeners in welded condition will be provided)
- 1.14.2.11 All welded joints should be painted with anti-corrosive paint, once radiography and stress relieving works are over. Daily welding reports in the proforma suggested by BHEL should be submitted by next morning without fail.
- 1.14.2.12 Suspension for piping, pressure parts, ducting etc., will be supplied in running lengths which shall be cut to suitable sizes and adjusted as required within the quoted cost.
- 1.14.2.13 All the dampers, valves, lifting equipments, power cylinders, etc., shall be serviced and lubricated to the satisfaction of BHEL engineer before erecting the same and also during pre-commissioning. The bearings of dampers shall be properly cleaned, serviced and lubricated before commissioning at no extra cost. Even after commissioning the equipments, if there are problems in the operation they have to be attended by the contractor during the tenure of the contract.
- 1.14.2.14 In case of any class of work for which there is no such specifications as laid down in the contract such as blue matching, welding of stainless steel parts etc., the work shall be carried out in accordance with instructions and requirements of the BHEL engineer at the quoted rates only.
- 1.14.2.15 Spring suspensions / constant load hangers have to be preassembled and adjusted for the required loading and erected as per instructions, of BHEL Engineer. Any adjustments, removal of temporary arrestors / lockers, etc., have to be carried out as and when required at no extra cost to BHEL.
- 1.14.2.16 The contractor shall carry out necessary preservative painting, periodic application of preservations on pressure parts and other equipments during erection / after erection until completion of work. Necessary preservatives / paints, other consumables are to be arranged by the contractor at his cost
- 1.14.2.17 Contractor shall provide necessary crew with all items like wire brushes, paint brushes, emery paper, cotton waste, scaffolding materials etc., at his cost.
- 1.14.2.18 No temporary supports shall be welded on the pressure parts of piping. Welding of temporary supports, cleats, etc. on the boiler columns shall be avoided. In case of absolute necessity contractor shall take prior approval from BHEL Engineer. Further, any cutting or alternation of member of the structure of platform or other equipment shall not be done without specific prior approval of BHEL Engineer
- 1.14.2.19 All hangers, supports and anchors (including concreting or welding) shall be installed as per drawing to obtain a reliable and complete pipe installation as per instructions of BHEL Engineer. Normally supports are issued in running meters. Any additional supports as called for by BHEL Engineer shall be fabricated by the contractor and

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provided at no extra cost. However, the raw material required for fabrication of such supports shall be supplied by BHEL free of cost. (Any machining or threading is involved will only be done by BHEL).

- 1.14.2.20 Normally the high pressure valves will have prepared edges for welding. But if it becomes necessary the contractor shall prepare new edges or recondition the edges by grinding or chamfering to match the corresponding tubes and pipes. All fittings like "T" pieces, weld neck flanges, reducers etc., shall be suitably matched with pipes for welding. The valves will have to be checked, cleaned or overhauled in full or in part before erection, after chemical cleaning and during commissioning. Edge preparation becomes the part of erection work. However, payment for new edge preparation reconditioning beyond reasonable limits will be considered as per man day rates. All the valves, after chemical cleaning, have to be checked, cleaned or over hauled in full or part before erection if called for as part of scope.
- 1.14.2.21 Adjustments like removal of ovalities in pipes and opening or closing the fabricated bends of all piping including high pressure piping to suit the layout shall be considered part of work and the contractor is required to carry out such work free of cost, as per instructions of BHEL, which shall include specific heat treatment procedures etc.,
- 1.14.2.22 Suspension for piping, pressure parts, ducting etc., will be supplied in running lengths which shall be cut to suitable sizes and adjusted as required within the quoted cost.
- 1.14.2.23 Fabricated pipes are sent in standard length and will be cut to suit the site conditions and the layouts. Tubes or pipes wherever deemed to be convenient will be sent in running lengths with sufficient bends. Bends up to NB 65 mm will have to be fabricated at site adopting specified heat treatment procedures, wherever required at no extra cost.
- 1.14.2.24 **The enclosed welding schedule in VOLUME- IA PART II is tentative only and the actual applicable welding schedules will be issued during erection of work at site.**
- 1.14.2.25 In the case of structural members / ducts in certain cases, the raw material will be supplied in random lengths and the contractor will have to make up the length / prepare the edges to suit the matching profiles, weld / bolt connect the joints at no extra cost. Normally, the machine profile will be cut out for the structural members but the contractor will have to carry out suitable alteration / adjustments at site, without any extra payment in case it becomes necessary.
- 1.14.2.26 Attachment, welding of necessary instrumentation tapping points, thermocouple pads, root valves, condensing vessels, flow nozzles and control valves etc., both

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for regular measurements and performance testing to be provided on boiler / its auxiliaries or pipelines covered within scope of this tender, will also be the responsibility of the contractor and the same will be done as per the instructions of BHEL Engineer. The erection and welding of all above items will be contractor's responsibility even if, (a) Product group under which these items are released are not covered in the scope of this tender, (b) Items are supplied by an agency other than BHEL if they are integral to the scope envisaged under this package. Payment will be regulated as per the settled terms and conditions.

- 1.14.2.27 The contractor shall fabricate piping, install lub oil systems and carry out the acid cleaning of fabricated piping. The contractor shall also service the lub oil system, carry out the pressure test of oil coolers. etc.,
- 1.14.2.28 All the tubes and pipes shall be cleaned and blown with compressed air and shown to the Engineer before lifting. Sponge ball test shall be carried out for all tubes before erecting the same. Bigger size pipes should be cleaned with flexible wire brush, wherever necessary. After cleaning is over, the end caps shall be put back in tube openings till such time they are welded to other tubes. Required compressors shall be arranged by the contractor at his cost.
- 1.14.2.29 All attachment welding including those for insulation and refractory work coming on the pressure parts shall have to be done by the contractor. Contractor's quoted rate shall include all these contingencies. Attachment welding on pressure parts shall be done by qualified and certified welders only.
- 1.14.2.30 It is the responsibility of the contractor to do the alignment, checking, etc., if necessary, repeatedly to satisfy BHEL Engineer / customer Engineers with all the necessary tools and tackles manpower, etc., without any extra cost. The alignment will be complete only when jointly certified so, by the BHEL Engineer & customer. Also the contractor should ensure that the alignment is not disturbed afterwards.
- 1.14.2.31 Burner tilt mechanism will be checked for freeness, serviced and adjusted, if necessary to obtain optimum tilt before and after installation.
- 1.14.2.32 Fine fittings, boiler trim piping, oil system and other small bore piping have to be routed according to site conditions and hence shall be done only in position. As such, layout of small bore piping in boiler and oil system shall be done as per the site requirement. Necessary sketch for routing these lines should be got approved from BHEL by the contractor. There is a possibility of slight change in routing the above pipelines when after completion, to suit the site conditions. The contractor should absorb this cost in his quoted rate.
- 1.14.2.33 Additional platforms for approaching different equipments as per the site requirement, which may not be indicated in drawings, shall be fabricated, assembled

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and erected by contractor. However, the contractor shall be paid for this work on accepted tonnage rate for erection of structure. The steel materials required for these works shall be supplied by BHEL free of cost and the contractor will have to install them to suit the requirement. Works of major nature not covered under this clause.

- 1.14.2.34 Complete penetration of water wall (Panel to panel) tube to tube and fins welding shall be achieved either by single side or preferably double side welding. The decision of BHEL Engineer is final.

NOTE: The water wall/spiral wall panels will be supplied with fin cut to a length of 300 mm on ends for alignment and welding of tube to tube of panels at site. The contractor may require to cut fins further to a maximum length of 300 mm (total 600 mm) for alignment and welding of tube to tube in water wall/spiral wall panels and welding of fins on both sides after completion of panel to panel welding within the quoted rate. The required material for fin will be supplied in rods. No extra payment will be made for the above works.

- 1.14.2.35 Work such as minor rectification of foundation bolts, reaming of holes, drilling of dowels, matching of bolts and nuts, making new dowel pin, etc. are covered in the scope of work.
- 1.14.2.36 The column erection has to be done tier by tier with all bracings, beams to be erected, welded / bolted. Second tier of erection can be carried out only after grouting of column base.
- 1.14.2.37 Certain extra lengths of various tubes/pipes and fabricated ducts are provided as erection allowance and the same have to be cut/adjusted to suit the site conditions and layouts or certain small lengths may have to be added for adjustments to suit the site conditions. For any mismatch while matching the joints in tubes, the cutting, adjusting, re welding, addition spool pieces should be done by the contractor to match site conditions without any extra payment.
- 1.14.2.38 Assistance for calibrating / testing the power cylinders / valves, gauges, instruments, etc. and setting to actuators coming under various groups shall be provided by contractor within the quoted rates.
- 1.14.2.39 Hanger rods are shown in the pressure parts arrangement drawing for boiler. Any cutting / welding and required heat treatment and necessary NDT of such hanger rods will be done by the contractor as part of the work within the quoted rate. The hangers for pressure parts will be tested for even distribution of load with the help of torque wrench.
- 1.14.2.40 Skin casing sheet for covering the boiler roof panels, and other areas will be supplied as fabricated items. Any cutting and re-fabrication to suit the site conditions shall be carried out within the quoted rates.
- 1.14.2.41 For all the site routed piping under PG-21, 24 & 42 as built drawings are to be submitted by the contractor immediately after erection. It is to be noted that piping for

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fine fittings, trim piping, oil system (PG 42) soot blower system shall be supplied mostly in running meters which will be erected and all joints are to be welded as per the drawings/site routing within the quoted rates by the bidder.

- 1.14.2.42 Regarding steam coil-Air Pre-heater the contractor is expected to erect as per the drawings. Hydraulic test of SCAPH has to be carried out on the ground before lifting it to the position.
- 1.14.2.43 Seal box to be painted with bituminous paint of IS158 by the bidder. The required paint shall be supplied by the bidder within the quoted rate.
- 1.14.2.44 Before lifting the heavy components like header, panels, burner assemblies, down comer pipes etc. soft materials like gunny bags to be used while lashing the rope to avoid dents, rubbing marks etc. The capacity, number of sheave pulleys, size of the rope, guide pulley locations are to be decided at site with respect to the capacity and positioning of the winch. The end caps provided at shop for various stubs are to be removed during final fit up only.
 - 1. While Lifting the headers lifting lugs or shell portion of the headers only to be used. The temporary supports to be removed prior to hydraulic test. While erecting the temporary supports, care should be taken so that they do not affect the erection of permanent supports. Tack welding of suspension rods with bearing plates to be done after final adjustment. Details for welding of bearing plates can be referred in the drawings/check list.
 - 2. Precautions to be used while erecting the collector channel supports. Equal loading of the hangers is to be ensured. Ring headers are erected before erection of water wall bottom hopper panels. Headers are to be arrested before welding to panels/headers/tubes/coils as the case may be. Sequence of welding to be followed while welding higher size joints.
 - 3. Each water wall tube is provided with an orifice assembly in the bottom ring header. Orifice adopter is welded inside the header and welded at shop. After chemical cleaning operations, the orifice assemblies are to be erected at site as per directive of engineer and drawings.
 - 4. Erection of various components is taken up from top to bottom. Planning has to be done every month in consultation with the engineer. Pre assembly of seal boxes for the peep hole openings, pressure tapping, soot blowers etc. can be done on the ground before erection, if feasible. The burner blocks are to be erected in convenient position before closing the furnace with panels. For panel to panel erection and welding panels erection attachments are supplied by units. Furnace alignment with respect to boiler /furnace axis is very vital and important. The alignment is to be achieved. Details to be checked with engineer.

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5. The gaps between coils and steam cooled /WW panels /between coils etc. to be maintained in line with drawing. Please check up the permissible tolerance before taking up the work.
6. Preassembly of end bars with crown plates including stress relieving for coil assemblies.
7. Pump case / volute is welded with suction manifold in line with procedures available with site office.
8. The required accuracy level to be ensured before welding as per drawing. Necessary radiography/NDT along with heat treatment to be done.
9. Down comer pipes erection can be done by carrying out preassembling the pipes whatever feasible as per availability. The suction manifold received in loose pieces and to be pre-assembled in the floor nearby. After welding the suction manifold, it is to be positioned, aligned and then only the down comers from the steam separator/ drum are to be connected. Erection of suction spool pieces, and hand operated valves for the system to be erected.
10. Before taking up the erection of coils, pre erection checks to be carried out like width and length of the coil, availability of flexible connectors, damages on the coils, permanent bows if any, sponge test for the coil and completion of ground inspection by inspector of boilers as deemed.
11. Erection of LTRH/ Economizer coils as applicable can be done by preassembling the upper and lower coils. Pre erection checks like width, length etc., and sponge test of coils for thoroughness to be done before erection. Required hanger tubes erection to be completed before LTRH / Economizer coils erection. **The preassembly of cassette baffles of LTRH and Eco coils can be carried out before their erection.**
12. Check for the gaps between SH steam cooled front wall and Eco/SH horizontal assemblies, gap between SH steam cooled rear wall and SH horizontal assemblies/ eco assemblies, spacing between rear WW arch and pendant assemblies and finish SH coils. Detailed drawings are to be referred during execution. The items indicated are suggestive only.
13. Check for the inner space between eco coils, LTRH, RH and SH coils as per drawing
14. Ensure proper completion of steam cooled spacers. Check for clearances for soot blower lance tubes. Radiant roof skin casing sheets are to be welded after application of castable refractory.

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15. 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.
16. While erecting the safety valves, check for the set pressure and type. The lever arrangement, blow down ring approach for floating should be ensured. Drip pan drains with proper slope to be given to safe location. Check the exhaust pipe arrangement for expansion and proper guides to be given. Ensure anchor points for the above pipes.
17. Ensure removal of drains plugs provided in the silencers, the gap between exhaust pipe and roof is sealed properly.
18. DWLGs to be erected as per drawing. Joint protocol to be made for its correct erection with supports
19. Other tapping points meant for monitoring the level should be erected and protocol is to be made. Maximum use of the pads and lugs welded on the steam separator/drum to be used for giving supports.
20. Sample coolers are to be erected preferably in clean area. All the lines should be air blown before termination on both ends. Sockets are to be used for sampling lines.
21. All the drain lines should have sufficient slope towards drain. Provide expansion loops in all the vents and drains as per the drawings. All the motor operated valve stems should be vertical preferably. All the valve packing with asbestos base to be lubricated once in 6 months till handing over. Necessary gland packing will be supplied by BHEL.
22. Prior to erection of any pressure part like headers, pipes, tubes, panels etc. inspection to be done for any foreign materials and damages and they are to be removed/ attended as per BHEL engineer.
23. Transport binders on all coils are to be removed.
24. Gas distribution baffles and vibration snubbers, mechanical spacer bars etc. are to be erected as per drawings.
25. Buck stays are preassembled and raised to their respective elevations and hung prior to erection of furnace walls. Before fixing them to furnace walls, ensure completion of panel to panel welding and voids in the buck stay region. The necessary scalloped bars /plates/pads are to be welded after leveling. Ensure completion of vertical buck stays including support hangers, links. The erection of leveler channels with guides to be completed.

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26. All the furnace guides to be erected as per drawing keeping gap of about 3 mm for free boiler expansion.
27. The necessary connection to the wind box is to be completed in all respects as per drawing. If any drain holes are envisaged, the same to be provided. No pipe line supports should be taken from the buck stays without getting the approval from engineer.
28. Sagging of roof tubes results in condensate stagnation during shut down. Hence ensure that radiant roof and back pass roof tubes are erected without sag.
29. Total boiler is to be examined in all levels for free expansion. All the arrestors are to be removed. Expansion indicators are to be erected in various levels as per drawing / instruction of engineer.
30. Some of the few important locations for voids filling: -
 - Around penetration for pendent surfaces and radiant roof/SH screen tubes/second pass roof tubes.
 - Between loose front ww tubes above front upper panels and below radiant roof.
 - Gap between radiant roof tubes at the junction of front wall.
 - Extreme rear arch tubes and side ww/extended ww panels.
 - Extreme SH screen tubes and SH extended steam cooled walls.
 - Gaps between tubes / nipples in the steam cooled rear, side and front wall and respective headers.
 - Extreme tubes of front and side ww lower panels.
 - Side ww/extended side ww and extreme tubes of radiant roof.
 - Extended side steam cooled wall and extreme tubes of SH screen tubes.
 - Steam cooled side wall and extreme tubes of second pass roof.
 - Between tubes in upper corner tubes.
 - Between tubes in lower transition tubes.
 - Gap between tubes/nipples of side ww lower header at the ash hopper throat region.
 - Voids due to lifting slots in fusion/fin welded panels.
 - Voids due to erection slots in fusion/fin welded panels.
 - Fusion/fin welded panel fin slits at the panel tube-tube butt joint locations.

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- **The above list is suggestive only. Voids are to be closed suitably to retain refractory in position and to achieve the gas tightness.**

- 1.14.2.45 Erection of Boiler structures and points to be taken care of for achieving verticality of Boiler columns.
- The column pieces are pre-assembled and site match marks to be provided.
 - Pre assembly checks to detect and deviations in the columns like length, camber sweep, twist etc.
 - Checking of foundations for its levels distance, diagonal, distance etc.
 - Proper tightening of the foundation bolts.
 - Erection of columns tier by tier and box by box. Grouting to be done immediately after 1st tier erection.
 - Ensuring the availability of guy ropes, etc. during column erection and removal of guy ropes after ensuring the verticality of columns.
 - Using calibrated theodolite for verticality measurement of columns.
 - Tightening of HSFG bolts to be done by turnoff nut method only after ensuring the verticality of the columns.
 - Measuring adjacent diagonals of the ceiling girders after its erection.
 - Ensuring the verticality of the columns before and after the Drum/steam separator erection.
- 1.14.2.46 All Rotating machineries and equipment shall be cleaned, lubricated, checked for their smooth rotation, if necessary dismantling and refitting before erection. If in the opinion of BHEL Engineer, the equipment is to be checked for clearance, tolerance at any stage of work or during commissioning period, all such works are to be carried out by contractor at his cost.
- 1.14.2.47 The fans shall be checked for blade clearance and other vital tolerances. The Flow control devices in fans like IGV/Damper units shall be serviced. Necessary assistance for balancing of equipment during trial run shall be provided by the contractor.
- 1.14.2.48 Vital clearance of mill should be checked at site and adjusted if required.
- 1.14.2.49 The HT motor bearings shall be blue matched at site and checked for bearing clearance. Scrapping of bearing housing, if required to any extent shall be carried out by the contractor. No extra claim for blue matching of any two surfaces will be

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entertained. The HT motors will also be checked for air gap and adjustment of stator / rotor to magnetic center shall be carried out as part of erection.

- 1.14.2.50 The contractor shall fabricate piping, install lube oil systems and carry out the acid cleaning of fabricated piping. The contractor shall also service the lube oil system, carry out the hydraulic test of oil coolers. etc.,
- 1.14.2.51 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.

1.14.3 ERECTION OF ESP, FGD & ITS AUXILIARIES

- 1.14.3.1 Loading at storage yard after identification, transporting to site or pre-assembly yard / erection site, unloading at pre-assembly yard / erection site, pre-assembling of equipment's wherever required for inspection or checking, erecting the material, aligning, welding, fastening, supporting, grouting, carrying out the necessary non-destructive testing as may be required, application of Insulation, providing services for trial operation, pre-commissioning activities upto the time of completion of commissioning activities and supply and application of final painting. The contractor should erect and assemble the components as per the drawings issued and the number of components supplied to him will be on the basis of shipping list / completion schedules. Complete pre assembling of components are in the scope of the contractor.
- 1.14.3.2 All the dampers, valves, lifting equipment's, power cylinders etc., shall be serviced and lubricated to the satisfaction of BHEL engineer before erecting the same and also during pre-commissioning. The bearings of dampers shall be properly cleaned, serviced and lubricated before commissioning at no extra cost. Even after commissioning the equipment's, if there are problems in the operation they have to be attended by the contractor during the tenure of the contract.
- 1.14.3.3 Any other systems / Components which are integral to ESP & auxiliaries, supplied by BHEL manufacturing units are also to be erected and commissioned by the contractor within the quoted / accepted tonnage rate / lump sum value.
- 1.14.3.4 The Erection & Alignment of HV rectifier transformer is in the scope of contractor. However, dry out, testing and commissioning is not in the scope of this contract. HVR Transformer to be erected and handed over for commissioning in good

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- condition. Refilling of oil, if required for HVR transformer, is included in the scope of the bidder till completion of HVR Transformer commissioning
- 1.14.3.5 Erection & dismantling of air blowers and connecting pipes & ducts, providing blanks/ dummies at the required locations and conducting gas-tightness test is in the scope of contract and shall be carried out within the quoted rate.
- 1.14.3.6 Certain extra lengths of various tubes/pipes are provided as erection allowance and the same have to be cut/ adjusted to suit the site conditions and layouts or certain small lengths may have to be added for adjustments to suit the site conditions. For any mismatch while matching the joints in tubes, the cutting, adjusting, re welding, addition spool pieces should be done by the contractor to match site conditions without any extra payment.
- 1.14.3.7 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 BHEL engineer
- 1.14.3.8 Wherever equipment's 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.
- 1.14.3.9 All the bearings, Gearboxes etc., of the equipment and electrical motors to be erected are provided with protective greases only. Contractor shall arrange as and when required by the engineer for cleaning the bearing/gear boxes etc., with kerosene or some other agent if necessary by dismantling some of the parts of the equipment during erection and shall arrange for re-greasing/lubricating them with recommended lubricants and assembling back.
- 1.14.3.10 All the motors/pumps shall be stripped opened, thoroughly serviced with proper care and re-assembled properly before erection by the contractor. During servicing, pre-commissioning & commissioning, if any deficiency is observed the same should be taken up with BHEL Engineer at site and rectified at site without any delay.
- 1.14.3.11 All site-fabricated pipes will be issued in running metres as straight. These are to be cut and edge prepared at site to required length to suit layout as given in the erection drawing. All the attachments like lugs, stoppers, cleats etc., will be supplied as loose items and to be cut and welded to the pipes at site as per erection drawing. Necessary drilling of holes on main pipe for welding stubs shall also be

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- done at site by the contractor. Fittings like bends, tees, elbow, MITRE bends, reducers, flanges etc., will be supplied as loose items.
- 1.14.3.12 ESP Collecting Electrodes may require straightening and repair for minor transport damages before erection as per erection manual by the contractor within the quoted price.
- 1.14.3.13 Additional platforms of permanent nature for approaching different equipment's, as per site requirement which may not be indicated in drawings shall be fabricated and installed by the contractor. However, the contractor will be paid for this work on accepted tonnage rate for ESP erection. The material required for platform will be supplied by BHEL at free of cost.
- 1.14.3.14 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 pre-fabricated clamping type ladders. No temporary welding on any structural member is permitted except under special circumstances with the approval of BHEL.
- 1.14.3.15 Any fixtures, concrete block supports, steel structures required for temporary supporting for pre-assembly or checking and welding for lifting and handling during pre-assembly and erection shall be arranged by the contractor.
- 1.14.3.16 The scope of equipment's to be erected under this contract is detailed in Tender Specification. The schedule of weights given wherein is approximate and is meant only to give a general idea to the tenderer about the magnitude of the work involved.
- 1.14.3.17 All the works such as cleaning, checking, leveling, blue matching, aligning, assembling, temporary erection for alignment, opening, dismantling of certain equipment's for checking and cleaning, surface preparation, edge preparation, fabrication of tubes and pipes as per general engineering practices at site, cutting, grinding, straightening, chamfering, filing, chipping, and rectification of foundation up to 30 mm, drilling, reaming, scrapping, shaping, fitting up etc. as may be applicable in such erection works are to be treated as incidental to erection and necessary to complete the work satisfactorily shall be carried out by the contractor as part of the work and at his quoted rates.
- 1.14.3.18 Fixing, welding of necessary instrumentation tapping points for regular measurements as well as performance testing, to be provided on auxiliaries
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covered within the scope of this specification will also be the responsibility of the contractor and will be done as per the instructions of BHEL Engineer. The fixing / welding of all the above items will be contractor 's responsibility even if the

- i). Product groups under which these items are supplied are not specifically indicated in the Tender Specification.
- ii). Items are supplied by an agency other than BHEL.

1.14.3.19

Suspension for pipes will be supplied in running lengths which shall be cut to size and adjusted as required. All joints connecting ducts, expansion pieces shall be seal welded on inside and as well outside. Also it may sometime become necessary to remove any of the erected members to facilitate erection of bigger / pre-assembled equipment. In such case the removal and re-erection of such members, which are essential will have to be carried out by the contractor without any extra payment.

1.14.3.20

In the case of structural members / ducts, in certain cases, the raw material will be supplied in random lengths and the contractor will have to make up the length/prepared the edges to suit the matching profile weld/bolt connect the joints at no extra cost.

1.14.3.21

Normally, the matching profile will be cut out for the structural members but the contractor will have to carry out suitable alterations / adjustments at site, without any extra payment, in case it becomes necessary.

1.14.3.22

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.

1.14.3.23

Contractor shall carryout necessary touch up painting periodic application of preservation on all components and other equipment during erection / after erection until completion of work. Contractor shall provide necessary crew with all items like wire brushes, paint brushes, emery paper, cotton waste, scaffolding materials etc.

1.14.3.24

Contractor has to arrange required fire proof tarpaulins to protect the machined components / assembled parts drawn from BHEL before and after erection at their cost.

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- 1.14.3.25 It is the responsibility of the contractor to do the alignment, checking, etc. if necessary, repeatedly to satisfy BHEL Engineer / Customer Engineers with all the necessary tools and tackles, manpower etc. without any extra cost. The alignment will be completed only when jointly certified so, by the BHEL Engineer & Customer. Also the contractor should ensure that the alignment is not disturbed afterwards.
- 1.14.3.26 Works such as minor rectification of foundation bolts, reaming of holes, drilling of dowels, matching of bolts and nuts, making new dowel pin etc. are covered in the scope of work.
- 1.14.3.27 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 various locations as indicated by BHEL Engineer. The housekeeping must be a routine and continuous activity in the various work fronts. If the contractor does not do this job satisfactorily, BHEL will arrange for the same at the cost of the contractor. Periodical payments to the contractor for the work done will be considered only if the housekeeping is certified as satisfactory by the customer.
- 1.14.3.28 It is the responsibility of the contractor to engage his workmen in shifts or on overtime basis for achieving the desired progress and target set by BHEL. The contractor 's quoted rate shall include all these contingencies.
- 1.14.3.29 All the valves, lifting equipment's, etc. shall be serviced and lubricated to the satisfaction of BHEL Engineer before erecting the same and also during pre-commissioning. The bearings shall be properly cleaned, serviced and lubricated before commissioning at no extra cost. Even after commissioning the equipment's, if there are problems in the operation they have to be attended by the contractor during the tenure of the contract. Welding or joining of extension spindle for valves to suit the site conditions and operational facility shall be part of erection work within the quoted rate.
- 1.14.3.30 All hangers, supports and anchors (including concreting or welding) shall be installed as per drawing to obtain are reliable and complete installation as per instructions of BHEL Engineer. Normally supports are issued in running meters. Any additional supports as called for by BHEL Engineer shall be fabricated by the contractor and provided at no extra cost. However, the raw material required for

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- fabrication of such supports shall be supplied by BHEL free of cost. (Any machining or threading is involved will only be done by BHEL).
- 1.14.3.31 Before lifting the heavy components, soft materials like gunny bags to be used while lashing the rope to avoid dents, rubbing marks etc. The capacity, number of sheave pulleys, size of the rope, guide pulley locations are to be decided at site with respect to the capacity and positioning of the winch. The end caps provided at shop for various stubs are to be removed during final fit up only.
- 1.14.3.32 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 equipment's. Contractor shall dismantle such instruments and re-erect whenever required prior to commissioning. Sometime this may have to be handed over to store or instrumentation contractor.
- 1.14.3.33 Ducts / expansion pieces are dispatched to site in loose walls / plates and these are to be assembled at site before erection.
- 1.14.3.34 No members of the structure / platform should be cut without specific approval of BHEL.
- 1.14.3.35 In case any class of work for which there is no such specification as laid down in the contract such as welding of stainless steel parts, etc. works shall be carried out in accordance with the instructions and requirements of the Engineer at the quoted rates only.
- 1.14.3.36 Contractor is strictly prohibited in using the erection components like angles, channels and hand rails for any temporary supporting or scaffolding works. In case of such misuse, a sum as determined by BHEL Engineer will be recovered from contractor's bills. Also the contractor will be responsible for the safe custody and proper accounting of all materials issued in connection with the work. If the contractor has drawn materials in excess of design requirements, recoveries will be effected for such excess drawals at the rate prescribed by manufacturing units.
- 1.14.3.37 Contractor shall carryout chipping and blue-matching of foundation concrete with the packer plates. The packer plates shall be supplied by BHEL. Necessary machining wherever required and blue-matching of packer plates shall be carried out by the contractor within the quoted rates

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- 1.14.3.38 Attachment welding of necessary instrumentation tapping points, both for regular measurements and performance testing to be provided on E.S.P / its auxiliaries or pipelines covered within the scope of this tender will also be the responsibility of the contractor and the same will be done as per the instruction of BHEL Engineer.
- 1.14.3.39 Spring suspensions / constant load hangers have to be pre-assembled and adjusted for the required loading and erected as per the instructions of BHEL Engineer. Any adjustments, removal of temporary arrestors / lockers etc. have to be carried out as and when required.
- 1.14.3.40 **Roof Insulation**
- One layer of insulation mattress on roof top of E.S.P roof (inner) shall be applied before outer roof is placed.
- 1.14.4 ERECTION OF STEAM TURBINE, TURBO GENERATOR AND ITS AUXILIARIES
- 1.14.4.1 Handling of Materials at BHEL / Client's Stores / Storage Yard, Transportation to site of erection, inspection, preparation of foundation, erection, leveling, centering, alignment, grouting & final alignment of Steam turbine, Turbo generator and auxiliaries including BOI identified, pre-assembly, erection, alignment welding, NDT, fixing hangers & supports, chemical cleaning/pickling, oil flushing, water flushing, hydro testing & steam blowing of integral piping/oil piping, H₂/CO₂/Water cooling system, pre-assembly, erection, welding, NDT of water cooled Condenser, feed water storage tank, de-aerator, LP/HP heaters, GSC & other coolers, flash tanks etc., including RE joints and BFVs inside TG Building, erection and commissioning of Motor Driven Boiler feed pumps, Motor driven Condensate Extraction Pumps, Vacuum pumps system, other miscellaneous pump sets and equipment as given in this scope of works & associated surface finish, supply & application of required primer & finish paints / Anti corrosive / Steam wash paints and labeling on equipment & piping, pre-commissioning, commissioning, trial operation & handing over of Steam Turbine, Generator and Auxiliaries.
- 1.14.4.2 EOT Crane in TG Hall shall be provided by BHEL to contractor, as per availability, after obtaining Customer clearance for same.
- 1.14.4.3 Bolt stretching fixtures for TG anchor bolts are to be arranged by the contractor.
- 1.14.4.4 Auxiliary Oil Pump / Jacking Oil Pump / Emergency Oil Pump etc., and their 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.

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- 1.14.4.5 Sand / Grit / shot blasting of condenser / turbine components is to be carried out by the contractor wherever necessary as instructed by BHEL Engineer. Contractor has to arrange Sand / Grit / shot blasting machine, compressor required consumables, etc. at his cost.
- 1.14.4.6 The contractor shall also carry out erection, testing, and commissioning of the oil centrifuge within their quoted rate.
- 1.14.4.7 Transportation of CO₂ & H₂ cylinders from the store and filling of Gas in the generator stator cooling systems, etc., as and when required shall be the responsibility of the contractor for commissioning / operation activities till handing over of the Unit to customer.
- 1.14.4.8 Individual sections of Deaerator / FST are to be lifted to de-aerator floor and to be assembled and/ erected / welded at de-aerator floor. Deaerator including all loose items, valves, stand pipes, root valves, fittings are included in the scope of contract. Contractor shall arrange other T&P as required for installation of De-aerator and Feed Water Storage Tank (FST). For effective utilization of crane, contractor shall plan his activities so as to carry out the work in a minimum possible time period. In case of any accessibility and approachability limitations of crane to place the FST and Deaerator on required foundation, the contractor shall make necessary arrangement temporary platform / approach including providing the materials as per requirement as part of scope of work. The erection, alignment & welded in position and Welding, NDT & heat treatment shall be carried out by the contractor with in quoted rate.
- 1.14.4.9 The feed water storage tank will be supplied in three sections with feed pipe, heating steam header, spray nozzles, supports etc., in loose components. These are to be erected, aligned & welded in position. Welding, NDT & heat treatment if required shall be carried out by the contractor within quoted rate.
- 1.14.4.10 Erection of platform and supporting structures around feed water storage tank / De-aerator / equipments / valves / filters etc. is covered in the scope of contract and shall be erected by the contractor within the quoted rate.
- 1.14.4.11 Erection, testing & commissioning of BFP along with mechanical seal, end chambers cooling lines, lube oil & working oil lines are also included in the scope of contractor.
- 1.14.4.12 BFP drive turbines & its auxiliaries will be supplied in parts consists of turbine assembly, governing valve assembly, lube oil console, oil pumps, gear box, couplings, coolers etc., which are to be assembled at site and erected.
- 1.14.4.13 The condenser will be supplied in components / parts and contractor shall have to carry out assembly and erect on the condenser foundation. This includes complete

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fabrication of shell out of steel plates, welding of hot well with bottom plates, assembly of water chambers and welding with side walls, bottom plates and dome wall, assembly of water chambers, assembly of support plates, baffles and stiffening structures etc. While carrying out the assembly stitch welding shall be done only after the due approval for alignment from BHEL Engineer. Final welding shall have to be carried out by step back seam method to ensure minimum deformation within acceptable limits of the welding parts.

- 1.14.4.14 The condenser main tube plates will be dispatched to site from works with surface protection only for water box side. The same shall be removed suitably by sand/ grit / shot blasting or with steam mixed with caustic soda as per the instructions of the BHEL Engineer before erecting the same.
- 1.14.4.15 The contractor shall have to carry out the condenser tubes insertion and expansion at site after the installation of condenser on their foundation. Before insertion of tubes the contractor shall check for absence of any dents mechanical damages or any other defects of tubes caused during storage or transportation. Tube should be thoroughly internally cleaned of all extraneous matter. Only fine emery paper shall be used for cleaning the tubes at the ends where expansion has to be carried out.
- 1.14.4.16 Before insertion of tubes the contractor shall clean the surface of the holes in the tube plates and tube support plates for paint / corrosion spots, oxide scales etc., using chemical cleaning agent like carbon tetra chloride.
- 1.14.4.17 Condenser tube expansion to be carried out by contractors' experienced operators, as per the erection procedure / BHEL engineer's instruction.
- 1.14.4.18 The tube shall be inserted such that it shall project 2 to 3 mm beyond the tube plate outer surface. The tube shall be expanded using an automatic electronic torque control tube expanding unit or pneumatic tube expander so as to get the % thinning of the tube walls and elongation of tube ends as recommended by the supplier / Drawing / Tube expansion procedure. The length of expansion in no case shall exceed a length of 70 to 80% of the tube plate thickness. Finally, proper trimming of the excess length of the tube shall be carried out and flare-up / bell mouthing has to be done by the contractor at his cost.
- 1.14.4.19 The contractor shall carry out the condenser neck welding with LP casing. It shall be ensured that all spring supports are evenly loaded and the gap between the condenser and the different spring supports is within 1.0 mm. The clearance between the condenser neck and the LP exhaust hood should be within 3 mm by suitably lifting the condenser. Machined packers of suitable thickness are to be used under the spring supports and condenser load is to be gradually transferred on these packers. The neck welding shall be subjected to non-destructive testing.

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- 1.14.4.20 The hydrostatic testing of steam space with the condenser vacuum system and hydraulic testing of water space with the circulating water (CW) lines after assembly of water boxes are also included in the scope of the contractor. Dummies are to be provided by the contractor at inlet and outlet for Hydraulic Test. Required MS plates shall be supplied by BHEL free of cost. Fabrication of dummies shall be done by the contractor at his cost.
- 1.14.4.21 Water boxes inside Carbon steel surfaces are to be Sand / Grit / shot blasted before hydraulic testing. After hydraulic testing water boxes and the water chambers of Circulating water side, they are to be thoroughly cleaned for removal of all traces of dirt, grease, oil, rust etc., it shall be dry and free from burns and shall have a metallic surface. The (Sand / Grit / shot) Blasting machine and accessories and also the required consumables shall be arranged by the contractor within the quoted rate. Painting to be carried out as per the procedure / approved painting schedule given by BHEL Engineer / Manufacturing unit during erection.
- 1.14.4.22 Handling equipment & Structures for Condenser and associated equipments and auxiliaries shall be erected by the contractor within the quoted rate.
- 1.14.4.23 One no LP Heater, and Steam Throw Device of the LP By pass Valve is to be erected inside each condenser in rear side and front side each, for which contractor has to cut open the condenser dome plate already erected. After erection of LP Heater and Steam Throw Device, condenser plates have to be strengthened / stiffened as per the instruction of BHEL Engineer.
- 1.14.4.24 The foundation deck of BFP's, Turbines and Generator is supported with Vibration Isolation Springs, which will be erected by the civil contractor. Floating of foundation decks and adjustments of springs is covered in this scope of work.
- 1.14.4.25 The contractor shall carryout the erection of rubber expansion bellows, stretching bolt assembly and connected joints within the quoted rate.
- 1.14.4.26 All the integral lube and control oil pipelines required TIG welding operations. Purging is required in case integral lube and control oil pipelines are of stainless steel material. The tubes / pipes are to be purged with Nitrogen Gas / Argon Gas for the purpose of creating inert atmosphere in the pipelines during the process of TIG welding. Nitrogen, Argon gas required for this purpose shall have to be arranged by the contractor at his cost.
- 1.14.4.27 The instrumentations other than an assembled part of the equipments / items are not included in the scope of this works and shall be carried out by other contractors. The fixing and assembly of the thermocouples for Turbine including assembly of junction box as per drawing is also in the scope within the quoted rate.

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- 1.14.4.28 All the weld seams shall be properly ground and subjected to examination. If any paint or rust (other than steam washable paints) noted in the steam side of the condenser parts, these are to be removed either by sand / shot / Grit blasting or buffing method.
- 1.14.4.29 All the weld seams shall be properly ground and subjected to radiographic examination as per manufacturer's recommendation. If any paint or rust (other than steam washable paints) noted in the steam side of the condenser parts, are to be removed either by Sand Grit / shot blasting or buffing method.
- 1.14.4.30 The Contractor shall carry out the reaming and honing of coupling holes with his own reamers, honing machine and honing accessories etc. at his own cost.
- 1.14.4.30 Erection of all the piping systems supplied along with turbine, generator, pumps and other auxiliaries covered in this contract, is to be erected by the contractor within the quoted rate. Certain instruments like pressure switches, gauges, air filters, regulators, filters, junction boxes, power cylinders, dial gauges, thermometers, flow meters, valve actuators, flow indicators etc., are received in assembled conditions as integral part of equipments. Contractor shall dismantle such instruments and re-erect whenever required prior to commissioning. Sometime this may have to be handed over to store or instrumentation contractor.
- 1.14.4.31 Erection of flow switches, steam traps, filters, flow meters, other metering elements, flow orifices, flow indicators, control valves supplied either by BHEL or customer forming part of the system is in the scope of work. This will include collecting from BHEL / Customer stores, transport to site, suitably cutting the erected piping, cleaning, erection, welding, radiography and stress relieving and commissioning.
- 1.14.5 ERECTION OF VARIOUS PIPING SYSTEMS INCLUDING VALVES:
- 1.14.5.1 Erection of all the piping systems supplied along with equipments, pumps and other auxiliaries covered in this contract is to be erected by the contractor within the quoted rate. All piping works including integral piping shall be completed up to & including erection / welding of root valves for further connection of impulse tubing.
- 1.14.5.2 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.
- 1.14.5.3 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.

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- 1.14.5.4 All Non-IBR piping will be supplied in running metres random length of 3 to 7 metres , contractor has to cut and edge prepare as per the standards / drawings and as per the instruction of BHEL Engineer within the quoted rate. Total Fabrication of piping is included in the scope. All the attachments like lugs, stoppers, cleats etc., will be supplied as plates and to be cut and welded to the pipes at site as per erection drawing. Necessary drilling of holes on main pipe for welding stubs shall also be done at site by the contractor. Fittings like bends, tees, elbow, mitre bends, reducers, flanges, thruster blocks, etc., will be supplied as loose items and edge preparation if required shall be carried out by the contractor.
- 1.14.5.5 Bends less than or equal to NB 65 mm will have to be fabricated at site adopting specified heat treatment procedures, wherever required at no extra cost.
- 1.14.5.6 For Non IBR Pippings, Contractor has to carryout fabrication works such as welding of stubs / nipples, attachments etc., within the quoted / accepted rate.
- 1.14.5.7 For all pipings (IBR and Non IBR), Contractor has to carryout fabrication and installation of structures required for pipe supports and approach / operation platforms including preparation of surface by grit / sand / shot blasting for painting applications within the quoted / accepted rate.
- 1.14.5.8 Normally weld neck valves will have prepared edges for welding. But, if it becomes necessary, the contractor shall prepare new edges, re-prepare the edges by grinding or chamfering to suit site conditions, which shall be done by the contractor at no extra cost.
- 1.14.5.9 All fittings like elbows, tees, reducers, weld neck flanges, inserts etc., shall be matched with pipes for welding which may require re-edge preparation, grinding etc., No extra cost shall be paid for this.
- 1.14.5.10 The valves will have to be cleaned, checked, lapped or overhauled in full or in parts before erection, after chemical cleaning, during commissioning. Any special tools required for lapping only will be arranged by BHEL.
- 1.14.5.11 All piping items below size 2", including pipes, valves, bends, tees, elbow, mitre bends, reducers, flanges, fittings, thruster blocks etc. shall be supplied as loose items as available commercially. Hence Fit-ups, edge preparation including welding of stubs, shall be included in the contractor's scope within the quoted rate.
- 1.14.5.12 For pipes nominal 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 size 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.

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- 1.14.5.13 Contractor should fabricate bends of $\leq 2"$ diameter size from running meters of pipe.
- 1.14.5.14 Wherever elbows of 45° deg or any other angle are required, the same shall be cut from 90° deg. elbow supplied and used. No extra cost shall be paid.
- 1.14.5.15 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. Routing of all the equipment drains to the nearest trench as per the instructions of the BHEL Engineer is in the scope of the bidder.
- 1.14.5.16 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 or not, 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, welding, 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.
- 1.14.5.17 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 NDT, heat treatment procedure shall be carried out by the contractor within the quoted rate.
- 1.14.5.18 Certain adjustments in length may be necessary while erecting pipelines / steel members. Removing / adding extra lengths to suit the final layout, preparing edges afresh and adopting specified NDT, heat treatment procedure is in the scope of work.
- 1.14.5.19 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.
- 1.14.5.20 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 gouging/ grinding and not by

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- 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.
- 1.14.5.21 All the weld joints on equipments and piping shall be ground or filed on completion of welding and before radiography as per instructions of BHEL Engineer so as to achieve smooth surface to avoid of ripples, undulations etc.,
- 1.14.5.22 Pipelines shall be cleaned off welding slag and burrs by hand files, wire brushes and flexible grinders wherever required and using cloth.
- 1.14.5.23 Flame cutting of piping or any other equipments shall be strictly done as per BHEL Engineer's instructions and clearance only.
- 1.14.5.24 The work on piping systems (air, water, oil, steam, gas etc.,) will include laying, edge preparation, fixing and welding of the elbows / fittings / valves etc., welded on the lines, fixing and adjustment of supports / hangers / shock absorbers and carrying out all other activities / works to complete the erection and also carrying out all pre-commissioning / commissioning operations mentioned in the specification as per BHEL Engineer's instructions and / or as per approved drawings / documents.
- 1.14.5.25 Flow nozzles, orifice, spray nozzles etc., forming part of the system (under this scope of work) irrespective of the supplier shall be mounted / erected after chemical cleaning and / or steam blowing and / oil flushing at site at no extra cost.
- 1.14.5.26 All piping will be supplied in running meters, contractor has to cut and edge prepare as per the standards / drawings and as per the instruction of BHEL Engineer within the quoted rate.
- 1.14.5.27 Contractor shall also weld small length of piping with root valve to the pressure, temperature, flow and level tapping points on piping or flow nozzles / orifices / metering elements fixed on piping as per the instructions of BHEL Engineer.
- 1.14.5.28 All drains / vents / relief / escape / safety valve piping to various tanks / sewage / drain canal / flash box / flash tank / condenser / sump / atmosphere etc. from the stubs on the piping and equipments erected by the contractor is completely covered in the scope of work.
- 1.14.5.29 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.

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- 1.14.5.30 Tubes or pipes wherever deemed to be convenient will be sent in standard length and will be cut to suit the site conditions and the layouts. Bends less than or equal to NB 65 mm will have to be fabricated at site adopting specified NDT, heat treatment procedures, wherever required at no extra cost.
- 1.14.5.31 All site-fabricated pipes will be issued in running meters as straight. These are to be cut and edge prepared at site to required length to suit layout as given in the erection drawing.
- 1.14.5.32 For all the site routed piping, as built drawings are to be submitted by the contractor immediately after erection.
- 1.14.5.33 Fine fittings, oil system 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.
- 1.14.5.34 The contractor shall fabricate piping, install lube oil systems and carry out the acid cleaning of fabricated piping. The contractor shall also service the lube oil system, carry out the hydraulic test of oil coolers. etc.,
- 1.14.5.35 All the attachments like lugs, stoppers, cleats etc., will be supplied as loose items and to be cut and welded to the pipes at site as per erection drawing. Necessary drilling of holes on main pipe for welding stubs shall also be done at site by the contractor.
- 1.14.5.36 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.
- 1.14.5.37 For any mismatch while matching the joints in tubes, the cutting, preparing edges afresh, re-welding, addition of spool pieces, adopting specified NDT, heat treatment procedure should be done by the contractor to match site conditions without any extra payment.
- 1.14.5.38 The surface of the pipes to be joined shall be suitably prepared as per instructions of BHEL Engineers. Edge preparation shall be done by chamfering machine, whenever required and all welding surfaces must be cleaned thoroughly.
- 1.14.5.39 Instrumentation drains, stubs which are sent in loose from manufacturing units are to be welded at site as per BHEL Engineer's instructions.

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- 1.14.5.40 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.
- 1.14.5.41 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 no extra charges to BHEL. For spool pieces' materials will be supplied free of cost by BHEL.
- 1.14.5.42 All the valve packing with asbestos base to be lubricated periodically as per the instructions of BHEL till handing over. Necessary gland packing will be supplied by BHEL.
- 1.14.5.43 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 / price.

1.14.6 APPLICATION OF INSULATION AND REFRACTORY

- 1.14.6.1 Handling at site stores / storage yard, Transportation to site of work, Application of refractory & Insulation materials and connected works for Boiler and auxiliaries, ESP, STG, Piping , ducts etc., and binding and cladding with sheets etc., using their own tools plants, tackles, all consumables, supervisor and men as enumerated in the scope of contract. Refractory & insulation works include application of refractory, wool insulation, sheet metal cladding, welding of hooks / supports to hold insulation and refractory under this contract but are not limited to the following.
- 1.14.6.2 Insulation of main and Aux. boiler portion, boiler Drum / steam separator, ceiling heat recovery area, air and flue gas ducts, and connected ducts, HP & LP piping, temporary acid cleaning and steam blowing piping connected tubes, oil and coal burners, oil and steam tracing lines complete and fuel and draft plants, all drain lines, traps, flanges, fine fittings, sampling lines, Fans and other equipment like Vessels, Flash tanks, Heaters, etc.
- 1.14.6.3 The work shall conform to dimensions and tolerances given in various drawings and quality manuals provided by BHEL. If any portion of work is found to be defective in workmanship, not conforming to drawings or other stipulations, the contractor shall dismantle and redo the work duly replacing the defective materials at his cost, failing which the job will be carried out by BHEL by engaging other agencies / departmentally and recoveries will be effected from contractor's bill towards expenditure incurred including BHEL's overhead charges.
- 1.14.6.4 All insulations and refractory materials including iron components and other sheets, casing materials, etc., required as per drawing will be supplied by BHEL and the

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same have to be erected / applied as per the drawings and specifications of BHEL by the contractor.

- 1.14.6.5 Clean the Surface to be insulated from Rust, Dust, Grease, Loose scale, Oil, Moisture, etc. Care shall be taken that flexible insulation is not unduly compressed. After insulating the equipment, the gaps / joints shall be filled with loose wool/ moulded insulation as applicable
- 1.14.6.6 Painting of inner side of sheet metal covering over the insulation walls with two coats of anti-corrosive paint (IS-158) to be applied to the entire satisfaction of BHEL Engineer and application of bituminous sealing compound on cladding/ sheet metal joints shall also be carried out by the contractor. Retainer type 'A' must be coated with Aluminium paint. For which the required amount of paint, and other accessories for painting, cleaning the surfaces etc., shall be supplied by the contractor within the quoted rate.
- 1.14.6.7 Bituminous sealing compound will be provided by BHEL free of cost which is supplied by the respective Mfg. Units.
- 1.14.6.8 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.
- 1.14.6.9 All the insulation and refractory materials and sheet metal covering etc., issued to the contractor shall be properly stored and handled before application of the same. If any damage occurs to the materials due to improper storage or due to any causes attributable to the contractor except for normal breakage or damaged material shall be to the cost of the contractor.
- 1.14.6.10 Contractor is liable for the exact accounting of the materials issued to him and any unaccountable losses shall be made good by him. The necessary accounting of the material issued will have to be furnished by the contractor periodically
- 1.14.6.11 The contractor shall provide the required quantity of wire, nails and other materials for centering works at their cost.
- 1.14.6.12 Wherever iron components are to be welded on non-pressure parts, the contractor shall employ only approved structural welders. It shall also be the responsibility of the contractor to arrange for welding hooks, flats, plates, supports and other fixtures also. All consumables tools and plants etc., required for the work shall be arranged by the contractor at their cost.
- 1.14.6.13 Contractor shall observe all precautions for laying and curing of Castable refractory. Any defective works found shall be re-laid by contractor at his own cost including materials.

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- 1.14.6.14 Wool insulations are received at site as bonded and un bonded mattresses in standard sizes. These has to be dressed / cut to suit equipment / site work by the contractor.
- 1.14.6.15 For the insulation of hot air duct, gas duct, ID duct etc., un faced bonded wool, mattresses are to be used with wire netting (wire netting is supplied separately) on the outside for rigidity.
- 1.14.6.16 Dressing of insulation bricks to suit site conditions curing the refractory concrete applied, sheet cladding over insulations, form the part of this work.
- 1.14.6.17 Removal type of insulation to be provided for valves, fittings, expansion joints etc., as per the drawings or as directed by BHEL Engineer.
- 1.14.6.18 All piping insulations shall be carried out in such a manner as to facilitate removal of bolts nuts and washers from the flanges.
- 1.14.6.19 Refractory works at complete combustion chambers, ceiling heat recovery area, oil and coal burner areas and application of castable refractory wherever specified in drawing or as directed by BHEL Engineer have to be carried out.
- 1.14.6.20 Fabrication of covering sheets may be necessary like preparing the sheets to the sizes and shapes specified in drawings, beading, swaging, beveling of sheets crowning of the sheets if necessary the same to supports over wool insulation with screws as specified in BHEL drawings or as instructed by BHEL engineer.
- 1.14.6.21 Fabrication, fixing or welding of hooks / supports to equipment of boiler parts, piping and other connected equipments to support wool insulation applying of primer paint to welded portion parts welding certain supports on parts other than pressure parts to hold refractory's (by engaging approved welders) as per the drawings or as instructed by BHEL Engineer will have to be carried out by the contractor.
- 1.14.6.22 The contractor shall leave certain gap and opening while doing the work as per the instructions of BHEL Engineer to facilitate inspection by Boiler Inspector or doing commissioning to fix gauges, fittings, instruments. Those gaps will have to be finished as per drawings at a later date by the contractor at his cost, as required by BHEL .
- 1.14.6.23 Cladding sheets shall be suitably pressed along with diagonals to form diamond shape so as to improve the strength of the sheets, to avoid humpiness and to give aesthetic look.
- 1.14.6.24 Plates, bars, rods and other materials that are to be cut, and re-welded from the fabricated places to suit erection requirements for which no extra payment will be made to the contractor.

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- 1.14.6.25 A log book shall be maintained by the contractor for the clearance of the area for application of refractory and insulation. If the contractor does the work on his own accord without prior permission the area should be redone at his cost.
- 1.14.6.26 The contractor shall draw only one week's requirement of material for their work from BHEL stores and keep them in their semi-closed shed near to the work area. The materials required for a particular space of work only shall be taken to the work spot. At the end of the day's work the leftover or unused materials shall be taken back to their semi-closed shed for keeping the materials safe. Necessary records shall have to be maintained by the contractor in respect of the above draws / deposits, on daily basis as instructed by BHEL.
- 1.14.6.27 Wastages allowance for the materials issued are envisaged as follows:
- | | |
|-------------------------------|----|
| a) Castable refractory | 2% |
| b) Insulation bricks & mortar | 2% |
| c) Wool mattresses | 2% |
| d) Cladding sheets | 5% |
- 1.14.6.28 Making structural supporting works for pourable insulation, laying pourable insulation, adhering to all specifications and instructions shall be the responsibility of the contractor
- 1.14.6.29 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. Also, the contractor will demolish all the hutments, sheds, offices, constructed by him and shall clean the debris after the contract is over. In the event of his failure to do so, the same will be arranged / removed by BHEL Engineer and the expenses incurred with overhead will be recovered from the contractors.
- 1.14.6.30 Welding of hooks as per pitch, non-pressure parts, applying red oxide paint to the welded portion as directed as per drawings before application of mineral wool mattresses will have to be done by the contractor.
- 1.14.6.31 Applying different layers of mineral wool as directed and as per drawings and specifications for boiler and its auxiliaries, pipelines valves and other vessels and after fixing require holdings materials, suitably if necessary, fabrication of rings etc., and fixing as directed and as per drawings and specifications shall also form part of this work.
- 1.14.6.32 If necessary the hooks may have to be made from the rods, raw materials supplied in running lengths. The contractor may have to carry out this work also and use the same hooks.

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- 1.14.6.33 In case the contractor is required to dismantle and re-erect certain area as and when required for pre-commissioning / commissioning activities the rate as indicated in the rate schedule shall be paid by BHEL for erection. However, for dismantling no extra charge will be paid under any circumstances.
- 1.14.6.34 Wherever additional / clamps, frame works, etc., are required to be fabricated and installed even though not indicated in the drawings shall be fabricated and installed at their cost. Only steel materials shall be given by BHEL free of cost, consumables like electrodes, gases etc., are to be arranged by the contractor at his cost.
- 1.14.6.35 Contractor has to arrange required fire retardant covering material at their cost to protect the insulation materials drawn from BHEL before and after erection.
- 1.14.6.36 The contractor shall provide any fixtures, concrete blocks / wooden sleepers, etc., which are required for temporary supporting of the insulation materials at site.
- 1.14.6.37 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.
- 1.14.6.38 Welding of all seal boxes covers after completion of refractory work shall be done by the contractor. No extra charges will be payable for the same.
- 1.14.6.39 Application of Castable refractory between tubes around burners on ceiling and as directed by Engineers and as per detailed drawings and specifications will have to be done by the contractor
- 1.14.6.40 Welding of iron components directly on pressure parts and HP piping are to be carried out by certified IBR high pressure welders.
- 1.14.6.41 Application of insulation and removal of the same for temporary piping under scope of erection of this contract is also included in the scope of the work. However, BHEL will supply the insulation materials free of cost.
- 1.14.6.42 Dressing of insulation to suit site conditions, sheet cladding over insulations, form the part of this work.
- 1.14.6.43 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.
- 1.14.6.44 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.

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- 1.14.6.45 All rectification including painting of Employer's structure which are damaged by contractor during his work.
- 1.14.6.46 Special type of insulation wool used in penthouse shall not be cut indiscriminately. All chicken mesh, cut bits shall be accounted for.

1.14.7 HFO & LDO Tanks:

- 1.14.7.1 Raw Material for Tank fabrication shall be supplied by BHEL. Fabrication, Erection and Commissioning of HFO & LDO Storage tanks, inclusive of application of insulation for HFO Tank shall be done by the contractor.
- 1.14.7.2 PESO approval for HFO & LDO tanks will be in the scope of the tank design agency, however obtaining NOC from local authorities wrt these tanks shall be in the scope of the contractor.
- 1.14.7.3 Supervision of fabrication, erection & commissioning of these two tanks at site shall be done by tank design agency. Role of supervision for HFO & LDO tanks by the design agency is limited to clarification wrt drawings, supplied materials.
- 1.14.8 **Civil Works & Fabrication & erection of structures, racks & trestles:** Refer rate schedule ID 9 for all civil Works activities. Further, for technical specification for Civil & Structural Works, please refer Chapter 2 of Part II, Volume IA of Technical specification.

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VOLUME-IA PART-I CHAPTER - XV

1.15 WELDING, HEAT TREATMENT & RADIOGRAPHY AND NON-DESTRUCTIVE TESTING

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

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

- 1.15.1 The bidder shall use the Customer approved quality welding electrodes only.
- 1.15.2 The pressure parts, equipments and piping shall be erected in conformity with the provisions of Indian Boiler Regulations and as may be directed, as per other standard / specification in practice in BHEL. The method of welding (viz) ARC, TIG or other methods as indicated in the detailed drawing or as instructed by BHEL Engineer shall be followed. BHEL Engineer will have the option to change the method to suit site conditions. All the prepared / patched edges will have to be suitably protected to prevent rusting or foreign material ingress.
- 1.15.3 Welding of pressure parts, high tensile structural steel, Piping shall be done by certified high pressure welders who possess valid certificate and who are approved by BHEL Engineer.
- 1.15.4 *Welding & NDE test are to be carried out, including 100% radiography and the required UT for the welded joints in ceiling girders and 100% RT, 100% Hardness for all T91, T92 joints (as applicable) within the quoted rates. Irrespective of the EWS, the areas of T91, T92 joints shall be tested for 100% RT and 100% Hardness. UCI-M1C10 equipment shall be used by the contractor for Hardness measurement. The contractor shall make arrangement for testing through portable UCI method only.*
- 1.15.5 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.
- 1.15.6 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.

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- 1.15.7 All charges towards testing of Welders for destructive and non-destructive test, testing and approval of welders for engaging in the erection work shall be borne by the contractor.
- 1.15.8 Faulty welds caused by the poor workmanship shall be cut and re-welded at the contractor's expense. The Engineer prior to any repair being made shall approve the procedure for the repair of defective welds. After the repair has been carried out, the compliance shall be submitted to the quality engineer.
- 1.15.9 The contractor shall carry out the root run welding of all HP / LP piping, valves by TIG welding method only. The contractor shall have to carry out full TIG welding of butt weld joints of tubes / pipes of lesser thickness if required. During the root runs of stainless steel joints, the contractor shall before and during welding have to purge the pipes with inert gas.
- 1.15.10 All expenses for testing of contractor's welders including destructive and Non-destructive tests conducted by BHEL at site or at laboratory shall have to be borne by the contractor only. Limited quantity of tube and pipe material required for making test pieces will be supplied by BHEL free of cost.
- 1.15.11 Only BHEL approved electrodes and filler wire will be used. All electrodes shall be baked and dried in the electric electrode-drying oven to the required temperature for the period specified by the Engineer before these are used in erection work. All welders shall have electrodes drying portable oven at the work spot. The electrodes brought to the site will have valid manufacturing test certificate. The test certificate should have a co-relation with the lot number / batch number given on electrode packets. No electrodes will be used in the absence of above requirement. The thermostat and thermometer of electrode drying oven will be also calibrated and test certificate from Govt. approved / accredited test house traceable to National / International standards will be submitted to BHEL before putting the oven in use. The contractor shall also arrange periodical calibration for the same. Separate ovens shall be used for baking and holding.
- 1.15.12 All butt / fillet welds shall be subject to Non –Destructive testing as per the Drawing/Procedures/Welding Schedules/tender Documents etc at no additional cost.
- 1.15.13 The contractor shall maintain a record in the form as prescribed by BHEL of all operations carried out on each weld. He has to maintain a record indicating the number of welds, the names of welders who welded the same, date and time of start and completion, preheat temperature, radiographic results, rejection if any, percentage of rejection etc. and submit copies of the same to the BHEL Engineer as required. Interpretation of the BHEL Engineer regarding acceptability or other wise of the welds shall be final. All site welding joints shall be subject to acceptance or BHEL/Customer Engineers.

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- 1.15.14 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.
- 1.15.15 All welds shall be painted with anticorrosive primer once radiography and stress relieving works are over. Necessary consumables and scaffolding etc. including paints shall be provided by contractor at his own cost.
- 1.15.16 Pre-heating, radiography and other NDT tests, post heating and stress relieving after welding of tubes, pipes, Non Pressure Parts like Crown Plate support assembly, including attachment welding wherever necessary, are parts of erection work and shall be carried out by the contractor in accordance with the instructions of the Engineer. Contractor at his cost shall arrange all equipment and consumables essential for carrying out the above process.
- 1.15.17 Contractor shall arrange all necessary stress relieving equipment with automatic recording devices. The contractor shall arrange for labour, heating elements, thermocouples, thermo-chalks, temperature recorders, ceramic pads, thermocouple attachment units, graphs, sheets insulating materials like asbestos cloth, ceramic beads, asbestos ropes etc. required for heat treatment / stress-relieving operations. The contractor should take a note of the following,
- Temperature shall be measured by thermocouple and recorded on a continuous printing type recorder. All the recorded graphs for heat treatment works shall be the property of BHEL.
 - All stress relieving equipment will be used after due calibration and submission of test certificate to BHEL. Periodic calibration from Govt. Approved / accredited Test Houses traceable to National / International standards will also be arranged by the contractor for such equipment at his cost.
 - The contractor shall obtain the signature of Engineer or his representative on the strip chart of the recorder prior to the starting and during soaking period of SR operations.
- 1.15.18 The contractor shall also be equipped for carrying out other NDT like LPI /MPI /Hardness test etc. as required as per welding schedules/ drawings/tender conditions

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within the finally accepted price/ rates. Ultrasonic testing, wherever required, will be arranged by contractor within the quoted rate.

- 1.15.19 The technical particulars, specification and other general details for radiography work shall be in accordance with ASME, IBR or ISO as specified by BHEL.
- 1.15.20 The contractor for radiography work shall use iridium-192 / Cobalt 60; the geometric un-sharpness shall not exceed 1.5 mm. The contractor should take adequate safety precautions while carrying out radiography. Contractor at his cost shall arrange necessary safe guards required for radiography (including personnel from BARC). Contractor shall construct radiography pit for the same. Location for the pit shall be finalized and provided by BHEL.
- 1.15.21 Low speed high contrasts, fine grain films (D-7 or equivalent) in 10 cm width only are used for weld joint radiography. Film density shall be between 1.5 and 2.0.
- 1.15.22 All radiographs shall be free from mechanical, chemical or process marks, to the extent they should not confuse the radiographic image and defect finding. Penetrometer as per ASME or ISO must be used for each exposure.
- 1.15.23 Lead numbers and letters are to be used (generally 6mm size) for identification of radiographs. Contract number, joint identification, source used, welder's identification and SFD are to be noted down on paper cover of radiograph.
- 1.15.24 Lead intensifying screens for front and back of the film should be used as per the above-referred ASME specification. The joint is to be marked with permanent mark A, B, C to identify the segments. For this a low stress stamp shall be used to stamp the pipe on the down streamside of the weld. For multiple exposures on pipes, an overlap of about 25-mm of film should be provided.
- 1.15.25 Radiography personnel with sufficient experience and certified by M/s BARC for conducting radiographic tests in accordance with safety rules laid down by Division of Radiological protection only have to be deployed. These personnel should also be registered with DRP / BARC for film badge service.
- 1.15.26 All arrangements for carrying out radiography work including dark room and air conditioner and other accessories shall be provided by contractor within the space allotted for office at his cost. As an alternative the contractor may deploy an agency having all above facilities and who are duly approved / accredited by BARC and / or other Regulatory authorities. Detailed particulars of such agencies will be submitted and got approved by BHEL Engineer before the actual deployment of agency for radiography work.
- 1.15.27 The contractor shall have a dark room fully equipped with radiography equipment, film (un-exposed), chemicals and any other dark room accessories. All radiography films shall be developed in the dark room at site. Contractor shall ensure that Radiography

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personnel be equipped with film badge dosimeter for monitoring cumulative radiation dose absorbed due to ionizing radiation.

- 1.15.28 In case of radiography of less than 100%, the joints identified by BHEL at random shall be radiographed.
- 1.15.29 Contractor shall note that 100% radiography will be done at the initial stages on all the piping welding joints. Subsequently radiographic inspection will be done on the basis of quality of welding. However minimum percentage of joints to be radiographed shall not be less than the requirement of BHEL welding schedule / IBR / Customer's requirements. The percentage may be increased depending upon the quality of joints and at the discretion of BHEL. Radiography on LP piping joints is not envisaged. However other NDT test as called for in the FQP including LPI, MPI and HT will have to be carried out.
- 1.15.30 All the Radiographs shall be properly preserved and shall become the property of BHEL. They are to be reconciled with the work done, joints radio graphed and submitted to BHEL / customer.
- 1.15.31 Since radioisotopes are being used, all precautions and safety rules as prescribed by BHEL/ BARC/ Customer shall be strictly followed. BARC / DRP certificate to be provided before taking up the work.
- 1.15.32 Radiography of joints shall be so planned after welding, that the same is done either on the same day or next day of the welding to assess the performance of HP welders. If the performance of welder is unsatisfactory, he is to be replaced immediately.
- 1.15.33 Wherever radiographs are not accepted, on account of bad shot, joints shall be re-radiographed and re- submitted for evaluation.
- 1.15.34 However, if the defect persists after first repair, further repair work followed with radiography shall be repeated till the joint is made acceptable. In case the joint is not repairable, the same shall be cut, re-welded and re-radio graphed at contractor's cost.
- 1.15.35 Heat treatment and radiography may be required to be carried out at any time (day and night) to ensure the continuity of the progress. The contractor shall make all necessary arrangements including labour, supervisors/ Engineer required for the work as per directions of BHEL.
- 1.15.36 The contractor shall assist BHEL Engineer in preparing complete field welding schedule for all the field welding activities to be carried out in respect of piping and equipment erected by him involving high pressure welding at least 30 days prior to the scheduled start of erection work at site. The contractor shall strictly adhere to such schedules.

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- 1.15.37 The contractor shall deploy required number of H.P. welders to carry out the H.P. weld joints. The welding works should not be held up due to shortage / want of I.B.R/ H.P. welders.
- 1.15.38 All welded joints shall be subjected to acceptance by BHEL Engineer.
- 1.15.39 The technical particulars, specifications and other general details of work shall be in accordance with BHEL welding, Heat treatment and NDE manuals or equivalent as decided by BHEL Engineer.
- 1.15.40 Contractor shall carryout Radiography as per welding Manual booklet applicable as per IBR, enclosed. However, percentage radiography shown in the respective drawings shall be final and binding on the contractors.
- 1.15.41 The field joints are to be radiographed and preheating and post weld heat treatment to be done as per BHEL procedure and manuals.
- 1.15.42 The percentage of Radiography are tentative, which may be increased depending upon the quality of joints at the discretion of BHEL.
- 1.15.43 Penetrometer as per ASME/ISO shall be used for all exposures.
- 1.15.44 Lead numbers and letters (generally of 6mm size) are to be used for identification of radiographic contract No., joints identification, sources used welder's identification, SFD used are to be noted down in the paper cover of radiography. Lead intensifying screens for front and back of the film shall be used as per the instructions of BHEL Engineer
- 1.15.45 The weld joint is to be marked with permanent mark A, B, C, etc. to identify the segments. For this a low stress stamp shall be used to stamp the pipe on the downstream side of the weld. For multiple exposures on pipes, an overlap of about 25 mm of film shall be provided.
- 1.15.46 The contractor shall be fully equipped with radiography equipments, films, chemicals and other dark room facilities. There must be a number of radiographic personnel with sufficient experience and certified by BARC for field radiographic inspection. Further, the contractor must follow strictly the safety rules laid down by BARC, from time to time, contractor's radiographers shall also be registered with BARC for film badge service.
- 1.15.47 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.
- 1.15.48 All the radiographs shall be properly preserved in air-conditioned rooms and shall become the property of BHEL.

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- 1.15.49 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.
- 1.15.50 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.
- 1.15.51 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.
- 1.15.52 The contractor shall also be equipped for carrying out other NDT like liquid penetrant inspection, magnetic particle inspection, etc. as and when required in the interest of work within the quoted rates.
- 1.15.53 For carrying out ultrasonic testing of welded joints of large size tubes and pipes, it will be necessary to prepare the surface by grinding to a smooth finish and contour as desired by BHEL Engineer. The contractor's scope of work includes such preparation and no extra charges are payable for this.
- 1.15.54 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.
- 1.15.55 The welded surface irrespective of place of welding shall be cleaned of slag and painted at the center with primer paint to prevent corrosion at no extra cost towards this.
- 1.15.56 All welders shall be tested and approved by BHEL Engineer before they are actually engaged on work though they may possess the required certificate. BHEL reserves the right to reject any welders without assigning any reason. The welder Identification code as approved by the BHEL Engineer shall be stamped by the welder on each joint done by them. The contractor will be responsible for the periodic renewal, retesting of the welders as demanded by BHEL.
- 1.15.57 BHEL Engineer is entitled to stop any Welder from the work if his work is unsatisfactory for any technical reasons or there is a high percentage of rejection of joints welded by him, which in opinion of the BHEL Engineer will adversely affect the quality of the

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welding though the Welders, has earlier passed the tests prescribed by BHEL Engineers. The welders having passed qualification tests do not relieve the contractor of a contractual obligation to check the welder's performance.

- 1.15.58 The welding process, weld joint details, joint configuration and material specification may change to suit the design requirements. The contractors quoted rates shall be inclusive of each contingency. All welds involved in the erection of temporary pipe lines for hydraulic test, chemical cleaning, steam blowing etc. to be carried out within the quoted rates. The number of joints to be welded as mentioned in the welding schedule consists of butt welds. All other welds viz attachment welds on pressure parts/non-pressure parts, fillet welds in non-pressure parts welding in the boiler and Rotating Machines has to be carried out by the bidder within quoted rates.
- 1.15.59 *For uniform heating and better closed loop control, pre heating, post heating, controlled rate of heating & cooling and post weld heat treatment cycles for tube specifications **SA213T91 & SA213T92** should be carried out using flexible ceramic pads with suitable heating machine.*
- 1.15.60 MPI must be followed on joints which had undergone ultrasonic testing.
- 1.15.61 Also refer relevant notes to weight schedule in chapter IX of this booklet.
- 1.15.62 The enclosed welding schedule in VOLUME- IA PART II Chapter 3 is tentative only and the actual applicable welding schedules will be issued during erection of work at site.
- 1.15.63 After completion of Hydro Test(interval), all relevant joints, catalogue, RT, SR and NDT reports shall be submitted to BHEL.

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VOLUME-IA PART-I CHAPTER – XVI

1.16 Hydraulic test

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

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

- 1.16.1 The pressure testing for boiler / piping system/ other equipments shall be carried out as per IBR / Customer / customers' consultant specification / BHEL. Customers' consultant specification forms the part of this tender specification.
- 1.16.2 All pressure parts and some of the Low Pressure parts shall be subjected to hydraulic test as per the Standard / statutory requirements. The contractor shall supply necessary labour and other services and make necessary arrangements to carry out the required tests as per the instructions and directions of the BHEL Engineers within the quote rates.
- 1.16.3 The contractor shall make all necessary arrangements including making of temporary closures on piping / equipment for carrying out the hydro-static testing on all piping, equipment covered in the specification at no extra cost.
- 1.16.4 Soundness of the welds shall be tested hydraulically under the supervision of the BHEL Engineer and Customer, to the pressure indicated in the drawing. Prior to the test, the boiler / piping system shall be inspected by the BHEL Engineer to the extent necessary to ensure compliance with clearance for the test, which will be obtained by the contractor from the Engineer.
- 1.16.5 Hydraulic testing, as required shall be carried out by the contractor. The servicing, installation, electrical connection, erection, testing and dismantling of Hydraulic Test pump, temporary pipelines, fittings, etc. shall be carried out by the contractor as part of this work.
- 1.16.6 All the hydraulic tests shall be repeated till all the pipelines / boiler/ other equipment etc. to satisfy the requirements / obligation of BHEL to their customer. As far as the hydraulic pressure test is concerned, the same shall be conducted at various stages to the satisfaction of IBR inspectorate / BHEL / Customer Engineers. Any rectifications required shall have to be done / redone by the contractor at his cost. The contractor shall carry out all the required tests and pre-commissioning and commissioning activities required for successful and reliable operation. These would include hydraulic test of piping, pre-boiler system detergent flushing/chemical cleaning, steam blowing, water washing etc. as instructed by BHEL.
- 1.16.7 Test records shall be made for pressure testing of above piping system. These records shall contain the following information:

a) Date of test

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

- 1.16.8 Contractor has to arrange required pumps with sufficient capacity for filling water in the tubes and pipes for conducting Hydraulic testing of LP lines. Contractor has to arrange Hydraulic Test pump / Hand Pump at his cost for Hydraulic testing of LP lines.
- 1.16.9 Hydraulic testing pumps for HP lines shall be provided by BHEL free of hire charges. The testing pumps will be issued to the contractor in working condition. Installation, electrical connection, erection, testing and dismantling and returning to BHEL stores, etc., shall be carried out by the contractor as part of this work without any extra charges. In case any servicing of the test pump is to be done during the course of the test, the contractor shall provide the necessary labour for the same and spares will be arranged by BHEL.
- 1.16.10 Contractor shall lay all necessary electric cables and switches etc. required for the hydraulic tests and other tests, flushing etc., and maintain the system till the tests are completed satisfactorily.
- 1.16.11 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.
- 1.16.12 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.
- 1.16.13 Welding and stress relieving of temporary blanks or suitably fixing temporary blank flanges with gaskets and fasteners and welding and providing suitable de-aeration / venting / draining points with valves as per BHEL Engineer's instructions, for performing hydro-test of piping and other equipments is within the scope of work. Gaskets, valves, fasteners will be provided free of cost by BHEL. Contractor shall cut steel blanks from steel provided without charging extra. After completion of hydraulic test, welded blanks shall be cut and removed and weld burrs ground finished and cavities/scars of cutting weld filled and ground as per BHEL Engineer's instructions.

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- 1.16.14 The contractor shall make all necessary arrangements including making of temporary closures / dummy on piping / equipment for carrying out the hydro-static testing on all piping, equipment covered in the specification at no extra cost. Necessary blanks will be provided by BHEL.
- 1.16.15 Hanger adjustment / re-adjustment during erection, before and after Hydraulic Test, before and after steam blowing, during and after full load operation, are to be carried out by the contractor within quoted rate.
- 1.16.16 In general, Hydraulic testing of piping shall be performed after all eventual pipe branches have been completed and valves installed. Should it be required to hasten erection work, pressure tests may be performed by sections. For this scope of work, the erected pipe lines shall be hydraulically tested as per site requirement in segments. For conducting hydraulic test, both ends of pipe lines shall be blanked by welding of plates. Only one or two set of plates and structural materials for blanking required for one segment will be provided by BHEL free of charge. After completion of hydraulic test in one segment, the same plates are to be cut and removed and utilized / welded on the other segment of the pipe lines, to carry out the hydraulic test for the respective segments. No separate plates for blanking for each segment will be provided. After completion of Hydraulic test, the required edge preparations shall be carried out on the end of pipe lines and to be welded with the respective pipe lines. In such cases joint connection shall be checked during a final and additional test, if required. The contractor shall note this aspect and quote accordingly.
- 1.16.17 During hydraulic test, the pipes being tested shall be isolated from the equipments to which they are connected.
- 1.16.18 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.
- 1.16.19 The following specifications shall also be complied with during hydrostatic test.
- a. Vent nozzles with valves shall be provided at the highest point of the runs, to eliminate air pockets. At the lowest point drain nozzles, with valves shall be provided to drain water from pipes. The nozzles and valves shall be of the same materials as the pipe.
 - b. The lowest part of the pipe shall always be filled first with water.
 - c. Pressure shall be slowly increased (without shocks) to the stipulated value and maintained as long as required to visually check all joints.
 - d. Following the control specified above the pressure shall be slowly decreased to the design pressure after which the pipe shall be subjected to the peening test, applying knocks every 150 mm approx. especially in the welded joint areas, with

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- a 0.5 – 1.5 kg. Hammer (depending on the pipe wall thickness). The hammer used shall be a round headed one.
- e. Following the peening test, the pressure shall be increased to the stipulated value and all welded joints shall be visually inspected.
 - f. Following these test, the pipe shall be drained or pumped out to the other section to be hydro test using the drain out pump to be provided by Contractor and wherever necessary shall be flushed with air for all pipes.
 - g. The pressure test is considered satisfactory if no cracks, unjustified pressure reductions, leakages, seepages etc., appear.
 - h. Should defects be found, these shall be repaired in the same manner as these during radiographic examination. Hydraulic test shall be repeated after defects have been repaired.

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VOLUME-IA PART-I CHAPTER-XVII

1.17 Testing and Commissioning

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

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

1.17 TESTING, PRE – COMMISSIONING & COMMISSIONING AND POST COMMISSIONING

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

- 1.17.1 The Contactor shall carry out all the required tests and pre-commissioning and commissioning activities in the equipments under the scope of this contract which are required for their successful and reliable operation of the system. These broadly would include Air leak test of Boiler, ESP, Ducts, SCR, other equipment, hydraulic test of boiler, land flow test, clean air flow test, chemical cleaning of piping and other quipment, water washing, oil flushing of oil system, Gas Distribution Test etc. as per the Drgs/FQPs/manuals, etc and as instructed by BHEL using contractors own consumables, labour and scaffoldings etc. Air leak test on pressure parts preliminary to hydraulic test by compressed air shall also be carried out to check and rectify the various leakage and defects etc. All the chemicals required for carrying out these activities will be supplied by BHEL free of cost.
- 1.17.2 All required tests (Mechanical and electrical) indicated by BHEL and their clients for successful commissioning are included in the scope of these specifications though some of the tests / activities are not listed in these specifications.
- 1.17.3 After completion of erection of furnace, ducts and air heaters, a test shall be performed on the steam generator by the contractor to establish the tightness of the erected equipment from the outlet of Forced Draught (FD) fan through the steam generator upto stack.
- 1.17.4 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.
- 1.17.5 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.

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- 1.17.6 The scope of pre-commissioning activities covers installation of all necessary equipments including temporary piping, supports, valves, blanking, pumps, tanks, with access platforms valves, along with accessories required for hydro test, chemical cleaning, steam blowing or for any other tests. The scope also covers the offsite disposal of effluents.
- 1.17.7 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. On completion, Temporary piping, pumps, valves, flanges, blanks, tanks, 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.
- 1.17.8 All items / material required for Boiler, ESP , SCR, STG, Piping etc. for conducting Air leak test, gas Distribution test, hydraulic test, alkali boil out, acid cleaning/EDTA cleaning steam blowing, Ammonia leak testing any testing required for SCR, etc., will be supplied by BHEL / its customer. However, servicing, dismantling and returning of the same to stores is the responsibility of the contractor who is erecting the equipment / piping. The contractor may note that **no separate payment shall be released** for any temporary works that are to be carried out for conducting pre-commissioning and commissioning tests. Bidders are advised to include expenses on temporary works along with the rates being quoted by them. Broadly the work on temporary systems will be as under:
- Erection of all temporary piping including valves, tanks, effluent pumps, electrical control panel, etc. and cabling along with insulation and supports for Air leak test, steam blowing, chemical cleaning, Ammonia leak testing & any testing required for SCR, etc and effluent disposal are to be carried out as part of work. Contractor will be responsible for their operation and any servicing required during the pre-commissioning activities. He will also service the equipment and handover the equipment to the other agency for further erection / commissioning activities. All the pumps, motors and electrical control panels/ switch gear, valves and actuators will be furnished to the contractor after due servicing.
 - Blowers, blanks, etc. and putty, temporary fixtures & ducts required for conducting air tightness test, etc are to be installed. (Putty to be procured by the contractor).
 - Dismantling of the temporary equipment, piping and return the same to the BHEL stores is also included in the scope of work.

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

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- 1.17.9 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.
- 1.17.10 Commissioning of the Boiler & ESP will involve trial run of all the equipment erected. The boiler has to be lighted up for refractory drying, alkali boil out, acid cleaning / EDTA cleaning, passivation, preservation, steam blowing and floating of safety valves. Chemical cleaning and oil flushing the lub oil lines, Flushing of all the lines by air, oil or steam as the case may be, trial run of the boiler and its auxiliaries, trial run of the fans, Lub. Oil pumps, Mills, servicing of valves dampers, actuators etc., and any other works incidental to commissioning are to be carried out. Contractor shall provide required workers along with supervisors with all the requisite tools round the clock and material for all these works, which shall form part of the work to be done.
- 1.17.11 It shall be the responsibility of the contractor to preserve the boiler as per BHEL's requirement. The required N₂ will be provided by BHEL for boiler preservation if required.
- 1.17.12 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.
- 1.17.13 It shall be specifically noted that the contractor may have to work round the clock during the pre-commissioning, commissioning and post-commissioning period along with BHEL Engineers. Hence contractor's quoted rate shall take into consideration of all expenses that will be incurred for such arrangement of personnel including engineers/supervisors.
- 1.17.14 It shall be specifically noted that the above employees of the contractor may have to work round the clock along with BHEL Engineers and hence overtime payment by the contractor to his employees may be involved. The contractors finally accepted rates should be inclusive of all these factors also.
- 1.17.15 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.

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- 1.17.16 During commissioning, opening / closing of valves, changing of gaskets, packings, re-erection, Re-alignment of Rotating and other equipment, attending to leakage and adjustments of erected equipment may arise. The finally accepted price /rates shall also include all such work.
- 1.17.17 In case any defect is noticed during tests, trial runs and commissioning such as loose components, undue noise or vibration, strain on connected equipment, steam or oil or water leakage etc., the contractor shall immediately attend to these defects and take necessary corrective measures. If any readjustment and re-alignment are necessary, the contractor at his cost shall do the same as per Engineer's instructions including repair, rectification and replacement work. 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. 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.
- 1.17.18 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.
- 1.17.19 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.
- 1.17.20 Replacing/ Cleaning and servicing of all the filters / strainers, in the system shall be done by the contractor within the accepted price. All oils and greases to be filled in the main equipments as first fill and subsequent topping up's will be furnished by BHEL. Frequent cleaning of the Suction Strainers / Basket filters / Bucket filters and other strainers may be required during various commissioning / pre-commissioning period like stem blowing / oil flushing etc., for which sufficient manpower for round the clock to be arranged by the contractor within the quoted rate.
- 1.17.21 At the time of each inspection, the contractor shall take note of the decisions/ changes proposed by the Engineer and incorporate the same at no additional cost.
- 1.17.22 Hydraulic testing pump for Boiler shall be provided by BHEL free of hire charges. The testing pump will be issued to the contractor in working condition. Installation, electrical connection, erection, testing and dismantling and returning to BHEL stores, etc., shall be carried out by the contractor as part of this work without any extra charges. In case

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any servicing of the test pump is to be done during the course of the test, the contractor shall provide the necessary labour for the same and spares will be arranged by BHEL.

- 1.17.23 All pressure parts and some of the Low Pressure parts shall be subjected to hydraulic test as per the Standard / statutory requirements. The contractor shall make necessary arrangements including supplying the Low Pressure Hydraulic test pump and other services to carry out the required tests as per the instructions and directions of the BHEL Engineers within the quote rates.
- 1.17.24 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 may be necessary.
- 1.17.25 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.
- 1.17.26 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. 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 value within quoted value.
- 1.17.27 All the tests shall be repeated till boiler / pipelines / equipments satisfy the requirements / obligation of BHEL to their customer. As far as the hydraulic pressure test is concerned, the same shall be conducted at various stages to the satisfaction of BHEL / Boiler Inspector / Customer Engineers. Any rectifications required shall have to be done / redone by the contractor at his cost.
- 1.17.28 Transportation of oil drums from customer/ 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, gas cylinders etc, 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.

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- 1.17.29 Replacing / cleaning of filters of the erected equipments, piping system etc. during pre-commissioning / commissioning stage are within the scope of work.
- 1.17.30 Contractor shall lay the temporary pipelines with fittings, accessories and erection / commission pumps, tanks, valves, fittings, hangers and supports and other installations as instructed by BHEL, Engineer for the purpose of chemical cleaning / alkali flushing / steam blowing / steam washing / steam flushing / water flushing / water washing / oil flushing etc. of piping and other equipments are in the scope of work. Necessary, materials for this will be provided by BHEL. Overhauling / cleaning / servicing of valves, pumps, fittings in temporary system and acid cleaning tanks etc. prior to the above operations / activities will also be carried out by the contractor at his cost. All the chemicals will be supplied by BHEL free of cost.
- 1.17.31 Chemical cleaning (Acid cleaning of piping / EDTA cleaning / alkali flushing) will involve the installation of temporary piping, valves, cutting of some of the existing valves, placing the rubber, wedges in the valves, gagging of valves, and installation of temporary tanks for chemical and for mixing. Necessary temporary access platforms to mixing tank are to be made by the contractor. The dissolving tank, neutralizing tank etc. required for acid pickling will have to be fabricated by the contractor within 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.
- 1.17.32 Laying of insulation of this temporary piping, tanks are to be carried out by the contractor within quoted rate, and required insulation materials will be provided by BHEL. The welding joints in the temporary pipe lines for acid cleaning and steam blowing are to be welded by HP welders only. Required NDT tests are to be carried out for the above joints as part of work as per customer / BHEL requirement.
- 1.17.33 Steam blowing lines for Oil piping shall be erected as per the instructions of BHEL Engineer. Necessary pipes and other items will be supplied by BHEL free of cost. All arrangements for erection including welding have to be arranged by the contractor as a part of the work. After completion of steam blowing, all the temporary lines to be dismantled and restoration of piping to be carried out, within quoted rate.
- 1.17.34 During steam blowing operations the required manpower shall be arranged by the contractor as per the instructions of BHEL Engineer within the quoted rates. The manpower for the above operation may be required round the clock if necessary. The contractor shall carry out the above operation as per the instructions of BHEL Engineer within the quoted rates.
- 1.17.35 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.
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Necessary low point drains and temporary piping for this will have to be erected by contractor from materials provided by BHEL.

- 1.17.36 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.
- 1.17.37 The contractor as per BHEL requirements will suitably make preservation of cleaned surfaces.
- 1.17.38 Contractor may have to replace old/damaged gaskets / packing etc. for equipments and the same shall be carried out by contractor as per requirement. Materials will be given by BHEL.
- 1.17.39 In case any erection defect is detected during various tests / operations, trial runs as detailed above such as loose components, undue noises or vibration, strain on connected equipment steam or oil or water leakage etc. the contractor shall immediately attend these defects and take necessary corrective measures. The parts to be replaced shall be provided by BHEL free of cost. If the insulation is to be removed to attend any of the defects the cost of removal and reapplication of insulation should be borne by the contractor.
- 1.17.40 Necessary scaffolding and approaches for conducting all the tests / commissioning activities shall also be within the scope of the contract.
- 1.17.41 The contractor shall carryout any other test not listed in the tender but 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.
- 1.17.42 During this period though the BHEL's / Client's staff will also be associated in the work, the contractor's responsibility will be to arrange required tools, man and plants till such time the commissioned units are taken over by BHEL's client.
- 1.17.43 Contractor shall cut / open insulation & other works if needed, as per BHEL engineer's instructions during commissioning for inspection, checking and make good the works after inspection is over. This contingency shall be included within the quoted value. During commissioning, opening of valves, changing of gaskets, attending to leakages, minor modification / rectification works may arise. The contractor has to carry out these works at his cost by providing required manpower in all the three shifts. In case any rework is required because of contractor's faulty erection and which is noticed during commissioning the same has to be rectified by the contractor at his cost.
- 1.17.44 For conducting gas tightness test, it may be required to erect the blowers and connecting ducts and commission the same for tightness test. It is the responsibility of

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the contractor to erect the blowers & dismantle once the test is over. Contractor shall carry out the work within the quoted rate and BHEL will provide blowers and dummies free of cost for conducting the test.

- 1.17.45 Contractor to provide necessary commissioning assistance from pre-commissioning state onwards and up to continuous operation of the unit & handing over to customer. The category of personnel to be as per site requirement and to meet the various pre-commissioning and commissioning programmes made to achieve the schedule agreed with customer.
- 1.17.46 After synchronization, the commissioning activities will continue. It shall be the responsibility of the contractor to provide manpower including necessary consumables, hand tools, supervision as part of commissioning assistance after synchronization till handing over of sets to customer.
- 1.17.47 After floating of safety valves, the commissioning activities and trial operations will continue up to handing over of the unit. Contractor shall provide the manpower as required at site. 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 indicate all these contingencies also. The various categories of workers required for pre-commissioning, commissioning and post-commissioning activities are as follows:
- a) Pipe fitters
 - b) Millwright Fitters
 - c) HP& structural welders
 - d) Riggers
 - e) Unskilled workers
 - f) Supervisors
 - g) Electricians
 - h) Ladders
 - i) Sheet metal fabricator/fitter
 - j) Any other category of workers as may be required.

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

- 1. Two Engineer in charge per shift for three shifts.
- 2. Three supervisors per shift for three shifts
- 3. Three fitters per shift for three shifts
- 4. Ten helpers per shift for three shifts

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5. One electrician per shift for three shifts

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

- 1.17.48 During commissioning any improvement or rectification due to design requirement is involved and if the contractor is asked to carry out the job, they shall be paid at man-day rates. For this purpose, daily labour report indicating therein nature of work carried out, consumables used, etc. shall be maintained by contractor, and got signed by BHEL Engineer every day. It is not obligatory on the part of BHEL to get the works done by the contractor. They can employ any other agency if they so desire at that time.
- 1.17.49 During the stages of pre-commissioning / commissioning / post commissioning, if 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.
- 1.17.50 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.
- 1.17.51 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.
- 1.17.52 D.S.L / equivalent system for hoisting equipment's are also to be erected and commissioned including load testing by the contractor within the quoted rates. Required manpower including electricians is to be arranged by the contractor for carrying out commissioning of electrical hoist and load testing of electrical hoist. Statutory inspection if any required to be arranged by the contractor. Required loads will be provided by BHEL free of cost.
- 1.17.53 Air tightness shall be performed on each pass of precipitator on completion of erection of ESP casing, hopper, inlet and outlet funnels with all internals fitted as per the approved drawings.
- 1.17.54 The activity shall be completed prior to installation of insulation of ESP and the work front for insulation shall be made available to the insulation agency without any delay.
- 1.17.55 TESTING, PRE-COMMISSIONING, COMMISSIONING & POST COMMISSIONING OF ROTARY MACHINES (if applicable)
 - 1.17.55.1 All the bearings, gearboxes etc. of the equipments and electrical motors to be erected are provided with protective greases only. Contractor shall arrange as and when

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required by the Engineer for cleaning the bearings, gears etc. with kerosene or some other agent, if necessary by dismantling some of the parts of the equipment during erection and shall arrange for re- greasing / lubricating them with the recommended lubricants and for assembling back the dismantled parts. Required lubricants and cleaning agent (kerosene etc) shall be arranged by the contractor at his cost. The quoted rate shall inclusive of the same.

- 1.17.55.2 All rotating machineries and equipment shall be cleaned, lubricated, checked for their smooth rotation, if necessary dismantling and refitting before erection by the contractor. If, in the opinion of the BHEL Engineer, the equipment is to be further checked at any stage of the work, necessary facilities for dismantling cleaning, lubricating & refitting shall be provided by the contractor at no extra cost.
- 1.17.55.3 The instructions of the motor manufacturer regarding storage of the motors and reconservation must be strictly followed without any deviation.
- 1.17.55.4 All the motors if necessary shall be stripped open thoroughly serviced with proper care and reassembled properly before erection by the contractor.
- 1.17.55.5 During servicing, if any deficiency is observed, the same should be taken up with BHEL Engineer at site without any delay.
- 1.17.55.6 All the shafts of the rotating equipments shall have to be properly aligned to those of matching equipment to perfection, accuracy as required and the equipment shall be free from excessive vibrations so as to avoid overheating of bearings or other conditions, which may tend to shorten the life of the equipment. All bearings shafts and other rotating parts shall be thoroughly cleaned and lubricated as per the recommendations of BHEL Engineers before starting.
- 1.17.56 TESTING, PRE-COMMISSIONING, COMMISSIONING & POST COMMISSIONING OF STG & AUX. (IF APPLICABLE)
 - 1.17.56.1 Lube oil, seal oil, governing oil, pipelines to Steam turbine, Generator, Pumps, etc. shall be oil flushed. Contractor will have to lay temporary piping to connect the entire system irrespective of whether the equipment/system connected has been erected by the contractor or not. Decisions of BHEL Engineer in this regard will be final and binding on the contractor.
 - 1.17.56.2 Cleaning of oil tank as per instructions of BHEL Engineer before and after oil flushing is the responsibility of the contractor.
 - 1.17.56.3 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 centrifuge bowl for sediments and laboratory tests of the oil samples taken from the system. After declaration of complete oil flushing of system, oil tank, coolers & the system shall be completely drained, thoroughly cleaned and refilled with fresh oil for

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putting the system in operation. The contractor shall provide requisite Man-power like skilled / semi-skilled workmen in three shifts during oil flushing as a part of this contract without any extra charges. Before commissioning of oil system the pipelines should be hydraulically tested using the hydraulic test pump to the required pressure.

- 1.17.56.4 After acid cleaning / pickling of lubricating system (including oil piping, oil tank and other fittings) of rotating machines, oil flushing of lubricating systems as per instructions of BHEL Engineer shall be carried out. Cleaning of all tanks of lubricating oil system of ST, STG and rotating machineries before and after oil flushing is in the scope of work.
- 1.17.56.5 The Contractor shall carry out the air tightness test on generator stator to the satisfaction of BHEL Engineers. The necessary arrangements for testing with dry clean air shall be made by the contractor. Also the contractor has to arrange the mercury manometer and mercury at his cost.
- 1.17.56.6 The contractor shall assist to carry out the following tests in generator within the quoted value:
 - 1.17.56.7 High voltage test of bushings
 - 1.17.56.8 Measurement of DC resistance of rotor and stator.
 - 1.17.56.9 Impedance test of rotor.
 - 1.17.56.10 Measurement of IR values of stator – rotor – RTD Thermocouples etc.
 - 1.17.56.11 The contractor shall carryout kerosene test of all the bearing housing of turbine, generator, pumps & other equipments and do the repair work if any. The contractor at his cost shall also arrange kerosene.
 - 1.17.56.12 All shaft journals and bearings of all the equipments under the scope of this tender shall be periodically inspected and preservation shall be done as per BHEL Engineer's instructions / BHEL quality instruction manuals.
 - 1.17.56.13 All bearings, shaft journals, shafts, and other rotating parts shall be thoroughly cleaned and lubricated as per the recommendations of BHEL Engineers before commissioning / starting.
 - 1.17.56.14 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.
 - 1.17.56.15 The HT motors will also be checked for magnetic center of stator / rotor as part of erection.

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- 1.17.56.16 For conducting Hydro test / steam blowing of MSL, HRH LP BP & CRH Lines, ESV, IV & LP BP Valves & CRH, NRV, internals are to be removed and after Hydro Test / steam blowing the internals are to re-assembled. Hydro Test / steam blow devices are to be fixed. These activities shall be carried out by the contractor as instructed by BHEL without any additional cost.
- 1.17.56.17 TG bearing filters are to be cleaned, as and when required during flushing / commissioning by the contractor at his cost till the unit is handed over to customer.
- 1.17.56.18 Replacing / changing mechanical / other seals, removal and cleaning / replacing of filters etc. during pre-commissioning / commissioning stage is within the scope of work
- 1.17.56.19 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.
- 1.17.56.20 For gas tightness test of gas system of stator, the contractor has to arrange Mercury Mono-meter at his cost.
- 1.17.56.21 Cleaning of the Suction Strainers for all CEPs is in the scope of this contract. Sufficient manpower for round the clock cleaning and as and when required has to be arranged by the contractor within the quoted rate.

VOLUME-IA PART-I CHAPTER-XVII PAINTING

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

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

1.18.1 FINAL PAINTING

- 1.18.1.1 The scope of work shall also include supply and application of final painting of all the erected equipments as required and specified in painting schedules for the components of boiler and its auxiliaries, Rotating Machines, ESP, SCR, FGD, STG & Aux, Piping, Civil Works & structures, etc.
- 1.18.1.2 Required paints, other consumable such as wire brush, brush etc. shall have to be arranged by the contractor at their own cost. The required manpower, other required consumables, T & P etc. shall be provided by the contractor within the quoted rate. The arrangement of primer/paint will be in contractor's scope.
- 1.18.1.3 All welded joints should be painted with anti-corrosive paint, once radiography and stress relieving works are over.
- 1.18.1.4 In the case of steel fabricated items, raw steel after fabrication has to be cleaned and subsequent painting to be carried out.
- 1.18.1.5 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.
- 1.18.1.6 Normally Paint shall be applied by brushing as per the instruction of BHEL Engineer. It shall be ensured that brush marks are minimum. If needed and insisted either by BHEL / 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 within the Quoted rates.
- 1.18.1.7 Before applying the subsequent coats the thickness of each coat shall be measured and recorded with BHEL / Customer.
- 1.18.1.8 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.

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No thinners shall be permitted. Paint manufacturer's instructions shall be followed in method of application, handling, drying time etc.,

- 1.18.1.9 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.
- 1.18.1.10 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.
- 1.18.1.11 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 value. Necessary instrument for measuring the thickness of paint applied is to be arranged by the contractor.
- 1.18.1.12 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. Painting to be done as per the procedure / approved painting schedule given by BHEL Engineer / Manufacturing unit.
- 1.18.1.13 The actual colour to be applied shall be approved by BHEL/ customer before starting of actual painting work.
- 1.18.1.14 Primer & finish paint shall be of reputed paint supplier approved by BHEL / Customer. Contractor has to procure paints from the BHEL / Customer approved agencies only, and the paints should be as per the customer painting specification. The quality of the finish paint shall be as per the standards of IS or equivalent as approved by BHEL / Customer. Before procurement of paint the contractor has to obtain the clearance from BHEL authorities. The batch certificates of paints to be submitted to BHEL Engineer before using the same.
- 1.18.1.15 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.
- 1.18.1.16 Before commencement of final painting, contractor has to obtain written clearance from BHEL / Customer for effective completion of surface preparation.
- 1.18.1.17 Before applying the subsequent coats, the thickness of each coat shall be measured and recorded with BHEL / Customer.
- 1.18.1.18 Wherever applicable, supply and application of primer / final painting of all the insulation items erected under the scope of this tender. The painting shall be as

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required and specified in the painting schedule, which forms the part of this tender book.

- 1.18.1.19 Painting of inner side of sheet metal covering over the insulation walls with two coats of anti-corrosive paint (IS-158) to be applied to the entire satisfaction of BHEL Engineer and application of bituminous sealing compound on cladding/ sheet metal joints shall also be carried out by the contractor. Retainer type 'A' must be coated with Aluminium paint. For which the required amount of paint, other consumables & accessories for painting, cleaning the surfaces etc., shall be arranged by the contractor within the quoted rate.
- 1.18.1.20 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.
- 1.18.1.21 Support tube plates, shell internals, dome internals, steam throw off device (steam side), air extraction piping etc., inside the condenser shall be painted with steam washable paints if required.
- 1.18.1.22 The interior surfaces of water boxes & water side surface of water chambers excluding tube plates are to be painted as per the procedure / approved painting schedule given by BHEL Engineer / Manufacturing unit.

1.18.2 PRESERVATION / TOUCH UP PAINTING

1.18.2.1 PRESERVATION / TOUCH UP PAINTING at BHEL/ Client Stores:

- 1.18.2.1.1 For material preservation at BHEL/ Client Stores, all the preservative consumables like paint, grease etc shall be issued by BHEL free of cost and contractor has to arrange for application of preservatives with their own T&P, consumables like brush, emery sheet etc.

1.18.2.1.2 PRESERVATION / TOUCH UP PAINTING at site of works:

- 1.18.2.1.3 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. The primer paint shall be matching shop primer.
- 1.18.2.1.4 Any rust on the materials shall be cleaned and painted before erection of the material. Cleaning of rust and painting shall be done by the contractor within the rates awarded in the contract and no additional cost will be provided for the same.
- 1.18.2.1.5 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 same

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primer wherever the shop coat has been abraded, removed or damaged during transit / erection, or defaced during welding.

- 1.18.2.1.6 The contractor shall clean, wherever necessary and paint inside surfaces of the equipments like coolers, oil tanks and other components as per instruction of BHEL Engineer during erection at the quoted rate. The Contractor has to arrange necessary paints within the quoted price.
- 1.18.2.1.7 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.
- 1.18.2.1.8 Required paints, other consumable such as wire brush, brush etc shall have to be arranged by the contractor at their own cost. The required manpower, other required consumables, T & P etc shall be provided by the contractor within the quoted rate. The arrangement of primer/paint will be in contractor's scope
- 1.18.2.1.9 Painting of portions of Employer's structures wherever connection/welding is carried out by contractor for supporting structures.
- 1.18.2.1.10 All rectification including painting of Employer's structure which are damaged by contractor during his work.
- 1.18.2.1.11 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 contractor. 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.
- 1.18.2.1.12 The condenser steam space shall be surface protected at least two coats of suitable steam washable paint which is to be supplied within the quoted rates by the contractor. Before the painting is taken up, the contractor shall clean the surfaces thoroughly by shot / grit / sand blasting or with steam mixed with caustic soda. Painting should be carried out by the contractor before tube insertion. Painting to be done as per the procedure / approved painting schedule given by BHEL Engineer / Manufacturing unit during execution.

TECHNICAL CONDITIONS OF CONTRACT (TCC)

- 1.18.2.1.13 The condenser will be dispatched to site from works with surface protection. Wherever the surfaces damaged/ rusted and primer got removed / peeled off, the same shall be made good suitably by Sand / shot blasting or with steam mixed with caustic soda and coated with same paint as per the instructions of the BHEL Engineer before erecting.

VOLUME-IA PART-I CHAPTER-XIX ACCOUNTING OF MATERIAL ISSUE

The steel issued to the contractor by BHEL (for Rate Schedule Id 9) will be accounted as mentioned in this chapter. Reconciliation of all other materials, shall be carried out as specified elsewhere in the tender.

1.19.1 ISSUE OF STEEL

1.19.1.1 The steel shall be issued to the contractor on the following basis:

(a) Structural Steel: Weighment basis (Unit – MT)

1.19.1.2 All the structural steel issued by the BHEL shall be properly accounted for. The total quantity of steel required for the work will be calculated from the approved fabrication drawings (if applicable). The measurement for payment as well as for accounting shall be based on the sectional weights as indicated in the following IS specifications. No rolling tolerances shall be accepted in any case for issue, return of materials, reconciliation and payment purposes.

IS: 808 (Latest revision) Beams, Channels and Angles

IS: 1730 (Latest revision) Plates, Sheets and Strips/Flats

1.19.1.3 In case any such sectional weights are not available in the above documents, the manufacturer recommendation shall be binding.

1.19.1.4 The steel issued to the contractor shall be mainly in standard length and sections as received from the supplier. However, the contractor shall be bound to accept the steel in length as available in the project stores no claims for extra payment because of issue of non-standard length will be entertained.

1.19.1.5 The contractor shall satisfy himself of the quality and quantity of the materials at the time of taking delivery from BHEL stores. No claims whatsoever will be entertained by BHEL because of quality or quantity after the materials are taken by the contractor from BHEL stores.

1.19.1.6 The contractor shall submit to the engineer, a statement indicating estimated quantity of steel required during a quarter, at least two months in advance of the quarter. In addition, the contractor shall also furnish the estimated requirement of steel during a month by the third week of the previous month indicating his requirement.

TECHNICAL CONDITIONS OF CONTRACT (TCC)

- 1.19.1.7 Following shall be limit for the maximum quantity of BHEL issue materials that would be with the contractor at any point of time when work is in progress (excluding what has already been incorporated in the works).

SL. NO.	ISSUE OF MATERIALS	MAX. QTY IN CONTRACTOR'S STORE.
1.	Structural Steel	Requirement of one month

- 1.19.1.8 Bidders to ensure that no lamination materials are taken over by them from BHEL. Fabrication wastage, if any due to above, shall not be compensated by BHEL.
- 1.19.1.9 Bidder to note that steel materials required for MS Grating, Galvanised Grating, GI Handrail, Stainless Steel Handrail, Stop Lock Gate, Stationery Screen, fasteners like MS/ HT/ HSFG bolts/ nuts, lock nuts, washers and foundation bolts, embedded items, etc. other than those supplied by BHEL, etc. shall be supplied by the bidder. However, Bidder shall use the scrap materials (if issued by BHEL) for their use in the permanent works as embedment/ inserts etc. after necessary store issue formalities and shall be accounted for monthly reconciliation.

1.19.2 RETURN OF MATERIALS

- 1.19.2.1 All surplus steel and all wastage materials will be taken back on weighment basis.
- 1.19.2.2 Surplus, unused and untampered steel shall be sorted section-wise and returned separately for a place directed by BHEL/Engineer within the project area. Return of such materials will not be entitled to any handling and incidental charges.
- 1.19.2.3 All wastage / scrap (including melting scrap, wastage, un usable scrap) shall be promptly returned to the stores and a receipt obtained for material accounting purposes. Return of such material will not be entitled to any transportation and incidental charge.

1.19.3 SCRAP & SERVICEABLE MATERIALS:

- 1.19.3.1 All Structural steel of length above 2 M except M.S. Plate shall be considered as serviceable materials provided the materials is in good and acceptable condition. Structural steel in length less than 2 M shall be treated as scrap.
- 1.19.3.2 Plates having both sides greater than 1 Metre OR if any side is less than 1 M but greater than 0.5 M and the total area is equal or greater than 2 Sq. Metre shall be considered as serviceable.

1.19.4 STEEL CONSUMPTION AND WASTAGE

**FOR STRUCTURAL STEEL, (ROLLED SECTION, PLATES ETC.)
CONSUMPTION & WASTAGE**

TECHNICAL CONDITIONS OF CONTRACT (TCC)

A) CONSUMPTION: -

The theoretical consumption of various sections shall be based on approved drawings. Weights shall be calculated considering the sectional weights as per Indian standard. No extra shall payable to the contractor for any deviation in weights for the two different procedures adopted for issue and calculation of the theoretical consumption including rolling tolerances.

i) Actual consumption = Issue – Surplus.

Surplus = Un- tampered, unused, uncut quantity of steel and

Serviceable materials as stipulated under clause “Scrap and Serviceable Materials (Refer Clause 1.19.3 above)” returned by the contractor to BHEL store along with relevant documents.

ii) Wastage = Actual consumption – Theoretical consumption.

B) WASTAGE

Allowable wastage: - 4% (FOUR percent) of the theoretical consumption shall be considered. Wastage shall be considered as cut pieces and scrap material, measured as per actual weighment basis. Invisible wastage (max limit to 0.5%), if any, shall be considered to be included in the specified 4 % allowable wastage.

S. No	CONSUMPTION OF STRUCTURAL STEEL (ROLLED SECTION, PLATES)	BASIS OF ISSUE
S-1	Theoretical consumption (without considering any wastage, scrap or loss) as per spec. & drg.	Free
S-2	Wastage limited to plus Four percent (+4%) of the aforesaid theoretical consumption (S-1) towards allowable wastage including invisible wastages (invisible wastages limited to 0.5% of theoretical consumptions)	Free
S-3	Wastage beyond four Percent (4%) of the aforesaid theoretical consumption (S-1)	Penal Rate

TECHNICAL CONDITIONS OF CONTRACT (TCC)

1.19.5 RECONCILIATION OF MATERIALS

The contractor shall submit a reconciliation statement of steel issued to him along with each RA Bill. At the time of submission of bills, the contractor shall properly account for the material issued to him as specified herein to the satisfaction of BHEL certifying that the balance materials are available in contractor's custody at site. At the time of submission of bills by the contractor, if it is noticed by BHEL that the wastage is high and calls recovery at the penal rate, then, BHEL will proceed for recovery for the excess wastage as per penal recovery rates as specified. The reference drawings for actual material consumption to be used for the purpose of reconciliation shall be drawings prepared by the BHEL and drawings approved by BHEL for fabrication works and such other drawings approved by BHEL.

1.19.6 RECOVERY OF MATERIAL

If wastage exceeds the specified limit, the recovery of excess wastage shall be made from monthly R/A Bill at the Penal Rate.

1.19.7 PENAL RATE OF MATERIALS

Recovery of wastages shall be made from the bills of contractor at the penal rate mentioned in the table below for the following cases:

- a) If the wastage exceeds specified limit
- b) If the wastage not exceeded specified limit, but not returned to BHEL store except invisible wastages
- c) For the not returning the surplus serviceable materials

A	STRUCTURAL STEEL – Long Products Rolled steel Beams, channels, and angles etc in sizes and lengths as available	Rs. 59,630/- per MT + GST and/or other taxes & duties
B	STRUCTURAL STEEL – Flat Products MS plates, MS flats, MS pipes, Chequered Plates, etc in sizes and lengths as available	Rs. 79,065/- per MT + GST or other taxes & duties

TECHNICAL CONDITIONS OF CONTRACT (TCC)

VOLUME-IA PART – II CHAPTER 1

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

SI No: 1

Clause 4.1.11 of SCC is deleted.

SI No: 2:

OCCUPATIONAL HEALTH, SAFETY & ENVIRONMENT MANAGEMENT/ QUALITY ASSURANCE PROGRAMME

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

Chapter IX Clause 9.1 is modified as below:

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

Chapter IX Clause 9.1.1 to 9.1.25 stands deleted.

Chapter IX Clause 9.2 to 9.62 stands deleted.

SI 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.

SI No: 4

The following clause is added under clause 1.10 Security Deposit in General Conditions of Contract (Volume I Book II): “1.10.8 Bidder agrees to submit Security Deposit required for execution of the contract within the time period mentioned. In case of delay in submission of Security Deposit, enhanced Security Deposit which would include interest (Base rate of SBI +6%) for the delayed period, shall be submitted by the bidder. Further, if Security Deposit is not

TECHNICAL CONDITIONS OF CONTRACT (TCC)

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.”

SI No: 5

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

SI No: 6: Reverse Auction

The chapter Reverse auction procedure published in ‘Forms and Procedures’ of Volume I Book-II stands deleted. Revised Reverse Auction Guidelines 2021 available in the website <http://www.bhel.com> shall be applicable.

SI No: 7

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.

SI No: 8

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

SI No: 9

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

SI 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 Part-II of Volume-IA Technical Conditions of Contract.

VOLUME-IA PART – II CHAPTER 2 to 18

In the next 386 pages as below:

Chapter	Details	No of sheets
Chapter - 2	Civil & Structural works – Specification Extract	2
Chapter - 3	Welding Schedule for Boiler	3
Chapter - 4	Painting Schedule for Boiler	10
Chapter - 5	Painting schedule for ESP, APH, FAN, Gates & Damper etc	10
Chapter - 6	Painting schedule for Piping	2
Chapter - 7	Drawings	8
Chapter - 8	Specific HSE Plan for Sub Contractors for Damanjodi project	139
Chapter - 9	General Guidelines for Insulation works	54
Chapter - 10	Guidelines for Heat treatment	18
Chapter - 11	Guidelines for Welding & NDE	98
Chapter – 12	Appendix 1 – SA 8000 compliance format	5
Chapter – 13	Form 15 Rev 02	06
Chapter – 14	Form 14 Rev 01	06
Chapter – 15	Proforma Of Bank Guarantee (In Lieu Of Security Deposit)- Form WAM 22	03
Chapter – 16	Procedure For Conduct Of Conciliation Proceedings	11
Chapter – 17	T&P Hire charges	10
Chapter -18	Painting schedule for FOHS tanks	01



SECTION - IX

CIVIL & STRUCTURAL WORKS

1.0 CIVIL

1.1 Civil design and construction will be done by Purchaser. The scope of work of the tenderer is as follows:

1.1.1 Provide necessary load data for the design of foundation of all equipment as covered in this specification.

1.1.2 Interfacing checking of drawings prepared by the Purchaser/consultant for the furnished input.

1.1.3 Final clearance of foundation for major equipments like Boiler, TG and rotating equipment pedestal above Finish Ground Level (FGL) before taking up the erection activities.

1.1.4 All civil works pertaining to earthing shall be carried out by the Tenderer.

2.0 STRUCTURAL STEEL, PLATFORMS AND STAIRWAYS

The details of the supporting steel structures, platforms and stairways proposed will be as follows:

2.1 Structural Steel

The complete structural steel necessary to support/ suspend the various components and technological equipments, ducts etc. as described in this specification should be furnished by the Tenderer. This will include all auxiliary columns, duct supporting columns, bracing, and all equipment support structure etc.

All structures will be designed for horizontal seismic forces as applicable under the latest revision of IS:1893 and wind forces as per latest revision of IS:875 whichever governs the design in addition to all dead and super imposed loads.

2.2 Design of Structural System

All structural steel work should be designed as per IS 800 and materials consist of low carbon steel material to specification IS 2062 as the case may be.



Section-IX- Civil & Structural works (cont'd)

2.3 Platforms and Stairways

2.3.1 The platforms and stairways proposed should be as follows:

2.3.2 A complete system of platforms and stairways should be furnished for boiler to enable access to the various parts of the unit.

2.3.3 The stairways should be arranged on one side of the boiler. Hand rails should be provided for all stairs and platforms as per standard.

2.3.4 Gratings

Fabricated floor gratings of diamond pattern should be supplied as per Manufacturer's standard.

2.3.5 Stair (step) Treads

Treads should be of diamond pattern fabricated as per general practice.

2.3.6 General

Live load for floors : 500 kg/m² (operating floor)
300kg/m² (for all other floors)

Platforms & walkways : 1200 mm (minimum width)

Stairs : 1000 mm (minimum width)

Slope of stairways : 45 degrees (maximum)

However, any other extra load needs to be considered in addition to the above load shall be considered by the tenderer for design.

2.3.7 Boiler Roof Cladding/Coverings

For the main boiler proper, necessary structural steel work and roof sheeting material (colour coated sheets of 22 SWG) along with the materials required for fixing the roof covering material should be provided.

2.3.8 Piping structures

Existing pipe/cable rack structures wherever used by the Tenderer for their scope of work, stability check to be done. In case, the structures found to be weak necessary strengthening and modification work to be carried out by the Tenderer.

Tentative site joints for NALCO-Unit-6 - 1 x 300 TPH, Cust. No. 7906				
Sl. No.	Size (OD x Thk.) / Weld Size	Material combination	Quantity	Remarks
Economiser system				
1	273X21.44	SA106GRB+SA106GRB	40	TIG +ARC
2	44.5X4.5	SA210GRA1+SA210GRA1	450	TIG
SH system				
1	127X12.5	SA106GRB+SA106GRB	40	TIG +ARC
2	44.5X4.0	SA213T11+SA213T11	120	TIG
3	44.5X7.1	SA213T11+SA213T22	30	TIG +ARC
4	44.5X7.1	SA213T22+SA213T22	30	TIG +ARC
5	323.9X25.4	SA335P11+SA335P11	10	TIG +ARC
6	51X4.5	SA213T11+SA213T11	100	TIG
7	51X4.5	SA213T347H+SA213T347H	100	TIG
8	355.6X27.79	SA335P22+SA335P22	15	TIG +ARC
Circulation system				
1	63.5X5.0	SA192/SA210GRA1+SA210GRA1/SA192	1420	TIG +ARC
2	323.9X25.4	SA106GRB+SA106GRB	30	TIG +ARC
3	323.9X33.32	SA106GRB+SA106GRB/SA234WPB	5	TIG +ARC
4	88.9X6.3	SA106GRB+SA106GRB	140	TIG +ARC
In addition to the above, 2900 bank/screen/wall tubes expansion joints with Dia 63.5/D51 are to be expanded into lower and upper drum.				
Soot Blower Piping				
1	21.3 x 2.77	SA 106 Gr. B + SA 106 Gr. B	13	TIG
2	33.4 x 3.38	SA 106 Gr. B + SA 106 Gr. B	25	TIG
3	60.3 x 3.91	SA 106 Gr. B + SA 106 Gr. B / SA 234 WPB / SA 105 / SA 217 WC6	555	TIG
4	88.9 x 5.49	SA 106 Gr. B + SA 234 WPB	3	TIG +ARC
5	60.3 x 8.74	SA335 P22 + SA182F22CL3 / SA234WP22CL1 / SA217WC6	13	TIG +ARC
6	33.4 x 6.35	SA234WP22CL1 + SA335P22	6	TIG +ARC
7	33.4 x 6.35	SA335P22 + SA182F22CL3	5	ARC
8	21.3 x 4.78	SA234WP22CL1 + SA335P22	2	TIG
9	33.4 x 4.55	SA 106 Gr. B + SA 105	59	ARC
10	48.3 x 3.68	SA 234WP B + SA 105	2	ARC
11	33.4 x 4.55	SA 106 Gr. B + SA 234 WPB	16	TIG
12	63.7 x 10	SA 106 Gr. B + SA 105	1	TIG +ARC
13	21.3 x 2.77	IS 1239 + SA106Gr.B	5	ARC
14	21.3 x 2.77	SA106 Gr.B + SA105	2	ARC
15	34.2 x 3.25	IS 1239 + IS 1239	6	ARC
16	5 	IS2062Fe410A + IS2062Fe410A	39 m	ARC
17	10 	IS2062Fe410A + IS2062Fe410A	28 m	ARC
18	3 	IS 1239 + IS2062Fe410A	53 m	ARC
19	3 	IS 1239 + IS 1239 (OR) IS2062Fe410A	12 m	ARC
20	4 	API5LGr.B + IS2062Fe410A	2 m	ARC
21	5 	IS2062Fe410A + IS2062Fe410A	4 m	ARC
22	5 	IS2062Fe410A + IS2062Fe410A	3 m	ARC
23	4 	API5L Gr.B + IS2062Fe410A	1 m	ARC
24	6 	IS2062Fe410A + IS2062Fe410A	6 m	ARC
25	6 	IS2062Fe410A + IS2062Fe410A	1 m	ARC
26	4 	SA106 Gr.B + IS2062Fe410A	80 m	ARC
27	8 	IS2062Fe410A + IS2062Fe410A	27 m	ARC
28	10 	IS2062Fe410A + IS2062Fe410A	8 m	ARC
29	10 1/2 	IS2062Fe410A + IS2062Fe410A	15 m	ARC
30	5 	IS2062Fe410A + IS2062Fe410A	11 m	ARC
31	5 	SA106 Gr.B +IS2062Fe410A	2 m	ARC

Sl. No.	Size (OD x Thk.) / Weld Size	Material combination	Quantity	Remarks
32	76.1 x 7.1	SA106 Gr.B + SA 105	2 m	ARC
33	12 $\overline{X}$	IS2062Fe410A + IS2062Fe410A	1 m	ARC
34	12 1/2 $\overline{K}$	IS2062Fe410A + IS2062Fe410A	1 m	ARC
35	8 ∇	IS2062Fe410A + IS2062Fe410A	2 m	ARC
36	10 $\overline{X}$	IS2062Fe410A + IS2062Fe410A	1 m	ARC
37	6 ∇	IS2062Fe410A + IS2062Fe410A	115 m	ARC
38	3 ∇	IS2062Fe410A + IS2062Fe410A	6 m	ARC
39	10 $\overline{X}$	IS2062Fe410A + IS2062Fe410A	7 m	ARC
Boiler Trim Piping				
1	140 x 31.9	SA105 + SA 105	3	TIG +ARC
2	140 x 31.9	SA182 F22 CL3 + SA182 F22 CL3	1	TIG +ARC
3	139.7 x 39.7	SA217 WC9 + SA182 F22 CL2	2	TIG +ARC
4	21.3 x 3.73	SA106 Gr.B + SA106 Gr.B (OR) SA234 WPB	44	TIG
5	33.4 x 4.55	SA106 Gr.B + SA106 Gr.B (OR) SA234 WPB	165	TIG +ARC
6	48.3 x 5.08	SA106 Gr.B + SA106 Gr.B (OR) SA234 WPB (OR) SA105	161	TIG +ARC
7	60.3 x 8.74	SA106 Gr.B + SA106 Gr.B (OR) SA105	77	TIG +ARC
8	60.3 x 5.54	SA106 Gr.B + SA106 Gr.B/SA234 WPB/SA216WCB	58	TIG +ARC
9	21.3 x 4.78	SA106 Gr.B + SA106 Gr.B (OR) SA234 WPB	20	TIG
10	21.3 x 4.78	SA335 P22 + SA335 P22 (OR) SA234 WP 22CL1	44	TIG
11	33.4 x 4.55	SA335 P22 + SA335 P22 (OR) SA182F22CL3	88	TIG +ARC
12	33.4 x 4.55	SA106 Gr.B + SA182F12CL2	5	ARC
13	31.8 x 6.35	SA182F12CL2 + SA213TP347H	2	ARC
14	60.3 x 8.74	SA335 P22 + SA335 P22/SA182F22 CL3	46	TIG +ARC
15	21.3 x 4.78	SA106 Gr.B + SA105	40	ARC
16	168.3 x 18.26	SA335 P22 + SA335 P22 / SA234 WP22	20	TIG +ARC
17	168.3 x 18.26	SA217 WC9 + SA335 P22	4	TIG +ARC
18	21.3 x 3.73	SA106 Gr.B+SA105 (OR) SA106 Gr.B	64	ARC
19	33.4 x 4.55	SA106 Gr.B + SA105 (OR) SA234 WPB	275	ARC
20	48.3 x 5.08	SA106 Gr.B + SA105 (OR) SA234 WPB	128	ARC
21	60.3 x 5.54	SA106 Gr.B + SA105 (OR) SA234 WPB	36	ARC
22	21.3 x 4.78	SA335 P22 + SA182F22CL3	55	ARC
23	33.4 x 4.55	SA335 P22 + SA182F22CL3/SA234WP22CL1	109	ARC
24	60.3 x 8.74	SA335 P22 + SA182F22CL3	21	ARC
25	14 x 2.9	SA213 TP347H + SA182 F316/SA182 F304	639	ARC
26	14 x 2.9	SA213 TP347H + SA182 F12 CL2	1	ARC
27	60.3 x 8.74	SA182F12 CL2 + SA182F22	1	TIG +ARC
28	273 x 23	SA216 WCB + SA106GR.B	9	TIG +ARC
29	60.3 x 8.74	SA106 Gr.B + SA182F12CL2	1	TIG +ARC
30	168.3 X 7.11	SA106 Gr.B + SA105	4	ARC
31	168.3 X 7.11	SA106 Gr.B + SA234 WPB	4	TIG +ARC
32	168.3 X 7.11	SA335 P22 + SA234WP22 CL1	2	ARC
33	168.3 X 7.11	SA335 P22 + SA234WP22 CL1	3	TIG +ARC
34	114.3 x 6.02	SA335 P22 + SA387 Gr.22 CL2	2	ARC
35	114.3 x 6.02	API 5L Gr.B + API 5L Gr.B	5	TIG +ARC
36	323.9 x 7.14	SA106 Gr.B + SA106 Gr.B	6	TIG +ARC
37	48.3 x 5.08	SA335 P22 + SA182F22CL3	11	ARC
38	27.3 x 2.65	IS 1239 + SA105	27	ARC
39	34.2 x 3.25	IS 1239 + IS1239	50	ARC
40	5 ∇	API 5L Gr.B IS2062 Fe410A	55 m	ARC
41	5 ∇	SA106 Gr.B + IS2062 Fe410A	9 m	ARC
42	5 ∇	IS2062 Fe410A + IS2062 Fe410A	110 m	ARC
43	8 ∇	IS2062 Fe410A + API5LGr.B	17 m	ARC
44	6 ∇	IS2062 Fe410A + IS2062 Fe410A	83 m	ARC
45	113.9 x 3.6	IS 1239 + IS1239	66 m	ARC

Sl. No.	Size (OD x Thk.) / Weld Size	Material combination	Quantity	Remarks
46	4 	SA106Gr.B + IS2062Fe410A	11 m	ARC
47	13 	IS2062Fe410A + IS2062Fe410A	8 m	ARC
48	7 	IS2062Fe410A + IS2062Fe410A	4 m	ARC
49	10 	IS2062Fe410A + IS2062Fe410A	4 m	ARC
50	10 1/2 	IS2062Fe410A + IS2062Fe410A	7 m	ARC
51	5 	IS2062Fe410A + IS2062Fe410A	55 m	ARC
52	8 	IS2062Fe410A + IS2062Fe410A	2 m	ARC
53	12 	IS2062Fe410A + IS2062Fe410A	2 m	ARC
54	12 1/2 	IS2062Fe410A + IS2062Fe410A	2 m	ARC
55	25 	IS2062Fe410A + SA105	2 m	ARC
56	10 	IS2062Fe410A + IS2062Fe410A	2 m	ARC
57	16 	IS2062Fe410A + IS2062Fe410A	2 m	ARC
58	4 	IS 1239 + IS1239	3 m	ARC
59	3 	SA106 Gr.B + SA240 TYPE 304	22 m	ARC
60	3 	SA335 P22 + SA240 TYPE 304	6 m	ARC
61	5 	SA335 P22 + IS2062Fe410A	2 m	ARC
62	34.2 x 3.25	IS 1239 + IS1239	66	ARC
63	5 	IS2062Fe410A + IS2062Fe410A	6 m	ARC
64	60.8 x 4.5	IS1239 + IS234 WPB	2	ARC
65	5 	IS2062Fe410A + IS2062Fe410A	3 m	ARC
66	355.6 x 7.92	SA106 Gr.B + SA106 Gr.B	6	TIG +ARC

BHARAT HEAVY ELECTRICALS LIMITED
HPVP UNIT - VISAKHAPATNAM - 530012



M/S. NALCO DAMANJODI (Unit-6) 18.5 MW CGPP-1x300 TPH COAL FIRED BOILER
HPVP S.O. No. 7906
PAINTING SCHEDULE

Prepared by	Y.PRASANNA KUMAR Sr MANAGER/Engg.		
Reviewed by	L RAJASEKHAR DGM /HT-Engg.		
Approved by	S.K BISWAS AGM /HOD/Engg.		

**REVIEWED FOR
REFERENCE**

SIGNATURE:

K. Ramani

LETTER REF.: 28812-MD-PWR03-129A

DATE: 24.05.2021

M. N. DASTUR & COMPANY (P) LTD
KOLKATA

RECORD OF REVISIONS

Rev. No	Date	Details of revision	Remarks
00		New	
01	29.02.2020	Painting specification shall be read in conjunction with Annexure-III of Standard painting scheme document no: SIP: H: PP :22, dated:04.08.2018. Note no:19 added.	

Nalco - Damanjodi – Painting schemes

Sl.No.	PGMA / Description	Surface Prepa- ration & Surface Profile	Primer coat		Intermediate coat		Finish coat			Total DFT μm (min)
			Paint	No. of coats	Paint	No. of coats	Paint	No. of coats	Shade	
1 1a	Drum (Except Internals), Drum suspension 04-116,04-210 ,04-146	SSPC – SP3 Power tool cleaning	Red oxide Zinc Phosphate Primer to IS 12744 DFT=30μm per coat	2	--	--	--	--	--	60
2 5	Drum internals 04- xxx	SSPC-SP1/ or SSPC – SP3 Solvent / Power Tool Cleaning	Rust Preventive Fluid to PR: CHEM: 09 – 04 DFT=25μm per coat	1	--	--	--	--	--	25

Sl.No.	PGMA / Description	Surface Prepn &- Surface Profile		Primer coat		Intermediate coat		Finish coat			Total DFT µm (min)
				Paint	No. of coats	Paint	No. of coats	Paint	No. of coats	Shade	
3 1a	Buck stays, Boiler structures Galleries Stair-ways Walkways ID system structures 08-101,08-107,08-400,08-900,19-901,21-600,21-601,21-700,24-346, 35-410,35-420,35-430,35-510, 35-520,35-610,35-611,35-612,35-700,35-810,35-820,35-991,36-210, 36-220,36-230,36-240,36-250,36-260,,36-390, 36-820,37-010,37-810, 37-510,38-010,38-110,38-210,38-310,38-410,38-510,38-610, 38-611, 38-993,39-010,39-110, 39-111,39-112,39-210,39-301,39-302,39-303, 39-700,41-500,41-988,42-010,42-020,42-988, 43-004,43-005,43-104, 43-105,43-200,47-141,47-143,47-149,48-012, 48-482,48-484,48-485,48-492,48-494,48-495, 48-535,48-532,48-700,48-993,48-392,48-997, 65-200,65-710,65-736,65-997,67-200,67-204,67-272,67-276, 67-283,67-710,67-801,67-802,67-803,67-997	SSPC-SP3/ Power Tool Cleaning		PVC copolymer based (or) synthetic enameling alkyd resin based paint with 30 DFT(At Shop)	2			PVC copolymer based (or) synthetic enameling alkyd resin based paint with 30 DFT(At Site)	2**		120

Sl.No.	PGMA / Description	Surface Prepn &- Surface Profile	Primer coat		Intermediate coat		Finish coat			Total DFT μm (min)
			Paint	No. of coats	Paint	No. of coats	Paint	No. of coats	Shade	
4 30	Structures 34-010,34-110,34-120,34-210,34-310,34-410,34-420,34-430,34-510,35-110,35-120,35-130,35-140,35-150 ,35-160,35-210,35-220,35-230 35-310,35-320,35-330,35-340,35-530 & 35-540 SEE NOTES BELOW	SSPC – SP3 Power tool cleaning	Red oxide Zinc Phosphate Primer to IS 12744 DFT=30μm per coat	2	High build epoxy polyamide anamel paint to a DFT of 40μm / coat	1	High build epoxy polyamide anamel paint to a DFT of 40μm / coat(At Site)	1 **	Smoke grey shade no. 692 of IS 5	100
5 2	Loose tubes, SH & Eco.coils, 11-xxx 19-xxx	SSPC – SP3 Power tool cleaning	Red oxide Zinc Phosphate Primer to IS 12744 DFT=30μm per coat	2	--	--	--	--	--	60
6 3	WW, SH ,Eco Headers, SH & Eco lines & links Hot air ducts/dampers 05-137,05-147,05-155,05-175,06-400, 06-611,06-631,06-637,06-647,06-651, 06-655,06-997,07-101,07-200,07-201,07-211, 07-212,07-222,07-226,07-420, 07-401,07-601,07-993,07-997,10-174,10-178, 10-274,10-278, 12-803,12-850, 12-852,12-900,12-901, 12-993,12-997,18-001, 19-701,19-702,19-850,19-851,19-901,19-903,19-906,19-997,19-993,24-100,24-101,24-120,24-125,24-135,24-140,24-145,24-150,24-155,24-175,24-180,24-185,24-350,24-351,24-993,30-103,30-105,30-211,3-215,30-218,30-228,31-010,31-104,31-108,43-004,43-005,43-104,43-	SSPC-SP3/ Power Tool Cleaning	Alkyd Base Red Oxide or Zinc phosphate pigments as Primer to IS 12744 DFT= 40 μm per coat	2	--	--	--	--	--	80

	105,43-200,43-710									

**** : To be applied at site**

NOTE: ONLY SOME DUS OF THESE COMPONENTS UPTO 1 ST MBL SHALL BE APPLIED WITH THIS SPECIAL PAINT SYSTEM . FOR THE REST OF THE DUS, PAINT SYSTEM SPECIFIED IN Sl.No. 3 SHALL BE APPLIED.

Sl.No.	PGMA / Description	Surface Prepn &- Surface Profile	Primer coat		Intermediat e coat		Finish coat			Total DFT µm (min)
			Paint	No. of coats	Paint	No. of coats	Paint	No. of coats	Shade	
6 3	32-010,32-110,32-120,32-310, 32-410,32-510,32-520,32-530,33- 975,35-993, 36-993,39-993,42-001,42-002,42- 005,42-010, 42-020,42-030,42-046,42-065,42- 070,42-120,42-128,42-150,42-152,42- 154,42-157,42-158,42-200,42-300,42- 358,42-700,42-710,42-858,42-988,42- 997,45-200,45-802, 45-805,45-858,45- 997,47-200,47-141,47-143,47-149,47- 710,47-858, 48-012,48-014,48-015,48-019,48- 112,48-114,48-115,48-141,48-142,48- 144,48-145,48-200,48-202,48-204,48- 205, 48-207,48-212,48-214, 48- 222,48-224,48-232,48-234,48-382,48- 384,48-385,48-432,48-434,48-435,48- 462,48-464,48-465, 48-662,48-664, 48-667,48-862,48-864,48-867,48-993, 95-088, 97-084,97-088,97-282,97- 298,97-283,97-590,97-090,97-100,97- 591,97-577,97-592 04-988,20-988,21-987,21-988, 24-987,24-988,24-989,41-988,42-988, 95-988	SSPC-SP3/ Power Tool Cleaning	Red Oxide Zinc phosphate Primer (Alkyd Base) to IS 12744 DFT= 30 µm per coat	2	--	--	Red Oxide Zinc phosphate Primer (Alkyd Base) to IS 12744 DFT= 30 µm per coat	2	--	105
7. 9	09-001,09-002,09-003,20-511,21-800, 21-825,21-850,24-420,24-425,24-435, 24-460,24-465,24-480,24-485,42-300, 42-358,97-195	SSPC-SP3/ Power Tool Cleaning	Heat resistant Aluminium paint to IS 13183 Gr. II	2	--	--	--	--	--	40

8 1a	Floor Grills, Hand Rails etc 34-810,34-850,35-811,35-820,35-850,36-810, 36-850,38-810,38-850,39-810,39-850, 39-850	SSPC-SP3/ Power Tool Cleaning	Red Oxide Zn PO4 Primer to IS 12744 DFT= 30 µm per coat	1	--	--	Synthetic Enamel to IS 2932	2	Black	70

PAINTING SCHEME FOR VALVES

Sl.No.	PGMA / Description	Surface Prepa- ration & Surface Profile	Primer coat		Intermediate coat		Finish coat			Total DFT µm (min)
			Paint	No. of coats	Paint	No. of coats	Paint	No. of coats	Shade	
9	Cast carbon steel valves Cast alloy steel valves All API valves, QCNRV, SV & SRV Silencers	SSPC-SP3/ Power Tool Cleaning	Heat resistant Alumimum paint to IS 13183 Gr. I	2	--	--	Heat resistant Alumimum paint to IS 13183 Gr. I	2	Aluminum	80
	Forged valves	Phosphating	Coating weight 1500 mg per sq.ft.	--	--	--	--	--	--	--
	Soot Blower components 20-001,20-004,20-201,20-204,20-998	SSPC-SP6/ Comml. Blast Cleaning 35-50µm	Red oxide ZnPO4 Primer paint to IS 12744 DFT = 30 µm/coat	1	--	--	Syn. Enamel paint to IS 2932 DFT= 20µm per coat	2	Verdigris Green Shade No. 280 of IS5	70
	HP / LP system	SSPC-SP6/ Comml. Blast Cleaning 35-50µm	Heat Resistant Aluminium Paint to IS 13183 Gr.I	2	--	--	--	--	--	40

10	For CLH & VLH PGs 07,12,19,21,24,47,48 &80	Abrasive blast cleaning to Sa 2 ½ 35 50 microns	Alkyd Base Red Oxide or Zinc phosphate pigments as Primer to IS 12744 DFT= 40 µm per coat	2	--	--	-	-	Phirozi Blue Shade No. 176 of IS5	80

Painting Scheme – Details for procurement & application purposes

SL.No.	Generic nature of paint	Theoretical Covering Capacity Sq.m per Litre.	No. of pack	Volume solids, % (min)**	DFT in microns (min) per coat	Shade	Shade No. to IS5	Mode of appln.	Over coating interval, Hrs.
1	Inorganic zinc silicate coating (F9)	8	2	57	65	Phiroji Blue/ Required shade	176	Spray	12
2	Heat resistant Silicone Aluminium paint (F12)	15	1	-	18	--	--	Brush / Spray	24
3	Red oxide zinc phosphate primer paint as per IS 12744	10	1	As per IS 12744	30	Red Oxide	--	Brush / Spray	12
5	Epoxy zinc phosphate primer (P6)	8	1	49	15-20	Reqd. shade	Corrpd g. Shade no.	Brush / Spray	12
6	Temporary Rust preventive fluid to PR: CHE: 09 – 04	10	1	--	--	Amber	--	--	12
7	Epoxy high build coating (Polyamide cured epoxy resin medium suitably pigmented) F6B	10	2	57	30	Phiroji Blue	176	Spray	24

9	Acrylic Polyurethane finish paint (F2)	8	1	40	30	Phiroji Blue	176	Brush / Spray	12
10	Epoxy high build coating (Polyamide cured epoxy resin medium suitably pigmented) F6B	10	2	57		Light Orange	557	Spray/ Brush	12
11	Acrylic Polyurethane finish paint (F2)					Light Orange	557	Spray	24

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

NOTES:

1. Rust Preventive Coating should be given on HSFG Bolt threads.
2. Machined surfaces are to be applied with a coating of Temporary Rust Preventive oil.
3. All threaded and other surfaces of foundation bolts and its materials, insulation pins, Anchor channels, Sleeves shall be coated with Temporary Rust Preventive Fluid and during execution of civil works; the dried film of coating shall be removed using organic solvents.
4. All shade numbers are as per IS 5. Unless otherwise specified Colour / Shade of the finish coat shall be Smoke gray Shade No. 692 of IS 5.
5. PGMA's under Sub-Vendor items are not indicated. Please refer respective Engg. Document.
6. These Painting Schemes are valid for only Sale order No: 7906
07. No painting is required for Stainless Steel components.
08. Wherever inside surfaces of components under PGMA 48 – XXX, need protection till erection, two coats of Red-oxide zinc chrome primer paint to IS 12744 to a DFT of 60 microns shall be applied.
09. In components, wherever plates / sheets of thickness less than or equal to 5 mm and rods are used, power tool / hand tool cleaning to SSPC - SP3 / SP2 shall be followed and the painting shall be done as described in Scheme No: 05.
10. All PGMA's are deemed to have been included in relevant schemes. Any missing PGMA will be added to the relevant scheme, as and when required.

Enclosures:

1)Annexure -1 for Details of PG-MA

Sl No	Description	Surface preparation	Primer/ DFT in μm	Intermediate DFT	Finish DFT	Total DFT
APH						
1	Components in flue gas path and insulated Rotor post assy (52011), T bars (52013), Rotor housing assy (52030), Hot and cold connecting plate assy (52041,52042); Heating element baskets (without elements) 52010,	Power tool cleaning	Two coats of Red oxide zinc phosphate primer as per IS 12744 DFT 2x30 = 60 μm (min)	NIL	NIL	60 μm (min)
2	Components exposed to Atmosphere: STEAM COIL APH (50510); SPECIAL TOOLS/CONTRA(52000); Rotor drive assy(52100), Access door (52220), Air seal piping (52211), observation port other than glass part (52220), Rotorstoppage alarm other than aluminium (52220), Loose items of air receiver (52220), Guide bearing assy(52261), Support bearing assy (52262), Oil piping-GB,SB(52271,52272), Oil circulation unit(52274), Deluge and wash pipe assy (52301, 52302), Cleaning device assy (52338,52339); AH commissioning spare(52988)	Power tool cleaning	Two coats of Red oxide Zinc phosphate primer as per IS 12744 DFT 2x30 = 60 μm (min)	NIL	Two coats synthetic enamel as per IS 2932 smoke grey shade 692 of IS 5. DFT 2x30 μm = 60 μm (min)	120 μm (min)
3	Heating element baskets (with elements) 52010; Rotor post assembly machined items of (52011), Pin rack assembly (52012), Seals (52013, 52054, 52055), sector plates (52041, 52042) and machined components of APH	Temporary rust preventive oil Dry type, 40 μm (threaded portion); One coats of Red oxide Zinc phosphate primer, 30 μm (non threaded portion)				



Ranipet

**Painting schedule for APH, ESP, FAN, FGD and Gates & Damper for
NALCO DAMANJODI, 1X18.5 MW Project (BHEL WO NO: R181 & R182)**

Doc No: PS:NALC:R181 Rev 00

Date: 21/12/2020

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SI No	Description	Surface preparation	Primer/ DFT in μm	Intermediate DFT	Finish DFT	Total DFT
	Fans					
4	Foundation materials (56011,56021,56031); 56810 RADL FDFAN COUPLING;56820 RADL IDFAN COUPLING;56830 RADL PAFAN COUPLING;56870 SEAL AIR FAN COUPLING(RADIAL)	Temporary rust preventive oil(threaded portion), 40 Microns; One coats of Red oxide Zinc phosphate primer, 30 μm (non threaded portion)				
5	Components exposed to atmosphere: 56000 FAN TOOLS & FIXTURES;_56015 FD FAN CPLNG GUARD;_56025 ID FAN CPLNG GUARD;_56035 PA FAN CPLNG GUARD;56075 SA FAN CPLNG GUARD; 56079 SA FAN MTR CANOPY;_56670 RADIAL SEAL AIR FAN MOTOR;_56910 RAD FDFAN ACCESSORY;56911 FD FAN SILENCER;_56920 RADIAL ID FAN LUBE OIL SYSTEM;56930 RAD PAFAN ACCESSORY; 56931 PA FAN SILENCER	Power tool cleaning	Two coats of Red oxide Zinc phosphate primer as per IS 12744 DFT 2x30 =60 μm (min)	NIL	Two coats synthetic enamel as per IS 2932 smoke grey shade 692 of IS 5. DFT 2x30 μm =60 μm (min)	120 μm (min)
6	Components in Air/ Gas and under insulation: 56114 FD FAN ROTOR;56135 PA FAN ROTOR;56171 SA FAN ROTOR;56226 ID FAN ROTOR;_56310 FD BEARING HSG & ACC;56320 ID BEARING HSG & ACC;56330 PA BEARING HSG & ACC;56370 SA BEARING HSG & ACC;56414RADIAL FD FAN STATOR;56435 PA FAN STATOR;56471 SA FAN STATOR;56510 FD FAN EXPN JOINTS;56526 ID FAN STATOR;56530 PA FAN EXPN JOINTS	Power tool cleaning	Two coats of Red oxide zinc phosphate primer as per IS 12744 DFT 2x30 =60 μm (min)	NIL	NIL	60 μm (min)

Sl No	Description	Surface preparation	Primer/ DFT in μm	Intermediate DFT	Finish DFT	Total DFT

ESP						
7	78401 ROLL/SLIDE SUPPORTS; 78405 ESP-SUB-DELIVERY COMPONENTS; 78410 GD_DRIVE ARRANGEMENT; 78417 DRIVE ARG. FOR EMIT. SYS; 78423 INSPECTION DOORS; 78426 COLL ELEC RAPP DRIVE; 78442 OUTER ROOF-EP; 78455 PENT HOUSE FOR E P; 78461 EP PERF TEST EQUIPT;78464 MISCELLANEOUS ITEMS; 78465 APP PLATFORM-HOPPER;78466 WATER WASHING SYSTEM; 78481 SUPPOTING STRUCTURES FOR ESP; 78489 GUIDE PLATE/VANE EP INLET DUCT; 78988 COMMISSIONING SPARES; 78996 TOOLS & TACKLES; Supporting Structure for ESP(78481), Stair stringer Channels, Bracket, Supp Bracket, Frames Loose Channels , Toe Plates, Stiffener Plates and Angles for EP Galleries ,Stair and Walk Way(78465,78486, 89610)	Power tool cleaning	Two coats of Red oxide Zinc phosphate primer as per IS 12744 DFT 2x30 =60 μm (min)	NIL	Two coats synthetic enamel as per IS 2932 smoke grey shade 692 of IS 5. DFT 2x30 μm =60 μm (min)	120 μm (min)
8	Columns below 0.0 level-	Power tool cleaning	One coat of Chlorinated rubber based zinc phosphate primer to 50μm (min) to be applied.			
9	89610 EP GALLERIES&STAIRS; 89611ESP ROOF HANDRAILS;89612 FLOOR GRILL AND STEP TREAD;89613 FLOOR GRILL AND MOBILE LADDER;Stringer and guard plates, Hand rails, post, step treads, Floor grills	Hot dip galvanizing to a coating weight of 610gm per sq. m (minimum) and to a coating thickness of 85 microns (minimum)				
10	78415 EMITTING ELECTRODES; 78420 COLLECTING ELECTRODE; 78468 FIXING COMP. FOR ESP INSULATIN;78480 FOUNDATION MATLS FOR ESP;EE SUSPENSION HOOK (78313), CE SUSPENSION HOOK (79119)	Temporary rust preventive oil Dry Type 40 μm Temporary rust preventive oil Dry type, 40 μm(threaded portion); One coats of Red oxide Zinc phosphate primer, 30 μm (non threaded portion)				

Sl No	Description	Surface preparation	Primer/ DFT in μm	Intermediate DFT	Finish DFT	Total DFT
11	78406 INSULATOR HOUSING AS;_78408 GAS DIST. ASSY;_78409 GD-RAPPING MECHANISM;_78413 EMIT SYST SUSPENSION;_78416 EMIT ELECT RAPP MECH;_78419 COL ELEC SUSPENSION;_78421 EMIT SYS FRAME-TOP;_78422 EMIT SYS FRAME BOTOM;_78424 SHOCK BARS;_78425 COLL ELECT RAPP MECH;_78428 ESP ROOF BEAM;_78432 EMIT SYS FRAME-MIDDLE;_78443 HOPPER RIDGES;_78444 HOPPER UPPER PART;_78445 HOP MLD&LOWER PART;_78446 INSULATOR SUPP PANEL;_78447 ROOF PANEL ASSY;_78448 CASING STRUCTURE;_78449 CASING SHELL/PANEL;_78450 INLET-OUTLET FUNNEL;_78457 SPLITTER&GUIDE VANES	Power tool cleaning	Two coats of Red oxide zinc phosphate primer as per IS 12744 DFT 2x30 =60 μm (min)	NIL	NIL	60 μm (min)
	Gates and Damper					
12	Gates and Damper Temperature $\leq 80^{\circ}\text{C}$ 57010 GATE-FD FAN OUTLET;57033 DAMPER-SA SCAPH INLET;57110 GATE-PA FAN OUTLET;57141 SEAL AIR HAG AND ID FAN OUTGAT;57143 DAMPER-COLD AIR TO MILL;57209 MTG BKT FOR CL DAMPER AIR CYL;57491 BLOWER WITH MOTOR; 57497 KNIFE GATE VALVE; 57988 DUCTS COMMISSIONING SPARES	Power tool cleaning	Two coats of Red oxide Zinc phosphate primer as per IS 12744 DFT 2x30 =60 μm	NIL	Two coats synthetic enamel as per IS 2932 smoke grey shade 692 of IS 5. DFT 2x30=60 μm	120 μm (min)

SI No	Description	Surface preparation	Primer/ DFT in μm	Intermediate DFT	Finish DFT	Total DFT
13	Gates and Damper Temperature $\geq 80^{\circ}\text{C}$ 57063 DAMPER-SA SCAPH OUTLET; 57083 DAMPER-SA SCAPH BYPASS; 57270 GATE-HOT AIR TO MILLS; 57363 DAMPER-ECONOMIZER BYPASS ISOLN; 57413 DAMPER-ECONOMISER BYPASS CNTRL; 57460 GATE-ESP INLET; 57470 GATE-ESP OUTLET; 57480 GATE-ID FAN INLET; 57490 GATE-ID FAN OUTLET; 57560 GATE-FGD INLET; 57570 GATE-FGD OUTLET; 57583 DAMPER FGD BYPASS; 57603 DAMPER-SCR INLET; 57613 DAMPER-SCR OUTLET; 57623 DAMPER-SCR BYPASS; 57663 DAMPER HOT AIR BUS TO MILL; 57853 DAMPER HOT AIR TO MILL INLET; 57863 DAMPER HOT AIR MILL BYPASS; 57873 DAMPER HOT AIR TO ROCKHOLE PIP; 57883 DAMPER HOT AIR TO MILL OUTLET	Power tool cleaning	Two coats of Red oxide zinc phosphate primer as per IS 12744 DFT $2 \times 30 = 60 \mu\text{m}$ (min)	NIL	NIL	60 μm (min)
14	Gates blades, Machined components of G&D	Temporary rust preventive oil (Dry Type) 40 μm Temporary rust preventive oil Dry type, 40 μm (threaded portion); One coats of Red oxide Zinc phosphate primer, 30 μm (non threaded portion)				
15	57466 PLATFORMS AND LADDERS; 57566 PLATFORMS AND LADDERS-FGD GD	Hot dip galvanizing to a coating weight of 610gm per sq. m (minimum) and to a coating thickness of 85 microns (minimum)				

SI No	Description	Surface preparation	Primer/ DFT in μm	Intermediate DFT	Finish DFT	Total DFT
16	FGD, FW201 ABSORB. RC PUMP NOZZLE;FW202 ABS NOZL NB 300 & ABOVE; FW203 NOZZLE NB25 TO NB250;FW209 MAN HOLE DOOR FOR ABSORBER;FW213 ABSORBER SYSTEM INTERNALS;FW214 ABS BAFFLE GRATING;FW215 MIST ELIMINATOR & ACCESSORIES;FW216 ABS BAFFLE GRATING SUPP;FW217 ABS ME SUPPORT;FW218 ABS SPRAY PIPE SUPP; FW219 ABSORBER SYSTEM-BASE;FW221 ABSORBER SYSTEM-CASING BOTTOM; FW222 ABSORBER SYSTEM-CASING TOP; FW226 EMERGENCY QUENCH WATER TANK; FW227 EMERGENCY QUENCH SYSTEM; FW228 ABSORBER-W/D INTERFACE; FW229 W/D WASH SYSTEM;FW231 ABSORBER SHEAR PLATE;FW232 DUCT SUP BYP & BUF/GGH;FW234 DUCT SUP ABS & STACK/BYP;FW236 STRUCTURES FOR RC PUMP HOUSE;FW239 VIEWING PORTS; FW241 ABSORBER AGITATOR;FW260 DUCT STR BYP & BUF/GGH/ABS; FW262 DUCT STR ABS & BYP/STACK;FW285 SUPRTING STR FOR EMERGENCY QWT;FW293 ELEVATOR AND ACCESSORIES; FW297 PLATFORM FOR DUCT;FW298 PLATFORM FOR G&D;FW300 ABSORBER COLUMNS; FW301 ABSORBER BEAMS AND BRACINGS; FW302 ABSORBER LOWER FLOORS;FW303 ABSORBER UPPER FLOORS;FW307	Power tool cleaning	Two coats of Red oxide Zinc phosphate primer as per IS 12744 DFT 2x30 =60 μm	NIL	Two coats synthetic enamel as per IS 2932 smoke grey shade 692 of IS 5. DFT 2x30=60 μm	120 μm (min)

SI No	Description	Surface preparation	Primer/ DFT in μm	Intermediate DFT	Finish DFT	Total DFT
	ABSORBER MISCELLANEOUS;FW322 ABSORBER SYSTEM-CASING INTERM; FW328 W/D INTERFACE (CARBON STEEL); FW380ELEVATOR,COLUMNN';FW381ELEVAT OR BEAM AND BRACING; FW385 ELEVATOR M/C ROOM & GUIDE ; FW386 INTER-CONNECTING PLTF TO ABS; FW612 GALLARIES AND RAILINGS FOR DAM;FW613 GALLARIES AND RAILINGS FOR DUC;FW701 SLURRY PUMPS & ACCESSORIES;FW702 WATER PUMPS & ACCESSORIES;FW709 TRENCH COVER PLATE;FW710 MONORAIL FOR HOIST & CRANES;FW711 SHIM PLATE FOR PIPE RACK;FW713 CHAIN PULLEYS;FW714 HOISTS;FW717 MAN HOLE DOOR;FW761 STRUCTURE FOR PIPERACKS;FW765 STR FOR SUB PIPE RACK;FW766 PLATFORM FOR PIPE RACK;FW767 PLATFORM SUB PIPE RACK;FW768 TRESTLE FOR MAIN PIPE RACK;FW769 TRESTLE-SUB PIPE RACK; FW789 TEMPLATE-MISC;FW798 AIR RECEIVERS;FW815 RC PUMP INLT & OUTLT VALVE;FW816 MANL BTRFLY VALV- UTLTY;FW817 MOTOR BTRFL VALV- UTLTY;FW818 PNEM BTRFLY VALV-UTLTY; FW819 MAN BTRFLY VALV-LS SLRY; FW820 MOTOR BTRFLY VALV-LS SLRY; FW821 PNEUM BTRFLY VALV-LS SLRY; FW822 MAN BTRFLY VALV-GYP SLRY; FW823 MOTOR BTRFLY VALV -GYP SLRY;	Power tool cleaning	Two coats of Red oxide Zinc phosphate primer as per IS 12744 DFT 2x30 =60 μm	NIL	Two coats synthetic enamel as per IS 2932 smoke grey shade 692 of IS 5. DFT 2x30=60 μm	120 μm (min)



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Painting schedule for APH, ESP, FAN, FGD and Gates & Damper for
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Sl No	Description	Surface preparation	Primer/ DFT in μm	Intermediate DFT	Finish DFT	Total DFT
	FW824 PNEUM BTRFLY VALV-GYP SLRY; FW825 MAN BTRFLY VALV-AIR;FW826 MOTOR BTRFLY VALV-AIR;FW827 PNEUM BTRFLY VALV-AIR;FW828 MAN GATE VALV-UTLTY;FW829 MOTOR GATE VALV- UTLTY;FW830 PNEUM GATE VALVE- UTLTY;FW834 MAIN GLOBE VALV- UTLTY;FW840 CERAMIV VALVES;FW841 CONTROL VALVES;FW842 MAN PINCH VALV-GYP SLRY;FW845 BALL VALVES- WATER;FW848 CHECK VALVES- WATER;FW851 DIAPHRAGM VALV- SLURRY;FW854 ROOT VALV INSTRMNTN; FW861 CSRL PIPE-1 (GS,LS);FW862 CSRL PIPE-2 (GS,LS);FW863 CS PIPING (PW,CW,SW);FW864 SS PIPING (W/D)- other than ss if any.;FW865 GI PIPING (IA, DW)- other than galvanized if any.;FW867 RUBBER GASKET, SHEET- other than rubber if any.;FW868U-BOLTS;FW869 RUBBER EXP. BELLOWS;FW870 PIPING ACC.;FW871 PIPING SUPPORT STR.; FW988 COMMISSIONING SPARES;	Power tool cleaning	Two coats of Red oxide Zinc phosphate primer as per IS 12744 DFT 2x30 =60 μm	NIL	Two coats synthetic enamel as per IS 2932 smoke grey shade 692 of IS 5. DFT 2x30=60 μm	120 μm (min)

Sl No	Description	Surface preparation	Primer/ DFT in μm	Intermediate DFT	Finish DFT	Total DFT
17	Casing bottom, Casing Top- Inside surfaces (FW 219, FW 220, FW221, FW 222), Emergency quench water tank (FW 226)- Inside surfaces Process water tank- Inside surfaces (FW 748)	Power tool cleaning to St-3 (SSPC SP3)	Two coats of Red oxide zinc phosphate primer as per IS 12744 DFT 2x30 =60	NIL	NIL	60
18	FW268 FIXING COMP FOR DUCT; FW269 CLADDING SHEET FOR DUCT; FW280 FOUNDATION MATL FOR DUCT STRUC;FW281 FOUNDATION MATL FOR ABS;FW282 FOUNDATION MATL FOR ELEVATOR; FW283 FOUNDATION MATL RC PUMP SHED;FW760 FOUNDATION MATL FOR PIPE RACKS;FW763 FNDN MATL SUB PIPE RACK;	Temporary rust preventive oil Dry type, 40 μm (threaded portion); One coats of Red oxide Zinc phosphate primer, 30 μm (non threaded portion)				
19	FW207 OUTLET GUIDE VANE; FW251 EXPNSN JNT METALLIC; FW253 EXPANSION JOINT BETWEEN SCRUBR; FW255 DUCT BYP & BUF/GGH/ABS; FW257 DUCT ABS & BYP/STACK	Power tool cleaning	Two coats of Red oxide zinc phosphate primer as per IS 12744 DFT 2x30 =60 μm (min)	NIL	NIL	60 μm (min)
20	FW214 ABS BAFFLE GRATING; FW304 ABSORBER FLOOR GRILLS; FW305 ABSORBER STAIRS & HANDRAILS; FW382 ELEVATOR FLOORS; FW383 ELEVATOR STAIR AND HAND RAIL; FW384 ELEVATOR FLOOR GRILL; Hand rail post, Bend, ERW tubes, step treads, Floor grills, Ladders (FW304,FW305,FW382,FW384,FW383,FW214)	Hot dip galvanizing to a coating weight of 610gm per sq. m (minimum) and to a coating thickness of 85 microns (minimum)				

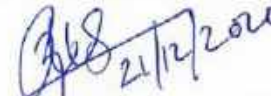
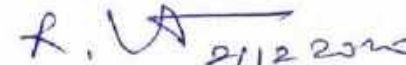
 Ranipet	Painting schedule for APH, ESP, FAN, FGD and Gates & Damper for NALCO DAMANJODI, 1X18.5 MW Project (BHEL WO NO: R181 & R182)	Doc No: PS:NALC:R181 Rev 00 Date: 21/12/2020 Page 10 of 10

SI No	Description	Surface preparation	Primer/ DFT in μm	Intermediate DFT	Finish DFT	Total DFT

Revision No	Date	Record of Revision
00	21/12/2020	Original Issue

Notes

1. Painting of commissioning spares and Mandatory spares shall be as per respective items as above.
2. No painting for SS, Aluminium, non ferrous, stainless steel and Galvanized items.
3. In sub-assy, wherever the plates / sheets of thickness less than or equal to 5mm and rods are used, Power tool cleaning or Hand tool cleaning to SSPC- SP3/ SP2 shall be followed. Painting scheme for SI no 2 of APH can be used in that case.
4. All components covered under different SL no. are to be painted. Incase any component is left out, the same shall be deemed to be included under the relevant section.
5. Painting of damaged surfaces will be same as the painting scheme in this specification with power tool cleaning.

Prepared by	Reviewed by	Approved by
 21/12/2020 Abdul Ghani Senior Engineer/QA	 21/12/2020 K Renjith Manager/QA	 21/12/2020 R.Arunachalam DGM/QA(Mech)



PAINTING SCHEME FOR PIPING

INSULATED & UNINSULATED PIPING, STRUCTURES, HANGERS & SUPPORTS, SUB DELIVERIES ETC.

QP NO: 7467:QPC:11

PROJECT NAME

NALCO DAMANJODI (1X18.5 MW) STG

REV. NO: 00

CUSTOMER / CONSULTANT:

NALCO / M.N. DASTUR & COMPANY (P) LTD.

BHEL CUSTOMER NOS

7467, 7468

DATE: 27.03.2021

S. No	PGMA / DESCRIPTION	SURFACE PREPARATION	PRIMER COAT			INTERMEDIATE COAT			FINISH COAT			SHADE	TOTAL DFT (MIN.)	REMARK
			PRIMER	NO OF COATS	MIN DFT PER COAT	PAINT	NO OF COATS	MIN DFT PER COAT	PAINT	NO OF COATS	MIN DFT PER COAT			
(I)	(II)	(III)	(IV)	(V)	(VI)	(VII)	(VIII)	(IX)	(X)	(XI)	(XII)	(XIII)	(XIV)	(XV)
1	INSULATED PIPING COMPONENTS WITH SURFACE TEMP > 60 Deg C (includes HFO piping)	SSPC SP3 / Power Tool Cleaning	Red Oxide Zinc phosphate Primer (Alkyd Base) to IS12744	2	40 Microns	---	---	---	---	---	---	---	80 Microns	
2	UNINSULATED PIPING COMPONENTS WITH SURFACE TEMP ≤ 60 Deg C	SSPC-SP10 / SA 2.5 (Blast Cleaning)	Red Oxide Zinc phosphate Primer (Alkyd Base) to IS12744	2	40 Microns	Epoxy Based MIO pigmented intermediate coat	1	70 Microns	Synthetic Enamel Paint (Long Oil Alkyd) to IS2932	2	25 Microns	Smoke Grey Shade No.692 of IS 5	200 Microns	
3	STRUCTURES, VESSELS, WITH SURFACE TEMP >80 Deg C & <150 Deg C	SSPC-SP10/ SA 2.5 (Blast Cleaning)	Inorganic Ethyl Zinc Silicate Primer to IS14946	2	25 Microns	---	---	---	High Build Epoxy Polyamide Cured Finish enamel Paint to IS 14209	1	70 Microns	Smoke Grey Shade No.692 of IS 5	120 Microns	
4	STRUCTURES, VESSELS, HEAT EXCHANGERS. WITH SURFACE TEMP ≤ 80 Deg C	SSPC SP3/ Power Tool Cleaning	Red Oxide Zinc phosphate Primer (Alkyd Base) to IS 12744	2	25 Microns	---	---	---	Synthetic Enamel paint (Long Oil Alkyd) to IS2932	2	35 Microns	Smoke Grey Shade No.692 of IS 5	120 Microns	
5	CLH and VLH	SSPC-SP10 / SA 2.5 (Blast Cleaning)	Epoxy zinc rich primer to IS 14589 Gr. II %VS=35 (min)	1	40 Microns	---	---	---	Aliphatic acrylic Polyurethane paint %VS=40 (min)	1	30 Microns	Phirozi Blue Shade No.176 of IS 5	70 Microns	Refer Note 2

J.N.T.C.

For Customer/Customer's Consultant use :

 Prepared by
 J.NANTHINI Dy.Mgr / QA&BE

 Approved by
 D.SANDRA PRIYA Dy.Mgr / QA&BE

Page 2/2

BHARAT HEAVY ELECTRICALS LIMITED  PIPING CENTRE, CHENNAI-17 QUALITY & BUSINESS EXCELLENCE	PAINTING SCHEME FOR PIPING		
	INSULATED & UNINSULATED PIPING, STRUCTURES, HANGERS & SUPPORTS, SUB DELIVERIES ETC.		QP NO: 7467:QPC:11
	PROJECT NAME	NALCO DAMANJODI (1X18.5 MW) STG	REV. NO: 00
	CUSTOMER / CONSULTANT:	NALCO / M.N. DASTUR & COMPANY (P) LTD.	
	BHEL CUSTOMER NOS	7467, 7468	DATE: 27.03.2021

S. No	PGMA / DESCRIPTION	SURFACE PREPARATION	PRIMER COAT			INTERMEDIATE COAT			FINISH COAT			SHADE	TOTAL DFT (MIN.)	REMARK
			PRIMER	NO OF COATS	MIN DFT PER COAT	PAINT	NO OF COATS	MIN DFT PER COAT	PAINT	NO OF COATS	MIN DFT PER COAT			
(I)	(II)	(III)	(IV)	(V)	(VI)	(VII)	(VIII)	(IX)	(X)	(XI)	(XII)	(XIII)	(XIV)	(XV)
6	Pipe Clamps	SSPC SP3 / Power Tool Cleaning	Red Oxide Zinc phosphate Primer (Alkyd Base) to IS 12744	2	25 Microns	---	---	---	Synthetic Enamel paint (Long Oil Alkyd) to IS2932	2	35 Microns	Smoke Grey Shade No.692 of IS 5	120 Microns	Refer Note 3
7	LDO piping	SSPC-SP10 / SA 2.5 (Blast Cleaning)	Red Oxide Zinc phosphate Primer (Alkyd Base) to IS12744	2	35 Microns	---	---	---	Synthetic Enamel Paint (Long Oil Alkyd) to IS2932	2	35 Microns	Smoke Grey Shade No.692 of IS 5	140 Microns	
8	SUB DELIVERY ITEMS (80901 PGMA)	As per manufacturer standard with a minimum of two primer coats and one finish coat with a total dry film thickness of not less than 105 microns. (Tender CI3.11.3)												
9	SS, GI & GUN METAL SURFACE	No Painting												

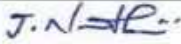
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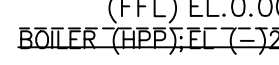
1. Surface Preparation and Painting shall be carried by the Vendor / Supplier after satisfactory completion of inspection and testing as per the approved Painting Scheme. **Detailed painting certificate in the format FM VIA (Rev 01) to be submitted to Consultant.**

2. Components Other than CLH and CLH coming in H&S PGMA's shall be painted as per SI.no.4.

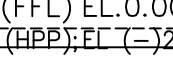
3. Smoke Grey shade for Carbon Steel clamps, White shade for Alloy Steel clamps.

APPROVED	
SIGNATURE: 	
LETTER REF.: 28812-MD-PWR03-148A	
DATE: 05-06-2021	
M. N. DASTUR AND COMPANY (P) LTD. KOLKATA	
Approved by the Purchaser / Consulting Engineer does not relieve the Contractor of his responsibility for the correctness of design, detail, manufacture and satisfactory performance of the equipment.	

		For Customer / Customer's Consultant use :	Page 2/2
Prepared by J.NANTHINI Dy.Mgr / QA&BE	Approved by D.SANDRA PRIYA Dy.Mgr / QA&BE		



SIDE ELEVATION (VIEW-XX)

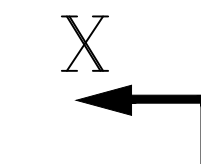


FRONT ELEVATION

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	CONSULTANT	 DASTAR	M. N. DASTAR & COMPANY (P) LTD CONSULTING ENGINEERS, KOLKATA
	PROJECT	INSTALLATION OF STEAM AND POWER PLANT FOR 5th STRE ALUMINA REFINERY EXPANSION AT DAMANODI, ODISHA UNDER PHASE-3 - EXPANSION OF MHR COMPLEX 13300 t/h ; 69.5 kg/cm ² (g); 487°C	
		BHARAT HEAVY ELECTRICALS LIMITED, UNIT: HEAVY PLATES & VESSELS PLANT, VISAKHAPATNAM-530012	
DATE DRG. No. DRN P. Srikanth 28-01-21 DRG. No. DRN P.K. Sahoo 28-01-21 DRG. No. DRN P.K. Sahoo 28-01-21		DATE GENERAL ARRANGEMENT OF BOLTER SIDE & FRONT ELEVATION	
ALL DIMENSIONS ARE IN MILLIMETERS SCALE 1 : 100		DRG. No.	0-00-022-U4222

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0-00-022-U4222



1. G.A OF BOILER SIDE & FRONT ELEVATION	-- 0-00-022-U4222
2. GA OF GAS DUCT FROM ECONOMISER TO APH	-- 0-00-022-U4241
3. LAYOUT OF ID SYSTEM (ELEVATION)	-- 0-00-020-U4239
4. LAYOUT OF ID SYSTEM (PLAN)	-- 0-00-020-U4240

1. WHEREVER FLOOR APPROACH IS NOT POSSIBLE FOR MAINTENANCE, APPROACH LADDERS WILL BE PROVIDED FOR MAINTENANCE OF VALVES/GATES/DAMPERS & OTHER EQUIPMENTS.

NATIONAL ALUMINIUM COMPANY LIMITED
BHUBANESWAR, ODISHA

[illegible]

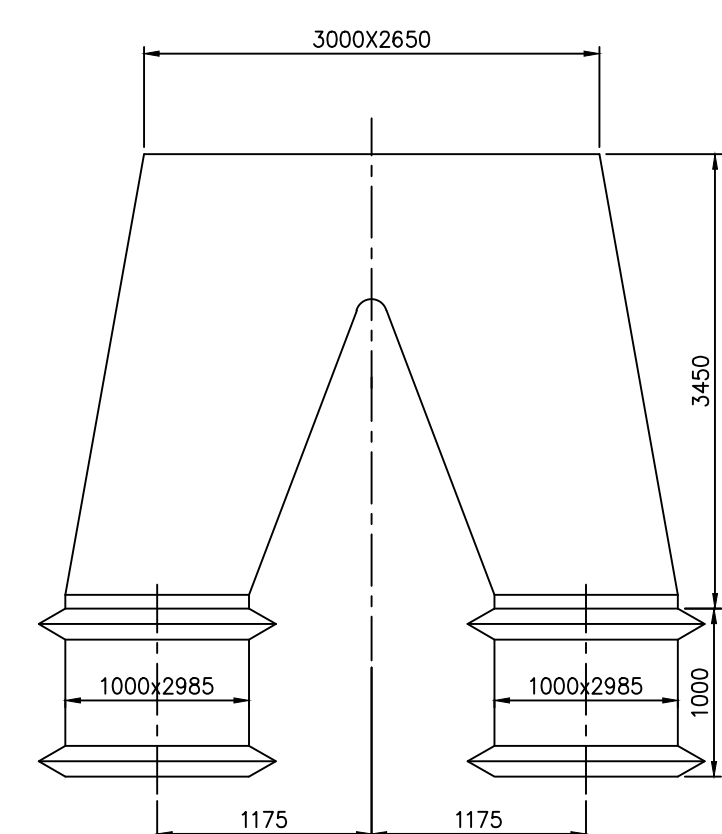
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		GENERAL ARRANGEMENT OF

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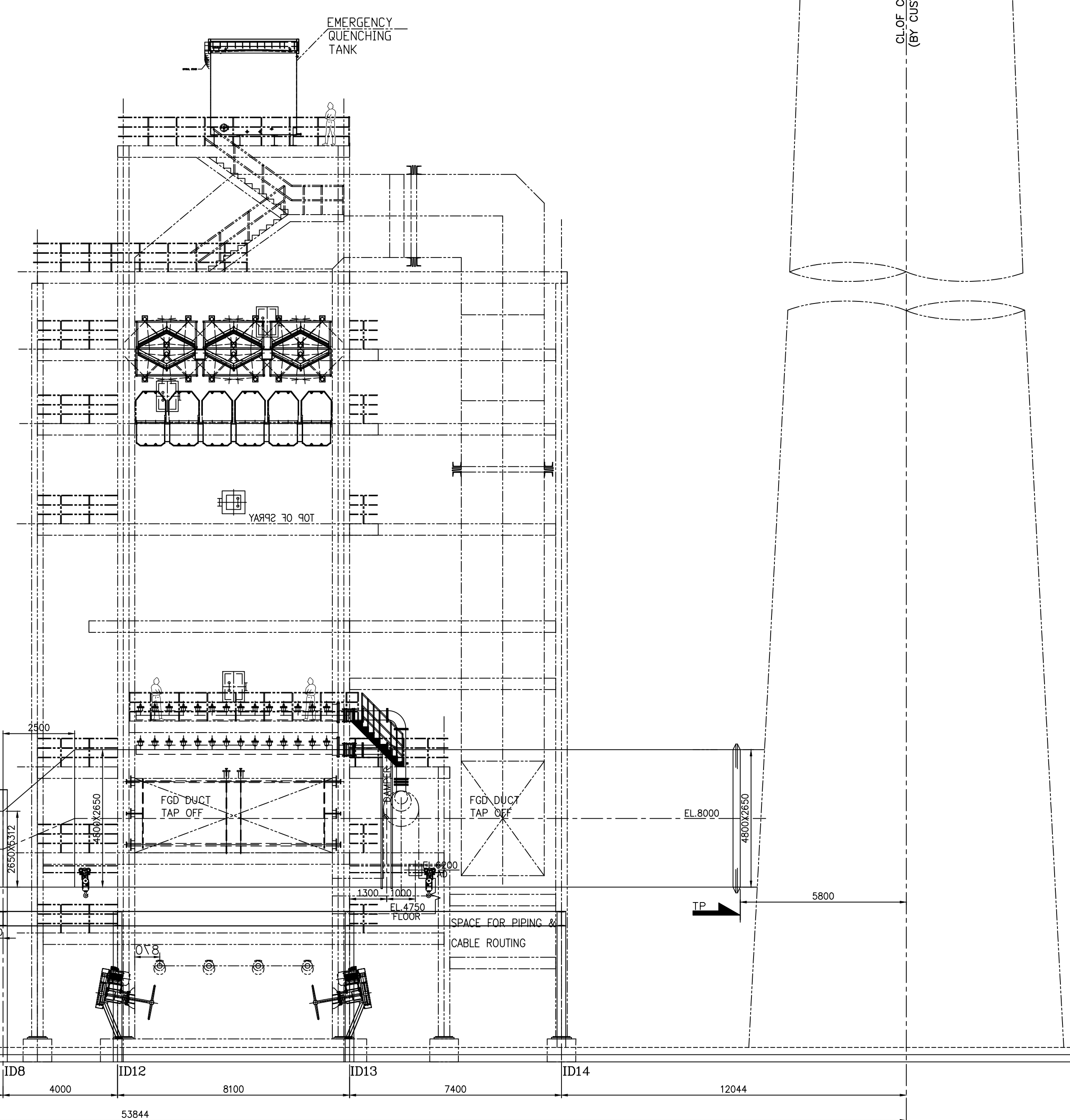
REV.	

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DRG. No.	0-00-022-U4223	REV. 4F

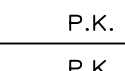


ID FAN OUTLET DUCT DETAIL



SIDE ELEVATION

CUSTOMER NUMBER : 7906

CLIENT		NATIONAL ALUMINIUM COMPANY LIMITED BHUBANESWAR, ODISHA	
CONSULTANT	 DASTUR		M. N. DASTUR & COMPANY (P) LTD CONSULTING ENGINEERS, KOLKATA
PROJECT	INSTALLATION OF STEAM AND POWER PLANT FOR 5th STEAM ALUMINA REFINERY EXPANSION AT DAMAJONDI, ODISHA UNDER PHASE-3 EXPANSION OF M&R COMPLEX 1X300 t/h : 69.5 kg/cm ² (g): 487°C		
		BHARAT HEAVY ELECTRICALS LIMITED, UNIT: HEAVY PLATES & VESSELS PLANT, VISAKHAPATNAM-530012	
359-329			
DRN	NAME	DATE	TITLE
DRN	P. Srikanth	28-01-21	LAYOUT OF ID SYSTEM (ELEVATION)
CHD	P.K. Sahoo	29-01-21	
APPD	P.K. Sahoo	29-01-21	
ALL DIMENSIONS ARE IN MILLIMETERS  SCALE 1 : 110			DRG. No. 0-00-020-U4239
			REV 3

REFERENCE DRGS: -

1. G.A OF BOILER SIDE & FRONT ELEVATION
2. G.A OF BOILER – PLAN
3. LAYOUT OF ID SYSTEM (PLAN)

-- 0-00-022-U4222
-- 0-00-022-U4223
-- 0-00-020-U4240

REV.	DATE	ALTD :	P. K. SAHOO
3	27-03-21	CHD&APPD:	P. K. SAHOO
		REVISED AS PER CUSTOMER COMMENTS	
		DTD.07.04.21	
		DRAWING GENERALLY REVISED.	
REV.	DATE	ALTD :	P. SRIKANTH
	23.04.2021	CHD&APPD:	P. K. SAHOO
2		REVISED AS PER CUSTOMER COMMENTS	
		DTD.15.03.21.	
		DRAWING GENERALLY REVISED.	
REV.	DATE	ALTD :	P. SRIKANTH
	22.02.2021	CHD&APPD:	P. K. SAHOO
1		REVISED AS PER CUSTOMER COMMENTS	
		DTD.04.02.21	



1. G.A OF BOILER SIDE & FRONT ELEVATION	-- 0-00-022-U4222
2. G.A OF BOILER - PLAN	-- 0-00-022-U4223
3. LAYOUT OF ID SYSTEM - ELEVATION	-- 0-00-020-U4239

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	CONSULTANT	 DASTUR	M. N. DASTUR & COMPANY (P) LTD CONSULTING ENGINEERS, KOLKATA	
	PROJECT	INSTALLATION OF STEAM AND POWER PLANT FOR 5th STREAM ALUMINA REFINERY EXPANSION AT DAMANJODI, ODISHA UNDER PHASE-3 EXPANSION OF M&R COMPLEX 1X300 t/h ; 69.5 kg/cm ² (g); 487°C		
		BHARAT HEAVY ELECTRICALS LIMITED.		
	055-029	UNIT: HEAVY PLATES & VESSELS PLANT, VISAKHAPATNAM-530012		
	NAME	DATE	TITLE	
DRN	P. Srikanth	28-01-21		
CHD	P.K., Sahoo	29-01-21	LAYOUT OF ID SYSTEM - PLAN	
APPD	P.K., Sahoo	29-01-21		
ALL DIMENSIONS ARE IN MILLIMETERS			DRG. No.	0-00-020-U4240
 SCALE 1 : 100				

SIDE ELEVATION

ELEVATION

PLAN

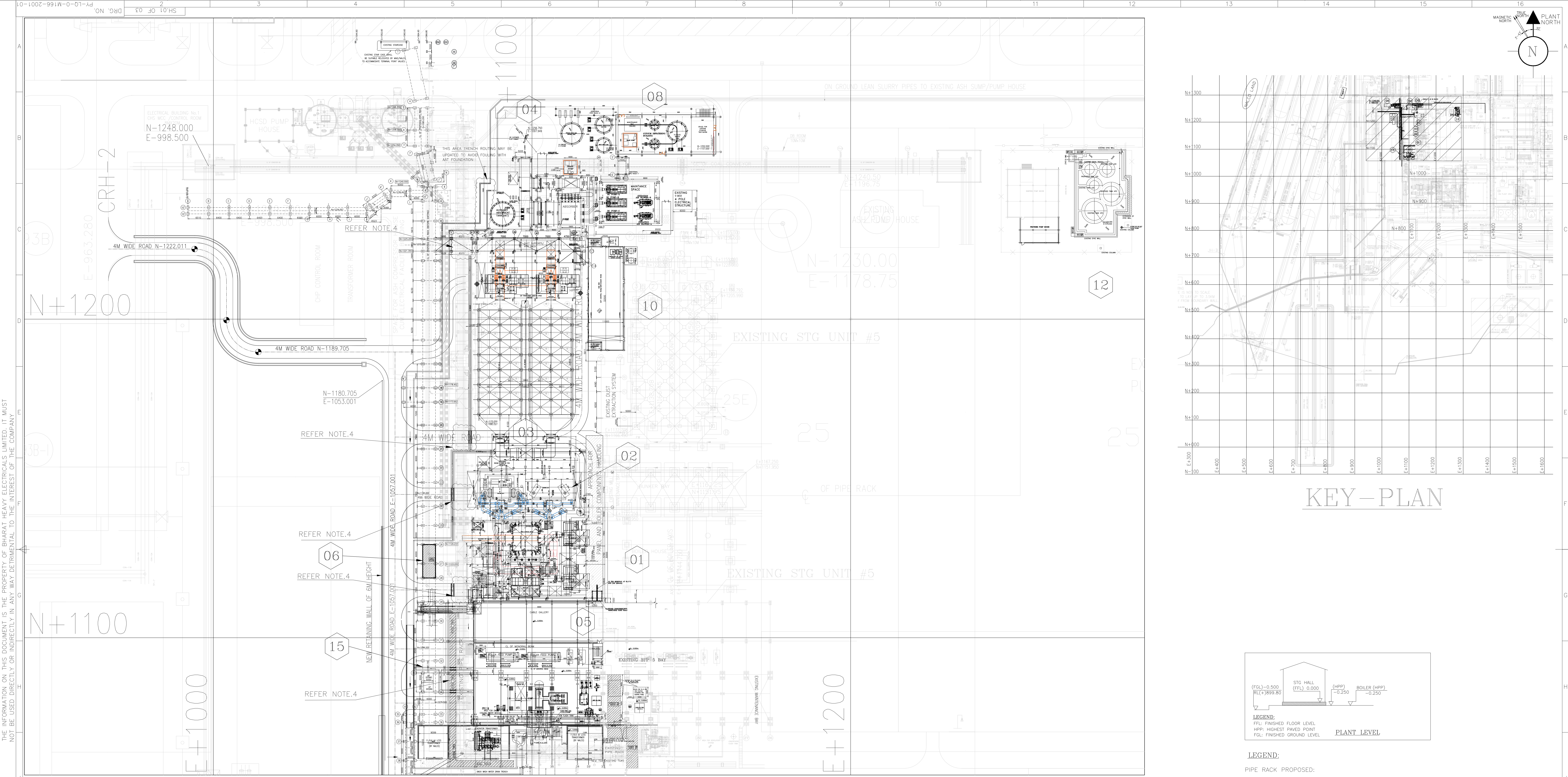
REFERENCE DRGS: —

1. G.A OF BOILER SIDE & FRONT ELEVATION

-- 0-00-022-U422
-- 0-00-022-U422

REV.	DATE	ALTD :	P.
	23-04-21	CHD&APPO:	P.
2	DRAWING GENERALLY REVISED.		
REV.	DATE	ALTD :	P.
	29-03-21	CHD&APPO:	P.
1	REVISED AS PER CUSTOMER C D.TD.15.03.21. DRAWING GENERALLY REVISED.		

CAUTION: THE INFORMATION ON THIS DOCUMENT IS THE PROPERTY OF THE COMPANY. IT IS NOT TO BE USED DIRECTLY OR INDIRECTLY IN ANY MANNER TO THE INTEREST OF THE COMPANY.	CLIENT	 NATIONAL ALUMINIUM COMPANY LIMITED BHUBANESWAR, ODISHA		ORDER NUMBER: 7350	
	APPD				
	CONSULTANT	 DASTUR	M. N. DASTUR & COMPANY (P) LTD. CONSULTING ENGINEERS, KOLKATA		
	PROJECT	INSTALLATION OF STEAM AND POWER PLANT FOR 5th STREAM ALUMINA REFINERY EXPANSION AT DAMANGUL, ODISHA UNDER PHASE-3 EXPANSION OF MAR' COMPLEX IX300 t/h : 69.5 kg/cm ² (g); 487C			
		BHARAT HEAVY ELECTRICALS LIMITED, UNIT: HEAVY PIPES & VESSELS PLANT, VISAKHAPATNAM-530012			
	NAME	DATE	TITLE		
	DRN P. Sarathi	22-02-21	GENERAL ARRANGEMENT OF GAS DUCT FROM ECONOMISER TO ASP		
	P.K. Sarangi	22-02-21			
	P.K. Sarangi	22-02-21			
	ALL DIMENSIONS ARE IN MILLIMETERS SCALE 1 : 100	DRG. NO.	0-00-022-U4241	REV.	



FOR CONTINUATION REFER SHEET.2

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GENERAL DIMENSIONAL LIMITS, FITS & TOLERANCES AS PER HY0230261

COMPUTER FILE NAME

SIGN. AND DATE

REV. DATE ALTERED PARAMESH G

REV. DATE ALTERED PARAMESH G

REV. DATE ALTERED PARAMESH G

DEPT. UNTOL. DIMS. GR. SCALE WEIGHT (KGS) REF. TO ASSY. DRG. ITEM NO. OF ITEMS

TITLE PLOT PLAN

NO. OF SHT. 03

NO. OF SHT. 03

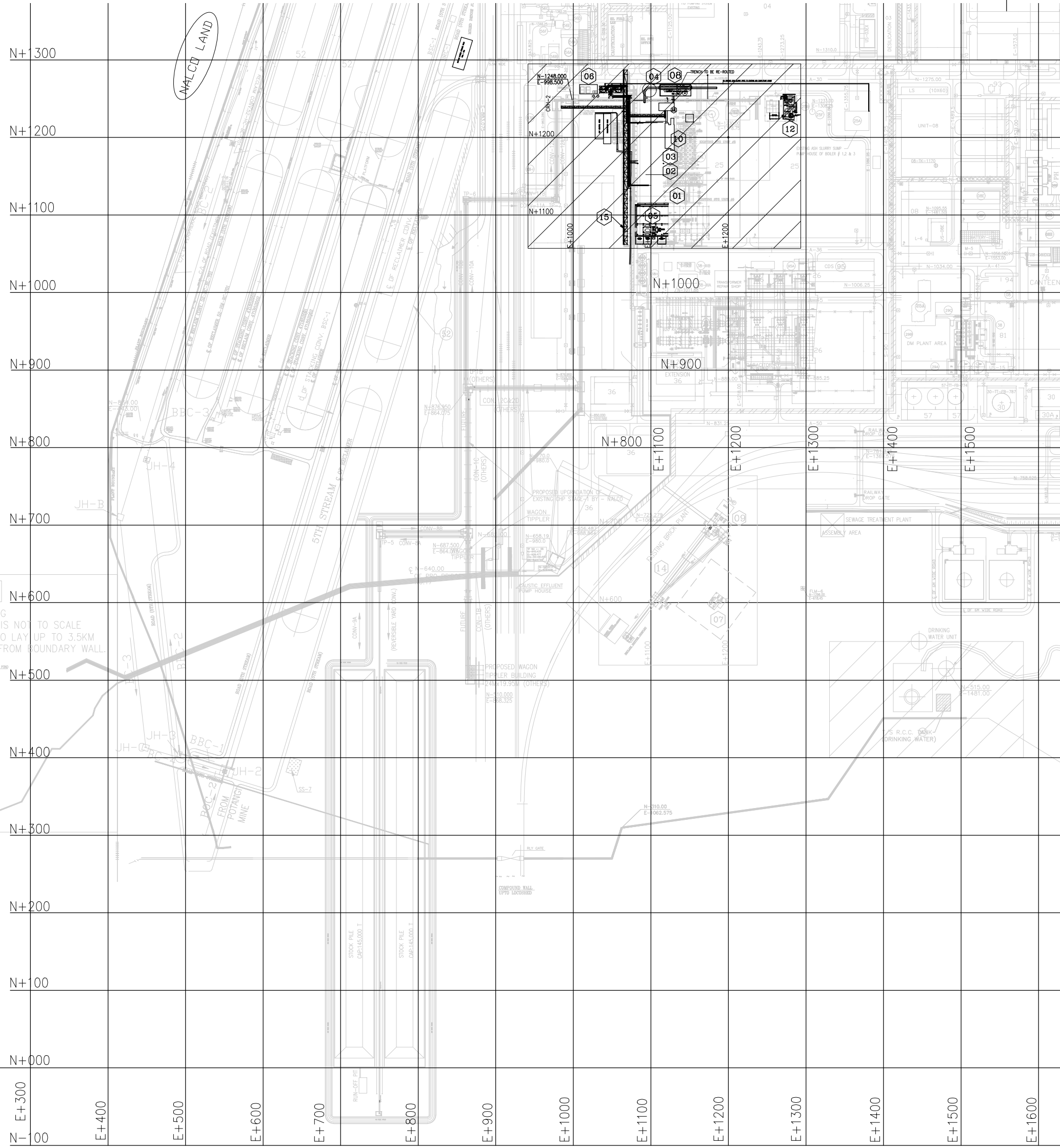
NO. OF SHT. 03

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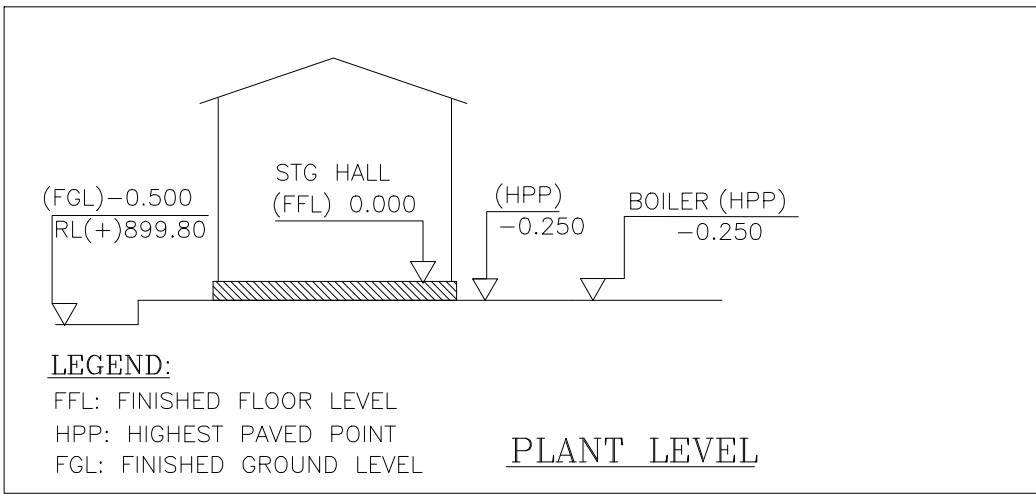
- 1.ALL DIMENSIONS ARE IN mm
- 2.ALL ELEVATIONS ARE IN METER
- 3.FFL EL (+) 0.00 of STG HALL corresponds to RL (+)900.000
- 4.EXISTING PIPE RACK HORIZONTAL BRACINGS TO BE SUITABLY MODIFIED BY MND/NALCO TO PROVIDE ACCESS ROAD OR INTERCONNECTING STRUCTURES BETWEEN NEW PIPE RACK AND NEW TG BUILDING.
- 5.REFER SHEET NO.03 FOR LEGEND (X) (for PROPOSED POWER PLANT FACILITIES)

REFERENCE DRAWINGS:

- 1.POWER PLANT AREA LAYOUT: 28812-000-000-PRJ-0002-RC



KEY-PLAN



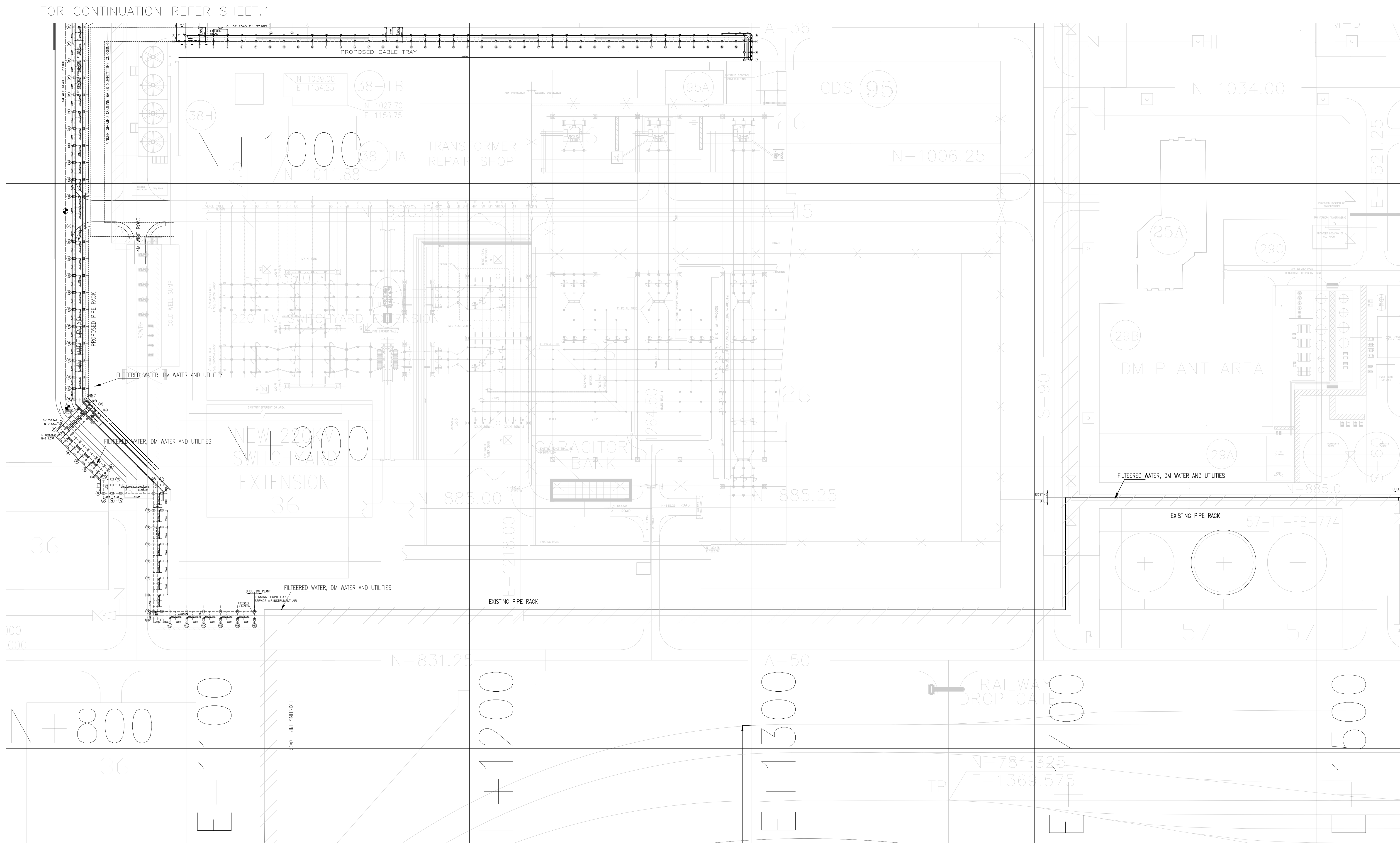
LEGEND:

PIPE RACK PROPOSED:

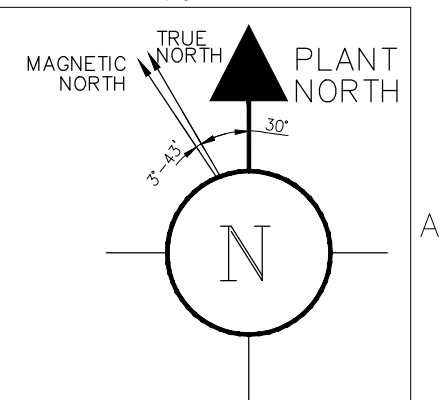
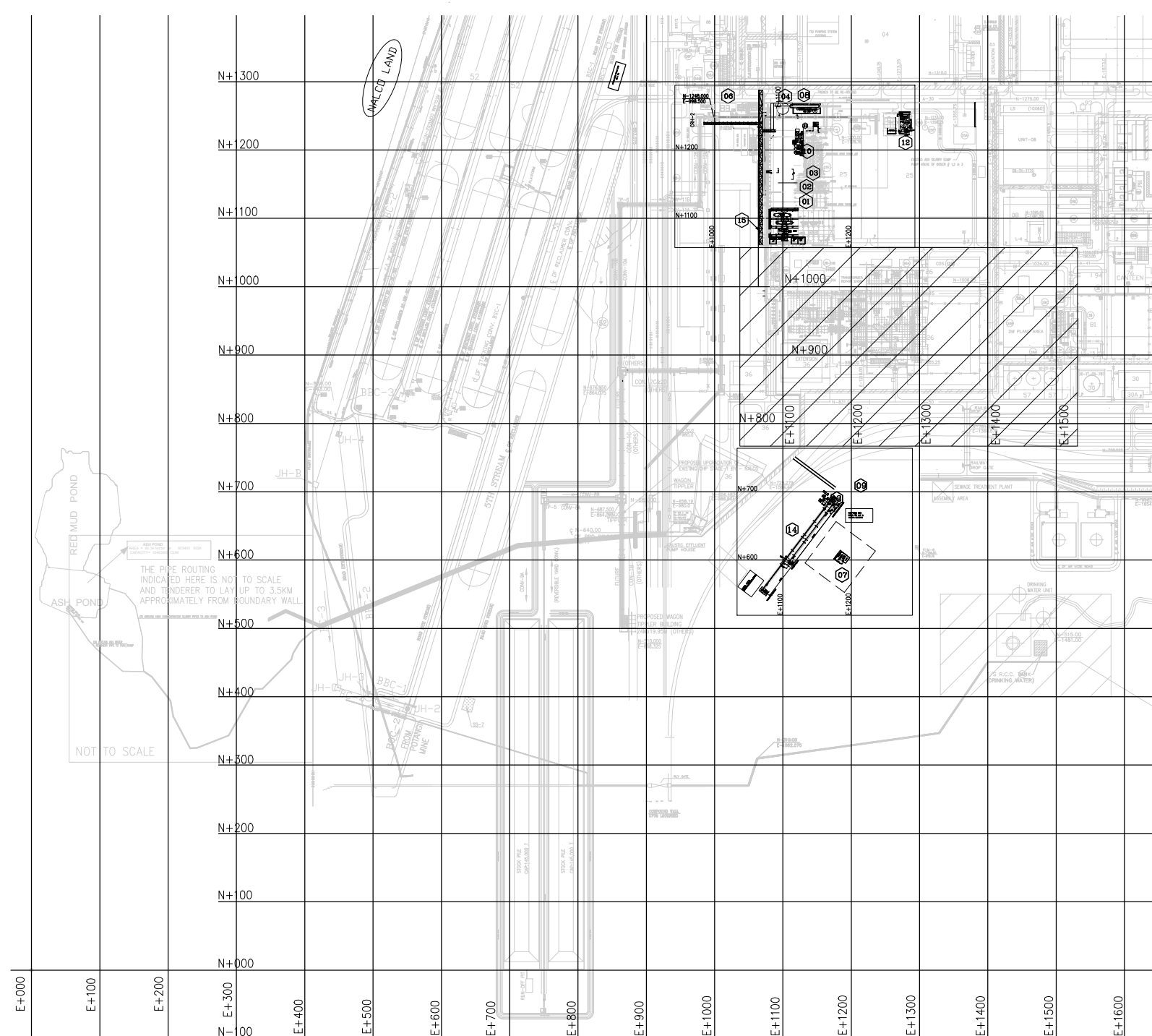
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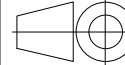
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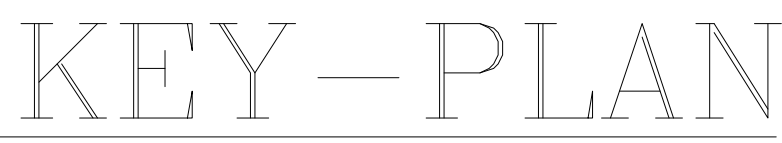
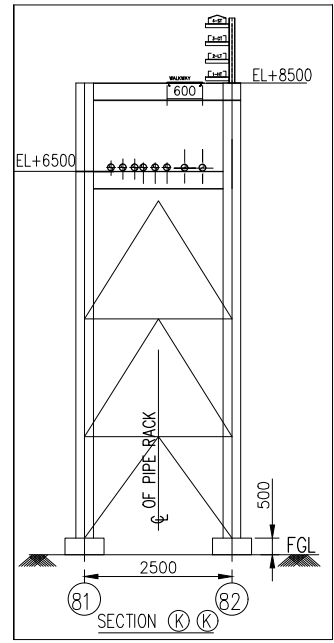
CLIENT	NATIONAL ALUMINUM COMPANY LIMITED BHUBANESWAR, ODISHA			
CONSULTANT	DASTUR M. N. DASTUR & COMPANY (P) LTD CONSULTING ENGINEERS, KOLKATA			
PROJECT	INSTALLATION OF STEAM AND POWER PLANT FOR 5th STREAM ALUMINA REFINERY EXPANSION AT DAMANJODI, ODISHA UNDER PHASE-3 EXPANSION OF M&R COMPLEX			
BHARAT HEAVY ELECTRICALS LTD. HYDERABAD	NAME	SIGN.	DATE	NO. OF VAR.
	DRN: BSA		15.10.20	
	CHD: PARAMESH G		15.10.20	
DEPT.: PL&SD CODE: 450	UNTOL. DIMS. GR.	SCALE	WEIGHT (KGS)	REF. TO ASSY. DRG.
	4/10/16	1:425		-N.A.-
				-N.A.-
TITLE	DRG. NO.	REV.	ITEM NO.	NO. OF ITEMS
PLOT PLAN	PY-LQ-0-M166-2001-01	03		
	SHT. No 01		NO. OF SHT. 03	



FOR CONTINUATION REFER SHEET.3



CLIENT	 NATIONAL ALUMINIUM COMPANY LIMITED BHUBANESWAR, ODISHA										L
CONSULTANT	 M. N. DASTUR & COMPANY (P) LTD CONSULTING ENGINEERS, KOLKATA										
PROJECT	INSTALLATION OF STEAM AND POWER PLANT FOR 5th STEAM ALUMINA REFINERY EXPANSION AT MANAMADI, ODISHA UNDER PHASE-3 EXPANSION OF M&R COMPLEX										
 BHARAT HEAVY ELECTRICALS LTD. HYDERABAD											
				NAME SRN: RMV APPD: PARAMESH C OPHD: UDAY KUMAR V		SIGN. 		DATE 15.10.20 15.10.20 15.10.20		NO OF VAR.	
DEPT.	UNTL.	DMS.		SCALE 1:600	WEIGHT (KG) REF. TO ASSY. DRG.	ITEM NO.		NO OF		M	
450	GR	S.M.F.				-N.A.-		-N.A.-			ITEMS
TITLE PLOT PLAN					CARD NO. N.A.	DRG NO. PLY-LQ -O-M166-2001-01			REV. 02		



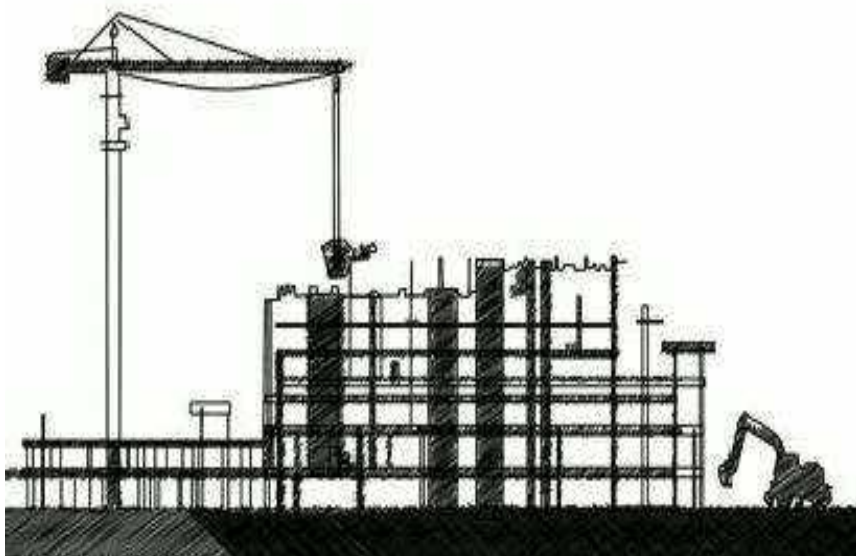
CLIENT	 NATIONAL ALUMINIUM COMPANY LIMITED BHUBANESWAR, ODISHA										
CONSULTANT	 M. N. DASTUR & COMPANY (P) LTD CONSULTING ENGINEERS, KOLKATA										
PROJECT	INSTALLATION OF STEAM AND POWER PLANT FOR 5th STREAM ALUMINA REFINERY EXPANSION AT DAMANODI, ODISHA UNDER PHASE-3 EXPANSION OF M&R COMPLEX										
 BHARAT HEAVY ELECTRICALS LTD. HYDERABAD				NAME		SIGN.		DATE		NO. OF	
				DRN. RAM				15.10.20		PAGES	
				CHD. PARAMESH C.				15.10.20		N.A.	
				APPD. UDAY KUMAR V.				15.10.20		N.A.	
DEPT. PLDSC CODE: 450	UNTO. DIMS. CODE: 504/FH		SCALE 1:450	WEIGHT (KG)	REF. TO ASSY. DRG. -N-A-		ITEM NO.		NO. OF PAGES -N-A-		
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				SHT. NO 03				NO. OF SHT. 03			
				15				16			



HEALTH, SAFETY AND ENVIRONMENT PLAN

For

**SITE OPERATION
For BHEL PSSR
NALCO
DAMANJODI SITE.
1 X 18.5 MW,
BTG PROJECT.**



POWER SECTOR

HSE PLAN FOR SITE OPERATIONS BY BHEL'S SUB-CONTRACTORS

AT A GLANCE

BEFORE START

SIGNING OF MOU

Agree to comply to HSE requirement- Statutory and BHEL's

PLAN

HSE ORGANISATION

Manpower

- 1 (one) safety officer for every 500 workers or part there of
- 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 INFRASTRUCTURE

• 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 1.8 meters), Hot Work, Heavy Lifting, Confined Space, Radiography, Excavation (More than 1.5 meters)

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, Hydra ,Winches & lifting tool and tackles	• 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.

	HEALTH, SAFETY AND ENVIRONMENT PLAN FOR NALCO DAMANJODI SITE	Doc no.: HSEP: 14 REV: 01 Date: 31.03.2021
	POWER SECTOR	

HSE PLAN FOR SITE OPERATION FOR

PROJECT: -

BHEL PSSR NALCO DAMANJODI SITE. 1 X 18.5 MW, BTG PROJECT

SCOPE OF WORK: -

SITE WORK FOR COAL FIRED STEAM GENERATOR, TURBO GENERATOR, Sox & NOx Control System & its Auxiliaries along with associated facilities for steam & power Plant under 5th Stream Alumina Refinery Expansion Project at NALCO Damanjodi, Odisha

LOA No:-

REVISION HISTORY SHEET

Date	Revision No	Details of Changes	Reason	Prepared	Reviewed	Approved
20.1.2021	00	First issue	First issue	Sandeep Dalal, SE/HSE-HQ	M. Shrivastava, AGM/HSE/HQ	M. Shrivastava, AGM/HSE/HQ
31.03.2021	01	Second issue	Discussed with consultant (M/s Dastur) to incorporate few points	Sandeep Dalal, SE/HSE-HQ	M. Shrivastava, AGM/HSE/HQ	M. Shrivastava, AGM/HSE/HQ

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FOR DASTUR/NALCO

CHECKED BY Page 4 of 141

APPROVED BY

NAME
DESIGNATION
DATE

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ASST. MANAGER SAFETY
27.04.2021

MR. SUBHASH MUKHERJEE
ASST. MANAGER SAFETY
27.04.2021

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**HEALTH, SAFETY AND ENVIRONMENT
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1.0 PURPOSE

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.

This document shall be followed by BHEL's Sub-contractor 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.

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. In case the customer has any specific requirement, the same is to be fulfilled.

2.0 SCOPE

The document is applicable for BHEL's Sub-contractor 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 worksite.
- 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 Sub-contractor 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 in to account all persons that may be affected by the work.
- Ensure fitness testing of all T&Ps/Lifting appliances like cranes, Hydra, 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.

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BHEL POWER SECTOR HSE TARGETS

EXPLOSION FATALITY	ZERO
LOST TIME INJURY FIRE	ZERO
VEHICLE INCIDENTS ENVIRONMENTAL INCIDENTS	ZERO
	ZERO
	ZERO

4.0 BHEL POWER SECTOR HEALTH, SAFETY & ENVIRONMENT POLICY

Health, Safety & Environment Policy of BHEL

In BHEL, Health, Safety and Environment (HSE) responsibilities are driven by our commitment to protect our employees and people we work with, community and environment. BHEL believes in zero tolerance for unsafe work/non-conformance to safety and in minimizing environmental footprint associated with all its business activities. We commit to continually improve our HSE performance by:

- Developing safety and sustainability culture through active leadership and by ensuring availability of required resources.
- Ensuring compliance with applicable legislation, regulations and BHEL systems.
- Taking up activities for conservation of resources and adopting sound waste management by following Reduce/Recycle/Reuse approach.
- Continually identifying, assessing and managing environmental impacts and Occupational Health & Safety risks of all activities, products and services adopting approach based on elimination/substitution/reduction/control.
- Incorporating appropriate Occupational Health, Safety and Environment criteria into business decisions, design of products & systems and for selection of plants, technologies and services.
- Imparting appropriate structured training to all persons at workplace and promoting awareness amongst customers, contractors and suppliers on HSE issues.
- Reviewing periodically this policy and HSE Management Systems to ensure its relevance, appropriateness and effectiveness.
- Communicating this policy within BHEL and making it available to interested parties.

sd/-

CMD, BHEL

	HEALTH, SAFETY AND ENVIRONMENT PLAN FOR 1x18.5 MW SPP BHEL PSSR NALCO DAMANJODI SITE	Doc no.: HSEP: 14
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5.0 MEMORANDUM OF UNDERSTANDING:

After award of work, Sub-contractor 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 w h i l e

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 with in prescribed time limit.

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

Name :

Place & Date:

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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 sub-contractors 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 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.

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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:

$$\frac{\text{Number of Reportable LTI} \times 1,000,000}{\text{Total Man Hours Worked}}$$

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:

$$\frac{\text{Days lost due to LTI} \times 1,000,000}{\text{Total Man Hours Worked}}$$

6.1.10 INCIDENCE RATE

Incidence Rate is the Number of LTI per one thousand man power deployed. Mathematically, the formula reads as:

$$\frac{\text{Number of LTI} \times 1000}{\text{Average number of manpower deployed}}$$

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7.1 NUMBER OF SAFETY OFFICERS

The Sub-contractor 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 sub-contractor should deploy sufficient safety officers and safety-steward /Safety-supervisor, as per requirement given above, since very 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.

7.2 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 Supervisor (Construction Agency)	A recognized Degree in Science (with Physics & Chemistry) alternatively Degree or diploma in any branch of engineering / tech with full time diploma in Industrial Safety with construction safety as one of the Subjects.	Minimum two years
3.	Safety Steward (Construction Agency)	As a minimum, he shall preferably possess School-leaving Certificate (of Class XII with Physics & Chemistry etc.) and trained in fire fighting as well as in safety/ occupational health related subjects, and preferably have adequate knowledge of the language spoken by majority of the workers at the construction site.	Minimum two years

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7.3 RESPONSIBILITIES

7.3.1 SITE IN-CHARGE OF SUB CONTRACTOR

- 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 coordinators.
- Shall screen all workers 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 1.8 meter should use Safety Harness tied to a lifeline/ 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 sub-contractor 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, mock drill, medical camps, induction training and training on HSE at site.
- Shall ensure full co-operation during HQ/External /Customer HSE audits.

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- Shall ensure submission of look-ahead plan for procurement of HSE equipment's and PPEs as per work schedule.
- Shall ensure good house keeping.
- Shall ensure adequate valid fire extinguishers are provided at the worksite.
- 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 24v.
- Temporary fencing should be done for open edges if handrails and–railings and toe guards are not available.

7.3.2 HEALTH, SAFETY AND ENVIRONMENT OFFICER OF SUB-CONTRACTOR

- 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 Toolbox / 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 healthy ness.
- 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, Sub-contractor on HSE matters

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8.0 PLANNING BY SUB CONTRACTOR

Monthly planning and review of HSE activities shall be carried out by Sub-contractor as per format No. HSEP:14-F30 jointly along with BHEL.

8.1 MOBILISATION OF MACHINERY/ EQUIPMENT /TOOLS & TACKLES BY SUB CONTRACTOR

- As a measure to ensure that machinery, equipment and tools & tackles 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 & Hydra.
 - Side Booms.
 - Forklifts.
 - Grinding machine.
 - Drilling machine.
 - Air compressors.
 - Welding machine.
 - Generator sets.
 - Dump Trucks.
 - Excavators.
 - Dozers
 - Grit Blasting Equipment.
 - Hand tools.
- Sub-contractor 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 Sub-contractor 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 SUB CONTRACTOR

- The Sub-contractor shall arrange induction and regular health check of their employees as per schedule VII of BOCW rules by a registered medical practitioner.
- The Sub-contractor 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.

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8.3 PROVISION OF PPEs

- Personnel Protective Equipment (PPEs), inadequate numbers, will be made available at site & the irregular 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 selection, 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.

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- Where workers are employed in sewers and manholes, which are in use, the sub-contractor 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:

- Workmen: Yellow
 - Safety staff: Green or white with green band
 - Electrician: Red
 - 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 tanks shall be ensured at least once in 3 months indicating date of cleaning and next due date.
- Potability of water should be tested as per IS 10500 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 sub-contractor 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 workplace.
- 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.

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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 Sub-contractor 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 Sub-contractor 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

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- 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 in side 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 Sub-contractor 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 Sub-contractor to handle any emergency

8.4.9 INSECT AND PEST CONTROL

Regular insect//pest control (Mosquito, Snake, Honey bee should be carried out by sub- contractor at all of his site work area, offices, mainly laboratories, canteen, labour colony and stores etc.

8.4.10 SCRAP YARD

- 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 Sub-contractor 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 workplaces & their approaches including passage ways as per IS: 3646 (Part-II). Some recommended values are given below:



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Sl. 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	300
7.	rough measurements etc.	
8.	Fine work like precision assembly, precision measurements etc.	700
9.	Sheet metal works	200
10.	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 (handheld) 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 break age of lamp.
- Emergency lighting provision for night work shall be made to minimize danger in case of main supply failure.

If the Sub-contractor 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 sub-contractor

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 / Sub-contractor 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)

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- 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 sub contractor'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 worksite.

9.2 HSE TOOL BOX TALK

- HSE tool Box talk shall be conducted by frontline foreman/supervisor of Sub-contractor 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 once 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/ Sub-contractor 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

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- 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

- Sub-contractor shall arrange HSE awareness programme periodically on different topics including medical awareness for all personnel working at site

10. HSE COMMUNICATION

10.1 INCIDENT REPORTING

- The Sub-contractor shall submit report of all incidents, fires and property damage 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 sub-contractor 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 workplace 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 photo graphs 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 MONTHLY, WEEKLY, DAILY, HSE ACTIVITY REPORTING

Monthly, Weekly & Daily HSE activities shall be reported by Sub-contractor to BHEL as per formats issued by BHEL from time to time (as for example refer to Format No. HSEP: 14-F31A).

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10.4 ACCIDENT INVESTIGATION

- The sub-contractor should conduct a thorough, proper, unbiased & scientific accident investigation after Every accidents at site. The accident/ incident shall be investigated by a team of Contractor's senior Site personnel (involving Site-in-Charge or at least by his deputy) for establishing root-cause and recommending corrective & preventive actions. Findings shall be documented and suitable actions taken to avoid recurrences shall be communicated to BHEL/Owner.
- Sub-contractor should actively participate & co-operate (means provide manpower and other resources) in accident investigation committees, RCA (root case analysis) committee etc formed by BHEL/Owner.
- Sub-contractor should preserve documents/evidence related with accidents until an accident investigation is completed.
- BHEL shall have the liberty to independently investigate such occurrences and the sub-contractor shall extend all necessary help and cooperation in this regard. BHEL shall have the right to share the content of this report with the outside world.

10.5 HSE DOCUMENTATION

- The sub-contractor shall evolve a comprehensive, planned and documented system covering the following as a minimum for implementation and monitoring of the HSE requirements and the same shall be submitted for approval by BHEL/Owner
 - HSE Organizational chart
 - Site Specific HSE Plan
 - Safety Procedures, forms and Checklist. Indicative list of HSE procedures/Format is attached as Appendix
 - Inspections and Test Plan
 - Risk Assessment & Job Safety Analysis for critical works.
- The monitoring for implementation shall be done by sub-contractor after regular inspections and compliance of the observations thereof.
- However, compliance of HSE requirements shall be the responsibility of the Contractor. Any review/approval by BHEL / Owner shall not absolve sub-contractor of his responsibility/ liability in relation to fulfilling all HSE requirements.

10.6 OCCUPATIONAL HEALTH

- The contractor shall identify all operations that can adversely affect the health of its workers and issue & implement mitigation measures.
- For surface cleaning operations, sand blasting shall not be permitted even if not explicitly stated elsewhere in the contract.
- To eliminate radiation hazard, Tungsten electrodes used for Gas Tungsten Arc Welding shall not contain Thorium.
- Appropriate respiratory protective devices(hood with respiratory devices) shall be used to protect workmen from inhalation of air borne contaminants like silica, asbestos, gases, fumes, etc.
- Workmen shall be made aware of correct methods for lifting, carrying, pushing & pulling of heavy loads. Wherever possible, manual handling shall be replaced by mechanical lifting equipments.
- For jobs like drilling/demolishing/dismantling where noise pollution exceeds the specified limit of 85 decibels, ear muffs shall be provided to the workers
- To avoid work related upper limb disorders (WRULD) and backaches, Display Screen equipments workplace stations shall be carefully designed & used with proper sitting postures. Power driven hand-held tools shall be maintained in good working condition to minimize their vibrating effects and personnel using these tools shall be taught how to operate them safely & how to maintain good blood circulation in hands.

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- The Contractor shall arrange health check up (by registered medical practitioner) for all the workers at the time of induction. Health check may have to be repeated if the nature of duty assigned to him is changed necessitating health check or doubt arises about his wellness.
- BHEL/Owner reserves the right to ask the contractor to submit medical test reports. Regular health check-ups are mandatory for the workers assigned with Welding, Radiography, Blasting, Painting, Heavy Lift and Height (>1.8m) jobs. All the health check-ups shall be conducted by registered Medical practitioner and records are to be maintained by the Contractor.

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11.0 OPERATIONAL CONTROL PROCEDURES

All applicable OCPs (Operational control procedures) will be followed by sub-contractor 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 sub-contractor will follow this as well, within quoted rate. These OCPs (applicable ones) will be made available to Sub-contractor 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 referred by sub-contractor, 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

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- 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 1.8 meters
- b. Hot working at height
- c. Confined space
- d. Radiography
- e. Excavation more than 1.5 meter depth
- f. Heavy lifting above 20 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 AND GAS CUTTING 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.

- Use trolleys and cradles of adequate strength, as far as possible, while moving the cylinders.
- Always keep LPG and other liquefiable gas cylinders in upright position and ensure that they are not knocked over
- Check that the valves of the gas cylinders are lightly shut when not in use.
- Do not release gas from the cylinder unless pressure regulator is fitted to its valve.
- Use gas hoses specially designed for the purpose with standard colour code
- Use proper clamps for hose connections, check leakage from hose connections before starting work. Never use steel wires for clamping.
- Take care that there are no kinks in the hoses and the hoses are laid such that nobody steps on the hoses and these do not get damaged due to activities in progress in the vicinity.
- Use flame flash back arrestors for both end such as torch and gas cylinder to avoid back firing in flammable gas cylinders.
- Open the valve of oxygen gas first and then flammable gas for lighting the torch
- Use friction gas lighters only for lighting the torch. Never use matches for smoldering manila ropes or rags for lighting the torch.
- Protect the gas cylinders and hoses from welding sparks or gas cutting sparks falling on them

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- Ensure that the valve key is easily accessible to close the valve immediately in case of emergency.
- Never crimp the hose for temporary shutting of gas. Always shut the supply through pressure regulators.
- Check the hoses daily for any visible damage. Discard the hoses in which gas had backfired.
- Remove the leaking cylinder of flammable gas immediately to an open space where it is least dangerous to life and property. Intimate the supplier of the cylinder.
- Ensure use of aprons, gloves and other PPE as appropriate.

11.3.2 RIGGING SAFETY

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 up right 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.

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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 over loaded with debris or materials as to render them unsafe.
- Before commencement of demolition work, permission/permit should be taken from Owner/Consultant.

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 (TPI) of BHEL. Sub-contractor 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 workplace. Where it is necessary to provide and/or store petroleum products or petroleum mixture & explosives, the Sub-contractor 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 Sub-contractor shall be responsible for obtaining the same. MSDS should be displayed at site.

11.3.7 ELECTRICAL SAFETY

- A. Providing adequate no. of 24V sources and ensure that no hand lamps are operating at voltage level above 24 Volts.
- B. Fulfilling safety requirements at all power tapping points.
- C. High/ Low pressure welders to be identified with separate colour clothing. No welders will be deployed without passing appropriate standard holding valid welding certificates. Approved welding procedure should be displayed at workplace.
- D. The sub-contractor 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.
- E. All portable electric tools used by the Sub-contractor shall have safe plugging system to source of power and be appropriately earthed.
- F. Only experienced electricians with a valid license by appropriate statutory authority shall be employed by the Sub-contractor to carry out all types of electrical works.
- G. Details of earth resource and their test date to be given to BHEL safety officer as per the prescribed formats of BHEL
- H. The Sub-contractor shall use only properly insulated and armored cables which conform to the requirement of Indian
- I. 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.
- J. All electrical appliances used in the work shall be in good working condition and shall be properly earthed.
- K. No maintenance work shall be carried out on live equipment.
- L. The Sub-contractor shall maintain adequate number of qualified electricians to maintain his temporary electrical installations.
- M. 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

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- N. 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 place as to caused anger or in convenience to any person or the public
- O. The Sub-contractor shall carefully follow the safety requirement of BHEL/ the purchaser with the regard to voltages used in critical are as.

11.3.8 SHOT BLASTING

Blasting is a specialized job involved a lot of hazards which often lead to accidents. There are many forms of risk associated with blasting work. Before beginning the work, employers should identify the hazards and assign a knowledgeable person who know the functioning of shot blasting machine trained to recognize hazards and with the authority to quick take corrective actions to remove them.

Safety measures should be taken before using shot blasting machine are:

- A. Provide training to shot blasters and support personnel on blasting health and safety hazards how to use control, personal hygiene practices and safe work practices.
- B. Safety Points Before Using Shot Blasting Machine
- C. Shot blasting operation can create a high level of dust and noise. shot blasting material and the surface being blasted may contain toxic materials that are harmful to workers. So respirator masks/helmet and safety glasses should be used to protect against nuisance type dust. Also must cover the worker's head ,neck and shoulder to protect the worker from rebounding abrasive.
- D. Review the blast area and security plan because the blast area is the area having the potential for flying material air overpressure can cause injury to a person. Review the communicating system used between blaster and blast area security personnel.
- E. Ensure that Machine is in good condition, fuel system of the machine is free from leakage. Blaster should be experienced.
- F. Use blast room or blast cabinet for smaller operations. Use restricted areas for non-enclosed blasting operations. Use exhaust ventilation system.
- G. Acknowledge the shot is properly loaded and secured. Steel grit shot have less potential to cause lung damage. So always use less toxic shots blasting material. Always use blasting material that can be delivered with water to reduce dust.
- H. Do not use compressed air to clean as this will create dust in the air. To prevent the spread of any hazardous material we should avoid blasting in windy conditions.
- I. Compressor for shot blasting should have a valid TPI.

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11.3.9 FIRE SAFETY

- A. Providing appropriate firefighting equipment at designated workplace and nominate fire officer/ warden adequately trained for his job.
- B. Sub-contractor 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.
- C. 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.
- D. 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.
- E. Non-compliance of the above requirement under fire protection shall in no way relieve the Sub-contractor of any of his responsibility and liabilities to fire incident occurring either to his materials or equipment or those of others.
- F. Emergency contacts numbers must be displayed at prominent locations
- G. 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.
- H. Correct type & required quantity of fire extinguishers and sand bucket should be provided at appropriate locations.
- I. Material storage area should have adequate fire fighting arrangement like fire extinguishers /sand buckets etc.
- J. Material storage area should have some person designated as fire watcher.

11.3.10 OPERATIONAL CONTROL PROCEDURE OF RADIOGRAPHY

- A. Exposure to penetrating radiation from Radioactive Isotopes and other source is becoming more and more pronounced in the construction field.
- B. A couple of decades ago, radioactive sources, used, were comparatively 'mild' and less encountered. With the growing demand of weld joint inspection, metal thickness / flaw determination, liquid level measurement in High temperature / pressure process vessels etc., the use and application of the radioactive sources specially, Y-radiation, has increased considerably.
- C. However, the protection and procedure for work safety and personnel protection have warranted very little basic changes
- D. Atomic Energy authorities have been alert and alive to the situation Well organized and efficient monitoring, controlled operation and rescue / recovery system has been developed and enforced. Some of these are: -
- E. Authorized person obtains all Radioactive Isotopes from BARC (Bhabha Atomic Research Centre, Mumbai) only
- F. Transportation and storage specifications and standards are rigidly monitored and enforced by the authorities.
- G. Any mishap, loss or damage is promptly attended to and rectified by the authorities, immediately on receipt of information.
- H. They promptly and formally collect all isotopes reaching their Half-life stage.

Site requirements for the safe use of field personnel are as follows:

1. Isotope storage – a designated and certified location should be maintained properly with prescribed warning board and fencing.
2. Personnel using the Isotope must be medically checked before being permitted to handle and found fit.
3. They must have a valid BARC certificate for safe handling of Isotopes.
4. They must use a film Badge or Dosimeter as prescribed by the authorities while working with Isotopes.
5. Isotope attached to a metal pencil should be removed from storage only for the optimum period of work.
6. Isotope MUST not be taken out of the container lead pot till actual exposure stage is reached. The exposure time must be calculated beforehand.
7. Ensure radiation monitoring equipment is working, when exposure is in progress.
8. On expiry of the exposure time, the source must immediately be put back in the container.
9. All personnel working with radiation sources must maintain the prescribed safe distance at all stages of work.
10. Isotopes Pencil must be handled by a Collimator or monitoring rod of specified length, to avoid any unsafe proximity to the operator's body.

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11. Isotopes or the pencil should never be touched by hand or allowed to come in contact with body.
12. The area of work must be cordoned for a minimum radius of 10m for a Y-ray Isotope of about 3 C (S.A) and more as the strength – “Specific Activity” of the source, demands. Specified warning Boards MUST be installed adequately around the cordoned area.
13. If an isotope is damaged or lost: a) Immediately seal the working / suspected areas for all traffic, pedestrian or vehicle. b) Do not remove any materials tools, containers, vehicles – anything from the suspected area. Inform BARC Authorities – Radiation Protection, Directorate of Atomic Energy.
14. Keep strict watch till the authorities arrive. The authorities will locate and dispose off the offending isotope. On no account site people or any other persons – except BARC designated personnel – should attempt to recover the lost isotope. Suspected over exposure of any personnel must be reported to medical Centre immediately.
15. On a routine basis: All personnel attached to the radiography / radiometer crew must have prescribed medical check-ups.
16. Dosimeter / film badges must be returned to BARC for processing. Safe exposure dosage for each individual over different time stages – fortnightly, monthly, annually are predetermined and compared against actual exposures. ☐ If a person is over exposed at any time he should be: a) Taken off Radiography / Radiometry work. b) Assigned other duties as advised by doctor. He has no cause for panic. A careful handling and strict observance of precautionary measures.

11.3.11 SCAFFOLDING

- A. 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.
- B. 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 than $\frac{1}{4}$ horizontal and 1 vertical.
- C. 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 other wise secured, at least 90cm above the floor or platform of such scaffolding or staging and extending along the entire length of the out side and ends there of 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 savor, from swaying, from the building or structure.

Requirements for different types of Scaffolds:

Suspended Scaffold

- D. Suspended scaffolds are platforms suspended by ropes, or other non-rigid means, from an overhead structure.
- E. Requirements for use are to be pre approved by HSE Head, under a specific Permit to Work.
- F. Rolling Scaffolds
- G. The height of rolling scaffolds shall not exceed three times the minimum base dimension.
- H. The minimum base dimension of rolling scaffold will be 1.25 meters (4 feet).
- I. Adequate help must be provided when moving a rolling scaffold.
- J. Secure or remove all loose materials, equipment and tools before moving a rolling scaffold.
- K. No one is permitted to ride a rolling scaffold when it is being moved. Castor brakes must be locked-on when the scaffold is not being moved.



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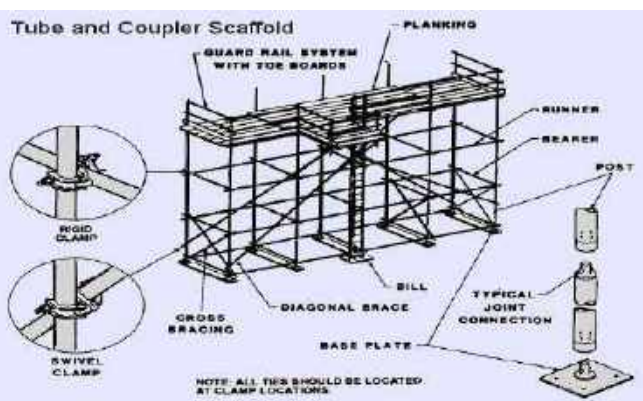
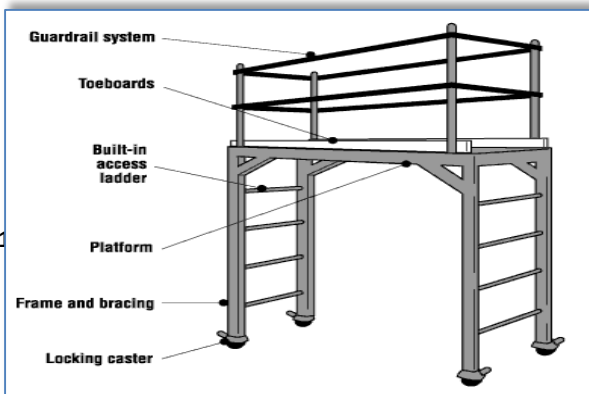


Fig. 13.2.1.3 Types of Scaffolds

Scaffold Tagging:- Scaffolds being erected, modified or dismantled must be tagged as suitable for use. The scaffolds can only be accessed by those involved with the process.

GREEN scaffold tag- shall be fixed when scaffold is complete and safe for use, signed and dated by the scaffolding competent person daily.

RED scaffold tag – to be fixed if scaffold is in some way defective and cannot be used or is still under erection.

Examples of scaffold tags

- Guard rails and toe-board/ barricades and sound platform conforming to IS:4912-1978 should be provided.
- All workers on job are medically fit for working at height (Person should not have vertigo)
- Where ever necessary, life-line (pp or metallic) and fall arrestor along with Poly amide 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 net shall be fire resistant, duly tested and shall be of ISI marked and then the net shall be located as per site requirements to arrest or to reduce the consequence 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 short cut 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 with valid TPI.
- 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 plat forms only.
- In case of roof work, walking ladder/platform should be provided along with life line 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

11.3.12 SAFETY HARNESS, LANYARD, LIFELINE & LIFELINE POST

- All height workers must use Full Body Safety harness with double lanyards with shock absorber (only). The primary lanyard is never unhooked until the secondary lanyard is secure. The design of the working platform should be such that under no circumstances, worker should have both lanyards unhooked while at height.

LANYARD

- The type of work and the environment conditions determine lanyard and lifeline selection. If welding, chemical cleaning that may damage lanyards, connectors or lifelines, sandblasting, etc., either protect the components or use more

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appropriate type of system.

- Lanyards and lifelines must incorporate, or be used with, an appropriate deceleration (shock absorbing) device.
- Deceleration devices include rope grabs, rip-stitch lanyards, specially woven lanyards, tearing, or deforming lanyards, automatic self-retracting lifelines and lanyards which dissipate or limit the energy imposed on the employee during fall arrest.
- Once in use, the system's effectiveness is to be monitored. In some cases, a program for cleaning and maintaining the system may be necessary. Lanyard and lifelines must use locking snap hooks only and under no circumstances must two lanyard snap hooks be connected.

LIFELINE

- All lifelines in general are to be made of min 8/12 mm dia. steel rope (plastic coated) and tied to columns with 3 clamps at each end. Wherever columns are not available to tie the lifelines, the vertical posts as per the design below are to be provided after carrying out drop load test initially. A load of 240kg to be dropped off the mid-point of lifeline in this test.



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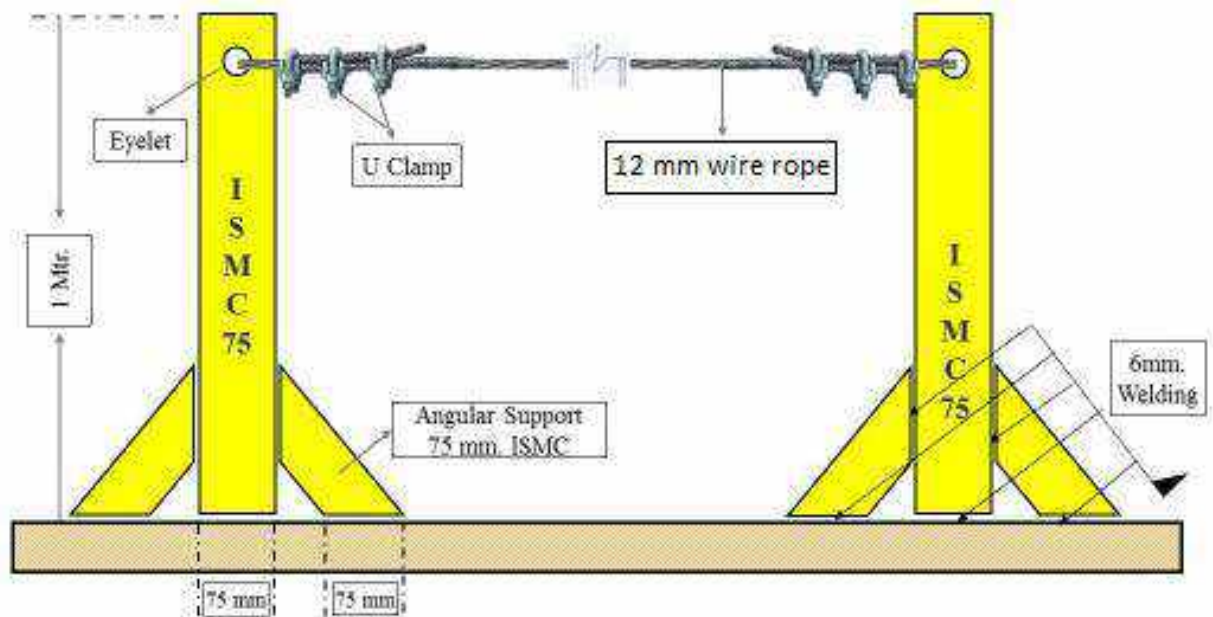
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LIFELINE POST

DIAGRAM : LIFELINE POST



- The support at vertical post shall be fixed at end-to-end. The maximum length of one end to another end shall be 6 meters
- If the length of a lifeline is more than 6 meters, then intermediate vertical post(s) are to be used. Such intermediate post(s) will act as supports and the lifeline rope should simply pass through the eyelets (holes) of such supports without being anchored
- The lifeline need not be wrapped / clamped to any intermediate post
- Such intermediate posts must be used at an interval of every 6 meters
- The post(s) in which the original lifeline is to be installed should be capable of sustaining a tensile stress of 2268 Kgs.
- In a horizontal lifeline installation, maximum allowable sagging is 500-600 mm
- For a single spun lifeline, no more than 2 persons are allowed to work; for more than two workers, another lifeline should be installed
- Horizontal lifeline should be so installed that it does not impede safe movement of workers
- All the installation work must be carried out by competent person with adequate knowledge

11.3.13 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.

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11.3.14 EXCAVATION

- A. Where ever 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.
- B. The following safety measures are to be ensured before and during excavation:
- C. All Excavation activities more than with depth of 1.5 meter or more shall require and Excavation Work Permit
- D. Check for underground utilities like electrical / telephone cables, sewage, water lines and proper care has to be exercised to protect and prevent damage to it
- E. Proper and adequate slope is maintained while excavating
- F. Adequate shoring or sheeting is done wherever require to prevent soil sliding
- G. Safe access through ladder or steps for exit & entry to excavation
- H. No material /excavated soil is kept within one meter from the edge
- I. Safe way is planned and provided for movement of HEM /transport equipment near excavation
- J. Safety helmet and shoes/gum boots are provided and worn by the workmen at excavation works
- K. Dewatering arrangement is made where water seepage is prevailed.
- L. Stop blocks are provided to avoid vehicles reversing into the excavated trenches
- M. Danger signs /Caution boards are displayed at work spot
- N. Hard Barricading is provided at excavated pits.

11.3.15 LADDER SAFETY

- A. 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.
- B. 29.2 cm for ladder up to and including 3 m in length.
- C. For longer ladders this width shall be increased at least ¼" for each additional foot of length.
- D. A sketch of the ladders and scaffolds proposed to be used shall be prepared and approval of the Engineer obtained prior to Construction.
- E. Ladder should be extended up to 01 meter

11.3.16 LIFTING SAFETY

- A. It will be the responsibility of the sub-contractor to ensure safe lifting of the equipment, taking due precaution to avoid any incident and damage to other equipment and personnel.
- B. All requisite tests and inspection of handling equipment, tools & tackle shall be periodically done by the sub-contractor by engaging only the Competent Persons as per law.
- C. Defective equipment or uncertified shall be removed from service.
- D. Any equipment shall not be loaded in excess of its recommended safe working load.

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11.3.17 HOISTING APPLIANCES

- A. Motors, gearing, transmission, electric wiring and other dangerous parts of hoisting appliances should be provided with efficient safeguards.
- B. Hoisting appliance should be provided with such means as will reduce to the minimum the risk of any part of as suspended load becoming incidentally displaced.
- C. 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.
- D. The worker should not wear any rings, watches and carry keys or other materials which are good conductor of electricity.

11.3.18 GRINDING SAFETY

- A. Grinders shall be equipped with the 'dead man switch'.
- B. All handheld grinding machines shall be complete with handle or commonly known as the 'T' bar. Removal of the handle during use is strictly prohibited.
- C. Each grinding machine shall be fitted with its correct guard as supplied by the manufacturer, to protect against flying particles.
- D. All pedestal/static grinding machines must have an efficient starting and stopping device, which is easily accessible.
- E. Each grinding machine shall be inspected regularly.
- F. Abrasive wheels, grinding or cutting discs without the manufacturer's maximum RPM marked shall not be used.
- G. Grinding and cutting discs are different in the manufacture and shall therefore only be used for its intended purpose.
- H. Cutting wheel is only allowed for cutting do not do grinding using cutting wheel, chances of breaking.
- I. They shall be stored separately and physically identified to avoid selection error.
- J. Proper PPE, including double eye protection such as the use of goggles underneath of a shatter-resistant face shield and an inhalation mask such as dust mask, Leather gloves shall be worn by all personnel operating grinding machines.
- K. Work areas around pedestal / static abrasive wheels equipment shall be kept clear of obstructions to reduce the risk of tripping hazards.
- L. Cables shall be run neatly in a manner and shall hang on insulated hangers that do not cause tripping hazards.
- M. When changing the grinding disc of the grinder, the power source shall be isolated and the plug physically removed.
- N. Expiry year of shall be visible on the disk. Do not use an expired grinding disk. & do not use a wheel without an expiry date.
- O. Subjected Work-pieces shall be secured using proper clamps. Holding the work piece onto one hand while performing grinding operations is strictly prohibited.
- P. Due to the possibility of a wheel dis integrating during start-up, employees shall be briefed not to stand directly in front of the wheel as it accelerates to full operating speed.
- Q. Worn out / damaged, grinding or cutting disc shall be replaced. When changing the disc, proper tools shall be use.
- R. All worn out / damaged, grinding or cutting disc shall be returned to the stores to ensure that they are dispose of properly.
- S. The power source shall be isolated and the plug physically removed while not in operation.

11.3.19 DRILLING SAFETY

- A. Run drill at correct RPM for diameter of drill bit and material. Ask shop personnel for the correct RPM.
- B. Always hold work in a vise or clamp to the drill table.
- C. Use a correctly ground drill bit for the material being drilled. Shop personnel can help select the correct bit.
- D. Use the proper cutting fluid for the material being drilled. Ask the shop staff about the appropriate fluid for the material you are machining.
- E. Remove chips with a brush, never by hand.
- F. Ease up on drilling pressure as the drill starts to break through the bottom of the material.
- G. Do not use a dull or cracked drill. Inspect the drill before using.
- H. Do not drill with too much pressure.

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- I. Always try to support part on parallels or a backing board when drilling thru material.
- J. Never place taper shank tools such as large diameter drills or tapered shank reamers in a drill chuck. Only straight shank tools such as standard drills can be clamped in chucks.
- K. Always clean drill shank and/or drill sleeve, and, spindle hole before mounting.
- L. Remove taper shank tools from spindle or sleeve with a drill drift and hammer.
- M. Never try to loosen the drill chuck while the power is on.
- N. Lower the drill spindle close to the table when releasing the drill chuck or taper shank drill to reduce the chance of damage should they fall onto the table.
- O. Never clean a machine while it is in motion!!
- P. If the drill binds in a hole, stop the machine and turn the spindle backwards by hand to release the bit.
- Q. When drilling a deep hole withdraw the drill bit frequently to clear chips and lubricate the bit.
- R. Always remove the drill chuck key, or, the drill drift from the spindle immediately after using it.
- S. Wear safety eye protection while drilling.
- T. Let the spindle stop of its own accord after turning the power off. Never try to stop the spindle with your hand.

11.3.20 WEATHER PROTECTION

- A. Contractor shall take appropriate measures to protect workers from severe storms, rain, solar radiations, poisonous gases, dust, etc. by ensuring proper usage of PPEs like Sun glasses, respirators, dust masks, etc. and rearranging/ planning the construction activities to suit the weather conditions. Effective arrangement (without creating inconvenience to project facilities & permanent installations) for protecting workmen from hailstorm, drizzle in the form of temporary shelter may be made at site.

11.3.21 WORKING AT HEIGHT

- A. The Contractor shall issue permit for working (PFW) at height after verifying and certifying the checkpoints as specified in the relevant permit format. He shall also undertake to ensure compliance to the conditions of the permit during the currency of the permit including adherence of personal protective equipment(s). Contractor's Safety Officer shall verify compliance status of the items of permit document after implementation of action is completed by Contractor's execution / field engineers at work site.
- B. All personnel shall be medically examined & certified by registered doctor, confirming their 'medical fitness for working at height. The fitness examination shall be done once in a year.
- C. The Contractor shall arrange (at his cost) and ensure use of Fall Arrester Systems by his workers. Fall arresters are to be used while climbing/descending tall structures or vessels / columns etc. These arresters should lock automatically against the anchorage line, restricting free fall of the user. The device is to be provided with a double security opening system to ensure safe attachment or release of the user at any point of rope. In order to avoid shock, the system should be capable of keeping the person in vertical position in case of a fall.
- D. The Contractor shall ensure that Full body harnesses conforming relevant IS standard is used by all personnel while working at height. The lanyards and life lines should have enough tensile strength to take the load of the worker in case of a fall.
- E. One end of the lanyard shall be firmly tied with the harnesses and the other end with life line. The harness should be capable of keeping the workman vertical in case of a fall, enabling him to rescue himself.
- F. The Contractor shall ensure that a proper Safety Net System is used wherever the hazard of fall from height is present. The safety net, preferably a knotted one with mesh ropes conforming to IS 5175/ISO 1140 shall have a border rope & tie cord of minimum 12 mm dia. The Safety Net shall be located not more than 6.0 meters below the working surface extending on either side up to sufficient margin to arrest fall of persons working at different heights.
- G. In case of accidental fall of person on such Safety Net, the bottom most portion of Safety Net should not touch any structure, object or ground.
- H. The Contractor shall ensure positive isolation while working at different levels like in the pipe rack areas. The working platforms with toe boards & hand rails shall be sufficiently strong & shall have sufficient space to hold the workmen and tools & tackles including the equipment required for executing the job. Such working platforms shall have mid-rails, to enable people work safely in sitting posture.

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- I. For steel wire rope type (plastic coated type) life line thickness should of Life lines should be minimum 12 mm or 8 mm (as per job requirement).
- J. Lifelines should be tied to a standard / rigid post.

11.3.22 PROPER ACCESS / EGRESS (ACCESSIBILITY)

- A. The Contractor shall provide safe means of access (in sufficient numbers) & efficient exit to any working place including provisions of suitable and sufficient scaffolding/ramps/steps/ ladders at various stages during all operations of the work for the safety of his workmen and owner/ client.
- B. The Contractor shall implement use of all measures including use of "life line", "fall- arresters", "retractable fall arresters", "safety nets" etc. during the course of using all safe accesses & exits, so that in no case any individual remains at risk of slip & fall during their travel.
- C. Safe access & egress arrangements (e.g. ladders, fall arresters, life-liners etc) should be satisfactorily incorporated
- D. Access / egress to Electrical Distribution Boards / Panels should be clear from wires / cables / earth-strips etc.
- E. The access to operating plant / project complex shall be strictly regulated. Any person or vehicle entering such complex shall undergo identification check, as per the procedures in force / requirement at project site.
- F. Accessibility to 'confined space' shall be governed by specific system / regulation, as established at project site.

11.3.23 HEAVY LIFTINGS

- A. The BHEL Sub-contractor shall submit detailed lifting plan for BHEL /Owner approval prior to lifting equipment which is 20 ton or more
- B. Or any other lift which is of complex dimension (constraints of its dimensions, location of foundation height, approach & weight.) /shape/ or very expensive in nature.
- C. Contractor shall obtain lifting permit before such lifting (e.g HSE-15 "Permit for heavy lift/critical erection")
- D. Prior to actual lifting activities, contractor shall check the validity of the crane/T&P Third party inspection (TPI) certificate issued by statutory/ competent authority. This requirement shall also apply to all lifting equipment utilized for the job.
- E. The Sub-contractor shall, at all times, be responsible for all lifting/rigging activities.
- F. The Sub-Contractor shall ensure medical fitness of all workmen who are engaged/involved in erection of equipment, vessels etc. and such fitness checks shall be carried-out every six months interval with the help of a registered medical practitioner & record shall be maintained.
- G. Adequate safety measures such as positive barricading, usage of appropriate PPEs, permit to work, etc. shall be taken during all heavy or critical lifts.
- H. Crane operators should be experienced & medically fit. They should also posses valid driving license and eye test Report/ Certificate.

11.3.24 LIFTING TOOLS & TACKLES

- A. Lifting tools/tackles, machinery, accessories etc. shall be inspected, tested and examined by competent people (approved by concerned State authorities-TPI) before being used at site and also at periodical interval (e.g. during replacement, extension, modification, elongation/ reduction of machine/parts, etc.) as per relevant statutes. Hydra, cranes, lifting machinery, mobile equipment / machinery / vehicles, etc. shall be inspected regularly by only competent / experienced personnel at site and requisite records for such inspections shall be maintained by every contractor. Contractor shall also maintain records of maintenance of

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11.3.25 HEAVY VEHICLES

- A. The sub-contractor should ensure all statutory compliance of heavy vehicles (e.g Dumper, Truck, Excavator, Crane , Hydra etc) used at construction site like valid RC, Insurance, PUC, etc
- B. The vehicles shall be fitted with reverse warning alarms & flashing lights / fog-lights and usage of seat belts shall be ensured.
- C. Vehicles shall be properly maintained and appropriate maintenance records should be kept.
- D. For Cranes, Hydras Third Party inspections (TPI) by competent person should be done once a year.
- E. In case of Cranes & hydras overload protection device (SLI) (mechanical or electronic) as per possibility should be ensured.
- F. Presence of over hoist protection device should be ensured.

11.3.26 SAFETY DURING INSULATION WORK

- A. Insulation job workers should be given proper PPEs (e.g. nose mask, goggles, hand globe) as per job requirement
- B. Entry to insulation Area should be restricted
- C. Area properly barricaded by the means of caution tapes
- D. After finish of insulation work excess insulation wools should be properly disposed off.

11.3.27 SAFETY DURING HYDRAULIC/ PNEUMATIC PRESSURE TESTING WORK

- A. Sub-contractor should follow appropriate safety guidelines / relevant BHEL OCPs during Hydraulic / Pneumatic Pressure Testing job.
- B. No unauthorized persons should be present near to such work area.

11.4 ENVIRONMENTAL CONTROL

- A. Environment protection has always been given prime importance by BHEL. Environmental damage is a major concern of the principal sub-contractor and every effort shall be made, to have effective control measures in place to avoid pollution of Air, Water and Land and associated life. Chloro fluoro carbons such as carbon tetra chloride and tri chloro ethylene shall not be used. Waste disposal shall be done in accordance with the guidelines laid down in the project specification.
- B. 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).
- C. 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 Sub-contractor shall use appropriate MSDS for clean-up technique
- D. All Sub-contractor shall be responsible for the cleanliness of their own areas.
- E. The Sub-contractor shall ensure that noise levels generated by plant or machinery are as low as reasonably practicable. Where the Sub-contractor anticipates the generation of excessive noise levels from his operations the Sub-contractor shall inform to Construction Manager of BHEL accordingly so that reasonable & practicable precautions can be taken to protect other persons who may be affected.
- F. It is imperative on the part of the Sub-contractor to join and effectively contribute in joint measures such as tree plantation,

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environment protection, contributing towards social upliftment, conversion of packing woods to school furniture, keeping good relation with local populace etc.

- G. The Sub-contractor 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 HOUSE KEEPING

- E. Keeping the 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 sub-contractor. Such cleanings has to be done daily/weekly/ or as per site requirement by Sub-contractor within quoted rate, by an identified group.
- F. If such activity is not carried out by sub-contractor / 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
- G. Proper house keeping to be maintained at work place and the following are to be taken care of on daily basis.
- H. All surplus earth and debris are removed/ disposed off from the working areas to identified locations.
- I. Unused/ Surplus cables, steel items and steel scrap lying scattered at different places/elevation within the working areas are removed to identified locations.
- J. 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
- K. Different work places for easy collection of scrap/waste. Scrap chute shall be installed to remove scrap from high location.
- L. Access and egress (staircase, gangways, ladders etc.) path should be free from all scrap and other hindrances.
- M. Work men shall be educated through tool box talk about the importance of housekeeping and encourage not to litter.
- N. 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.
- O. Fabricated steel structures, pipes & piping materials shall be stacked properly.
- P. 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.
- Q. Utmost care shall be taken to ensure overall cleanliness and proper upkeep of the working areas

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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 WORKPLACE

- Sufficient rubbish bins shall be provided close to work places.
- 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.

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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 to 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 WORK PLACE TRANSPORT SYSTEM (ROAD/ RAIL SAFETY)

- 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

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- 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 gate ways 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.
- For area where Rail lines also present at construction site, appropriate Rail safety guideline issued by BHEL/ Owner should be followed.

11.7.2 TRAFFIC ROUTE FOR PEDESTRIANS/ ROAD SAFETY

- 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 road way 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 seatbelts.
- 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

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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 inter locks
 - Sub contractor should ensure that drivers carry out these checks

11.7.5 STATUTORY COMPLIANCE OF 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 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 a construction site to be blocked by parked vehicles Drivers of vehicles shall only stop or park in the areas designate by the stringing fore man.
- Warning signs shall be displayed during transportation of material.
- All vehicles used shall be in worthy condition and in conformance to the Land Transport requirement.

11.7.6 MAINTENANCE OF VEHICLES

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 sub-contractors
- All the sub-contractor'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. Sub-contractor should nominate a supervisor to coordinate and implement the safety measures.
- Emergency 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.

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- 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 it self 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 HSE MS requirements. The Sub-contractor 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 with hold inspection, till such time the desired safety requirements are met.

12.1 DAILY HSE CHECKS

Both the Site Supervisors and safety officer of Sub-contractor 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.

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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 checklist.

12.5 INSPECTION OF 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 and vertigo test of height worker shall be ensured.
- Height working shall not be allowed during adverse weather.

12.6 INSPECTION OF 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 up right.
- Use of Flash back arrestor shall be ensured at both ends.

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- 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 OF 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 <24V 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

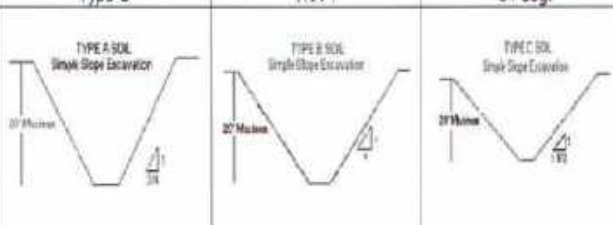
- Elevators shall be inspected by concerned supervisors once in a week as per format no. HSEP:14-F13.
- All elevators shall be inspected by competent person(TPI) and validity shall be ensured.
- The date of third party inspection and next due date shall be painted on elevator.

12.9 INSPECTION OF EXCAVATION

Excavation activities shall be inspected as per Format HSEP:14-F13A

- The following safety measures are to be ensured before and during excavation:
- All Excavation activities more than with depth of 1.22 meter or more shall require and Excavation Work Permit
- Check for underground utilities like electrical / telephone cables, sewage, water lines and proper care has to be exercised to protect and prevent damage.
- Proper and adequate slope is maintained while excavating
- Adequate shoring or sheeting is done wherever require to prevent soil sliding
- Safe access through ladder or steps for exit & entry to excavation
- No material /excavated soil is kept within one meter from the edge
- Safe way is planned and provided for movement of HEM /transport equipment near excavation
- Safety helmet and shoes/gum boots are provided and worn by the workmen at excavation works
- Dewatering arrangement is made where water seepage is prevailed.
- Stop blocks are provided to avoid vehicles reversing into the excavated trenches
- Danger signs /Caution boards are displayed at work spot
- Hard Barricading is provided at excavated pits. It should be made of scaffolding pipe and clamp with reflective nets.
- Trial Trench if required. Cable/Metal detector required for under ground services.

Soil Type	Height/Depth ratio	Slope Angle
Stable Rock	Vertical	90 deg.
Type A	¾ : 1	53 deg.
Type B	1 : 1	45 deg.
Type C	1½ : 1	34 deg.



Determining Soil Type		
Type	Description	Examples
A	Cohesive soils with an unconfined compressive strength of 1.5 tons per square foot or greater.	Clay, silty clay, sandy clay, clay loam and in some cases: silty clay loam and sandy clay loam.
B	Cohesive soils with unconfined compressive strength greater than 0.5 tsf but less than 1.5 tsf.	Angular gravel (similar to crushed rock), silt, silt loam, sandy loam and, in some cases silty clay loam and sandy clay loam.
C	Cohesive soils with unconfined compressive strength greater than 0.5 tsf or less.	Granular soils such as gravel, sand and loamy sand; submerged soil or soil from which water is freely seeping; submerged rock that is not stable.

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12.10 LIFTING & RIGGING SAFETY

- A. All Heavy / Complex Lifting operations as defined in Clause 6.12 shall require a Lifting Work Permit. A written rigging procedure and plan must be prepared for all individual heavy/ complex lifting operations.
- B. All the cranes and lifting tools & tackles shall be inspected on daily / weekly basis as well as monthly by expert as per applicable formats.
- C. In addition, inspection / certification as mandated by law shall be carried out wherein these shall be tested and certificates of fitness shall be obtained from 3rd party State Govt. approved competent agency before deploying at site and later periodically. BHEL shall be given advance intimation of any such inspections
- D. The last date of Third Party Inspection and the next Due date shall be conspicuously displayed on all cranes. A copy of certificate shall be pasted on operator's cabin of all the lifting equipment.

Following requirements shall be mandatorily followed, wherever applicable:

- E. The manufacturer's instruction for maintenance shall also be followed. All safety measures shall be followed.
- F. All tools tackles, lifting appliances; material-handling equipment etc. used by the Sub-contractor shall be of safe design and construction.
- G. The operators, slingers and signalers shall be qualified as per IS 13367 (part-1):2003 "Safe use of cranes- code of practices".
- H. There shall be a person responsible for co-ordination among cranes where multiple cranes are used, and lifting over 75% of the crane capacity to be avoided.
- I. Mobile phone should be banned for crane operator and lifting operation. Only walkie talkie shall be allowed in rigging/Lifting purpose.
- J. When performing similar lifts of identical items, only one rigging plan need be prepared, provided each of the lifts can be performed in accordance with the rigging plan.

LIFTS/ MOVEMENTS LESS THAN 5 TONS:

- K. An equipment rigging plan is not required for lifts less than 5 tons, safety measures are covered in the JSA. Personnel Lifts (Man-Basket / Jhoola):
- L. The design of personnel man basket shall be submitted to BHEL Engineer for approval before use. Relevant permit (Height work & others as applicable) shall be completed prior to lifting any people, along with a rigging plan.
- M. A separate Lifeline / fall arrestor anchored to a fixed structure outside of Jhoola shall be provided for the workers inside the basket. All occupants of the basket shall have Safety Harnesses equipped with rope grabs, which are to be hooked to the vertical lifeline.
- N. Man-basket shall be used where access through ladders or scaffolding is not feasible.
- O. Man-baskets shall be designed and engineered by a manufacturer (job made man-baskets are not allowed, unless designed and tested by a certified engineer), and built robust with MS Angles and flats or plates or channels only.
- P. Guard rails top and mid, must be in place and screened-in to avoid material from falling out of basket. The factor of safety shall be 200%.
- Q. It shall have a door with double latches and shall open inside. Anchor points shall be identified within the man-basket.
- R. The man-basket shall be thoroughly inspected and load tested and a trial run performed without personnel before being put to job.
- S. It shall be treated as a lifting tool (T&P Item) and shall undergo same certification cycle and inspection as other lifting equipment.
- T. An additional sling of required lifting capacity shall be fixed the man-basket main lifting point and attached to the crane above the ball or block.
- U. While lifting man-basket, the crane shall maintain a uniform speed of lift without any swing.
- V. Once man-basket reaches the destination, the lift brakes shall be locked as long as the basket remains at that point. The same care shall be taken in its descent. As for hanging man-basket, the same shall be hung off a rigid structure with help U-shaped handle welded to man-basket. This shall be tested once in a year by a competent person.
- W. Use of Rebar steel for making and monkey-ladder must be avoided.



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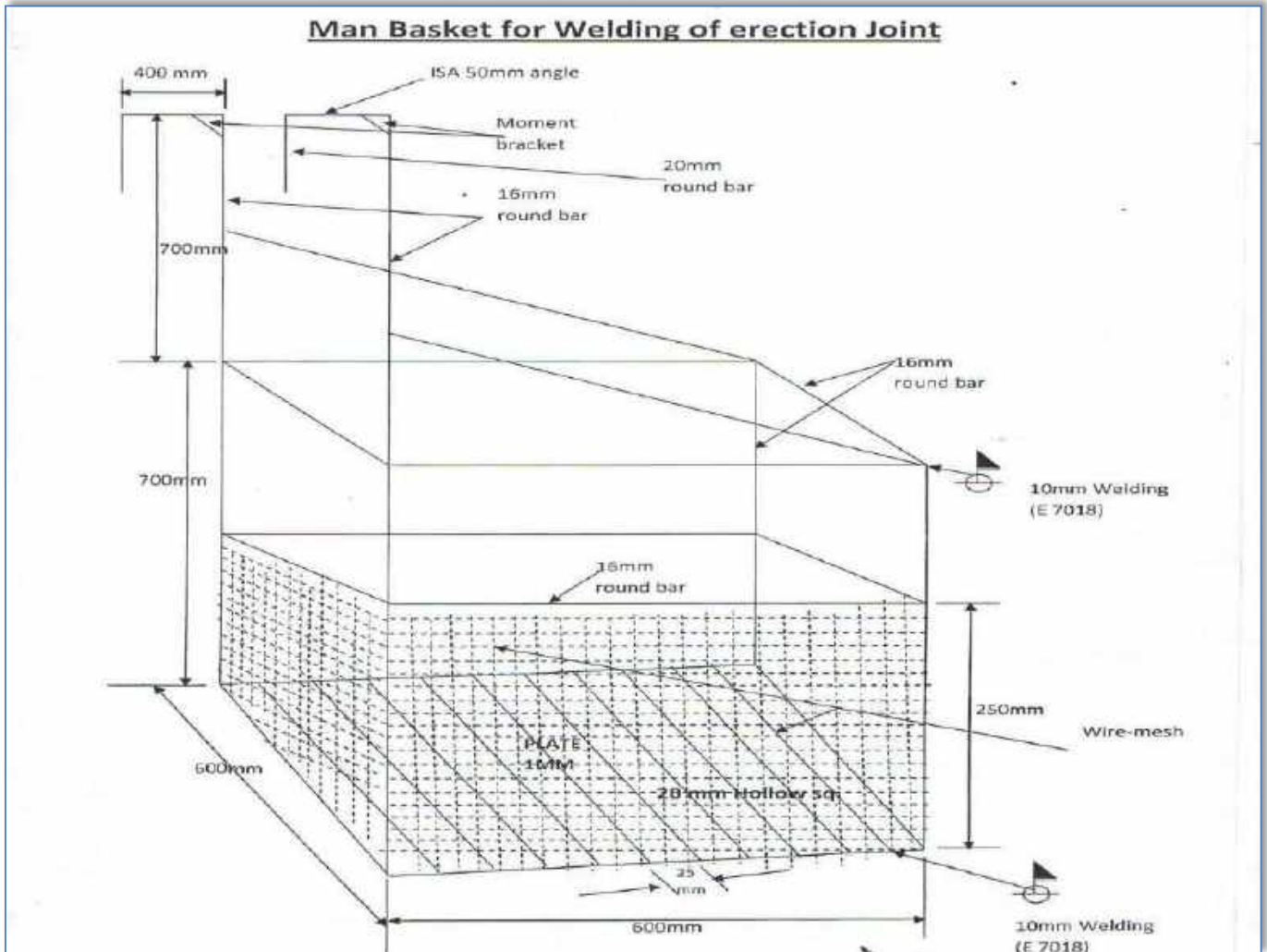
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13.0 HSE PERFORMANCE

- 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 of BHEL as per Format No. HSEP: 14-F33.
- BHEL shall reserve the right to use this assessment for evaluating bidder's capacity for future tenders
- Suitable HSE reward system shall be developed at site level to promote HSE compliance amongst workmen by the sub-contractor. 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 sub-contractor 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 sub contractor may be considered by BHEL after completion of the job.

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13.1 SAFETY DURING START UP, COMMISSIONING AND TESTING

- There are various activities involved prior to commissioning- the major ones are -Hydraulic Test, Steam Blowing, Transformers Charging, Boiler Light Up, Rolling and Synchronization and Full loading of unit.
- These activities shall be personally supervised by the site executive along with the commissioning engineer.
- Appropriate Work Permits shall be taken as applicable
- The readiness of upstream and downstream system shall be ensured before taking up.
- These shall be handled strictly by the authorized persons only and the team shall be suitably briefed about the activity including hazards & risks involved and control plan by the concerned executive-in-charge before start.
- Entry of persons to the area of activity shall be suitably restricted and the emergency functions like Ambulance, first aid center and Fire station shall be intimated about the plan well in advance.
- Tag-in/ Tag-out shall be in place while charging transformer and whenever necessary.
- Electricians with valid wiremen license only shall be permitted to work on power lines.
- The area and the passage shall be adequately illuminated
- Siren/Hooter for alerting workers during steam blowing should be ensured.

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14.0 HSE PENALTIES

- A. As per contractual provision HSE penalties shall be imposed on Sub-contractor 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.
- B. **If principal customer/ statutory and regulatory bodies impose some penalty on HSE due to the non-compliance of the sub-contractor the same shall be passed on to them.**
- C. The penalty amount shall be recovered by Site Finance department from sub-contractor's RA / Final bill.
- D. The Contractor shall adhere consistently to all provisions of HSE requirements. In case of non-compliances and also for repeated failure in implementation of any of the HSE provisions, DASTUR/Owner may impose stoppage of work without any cost & time implication to the Owner and/or impose a suitable penalty. The amount of penalty to be levied against defaulted Contractor shall be up to a cumulative limit of:
- E. This penalty shall be in addition to all other penalties specified elsewhere in the contract. The decision of imposing stop-work-instruction and imposition of penalty shall rest with Owner. The same shall be binding on the BHEL sub contractor. Imposition of penalty does not make the Contractor eligible to continue the work in unsafe manner.
- F. The amount of penalty applicable for (penalty by OWNER/CONSULTANT) on the Contractor on different types of HSE Violations is specified below:

Sl. No.	Violation of HSE Norms	Penalty Amount
1	For not using personal protective equipment (Helmet, Shoes, Goggles, Gloves, Full body harness, Face shield, Boiler suit, etc.)	Rs. 500/- per day/Item / Person.
2	Working without Work Permit/Clearance	Rs. 20000/- per occasion
3	Execution of work without deployment of requisite field engineer / supervisor at work spot	Rs. 5000/- per violation per day
4	Unsafe electrical practices (not installing ELCB, using poor joints of cables, using naked wire without top plug into socket, laying wire/cables on the roads, electrical jobs by incompetent person, etc.)	Rs. 10000/- per item per day.
5	Working at height without full body harness, using day. non-standard/ rejected scaffolding and not arranging fall protection arrangement as required, like hand- rails, life-lines, Safety Nets etc.	Rs. 10000/- per case per
6	Unsafe handling of compressed gas cylinders trolley, jubilee clips double gauge regulator, and not keeping cylinders vertical during storage/handling, not using safety cap of cylinder).	Rs. 500/- per item per day.
7	Use of domestic LPG for cutting purpose / not using flash back arresters on both the hoses/tubes on both ends.	Rs. 3000/- per occasion.
8	No fencing/barricading of excavated areas /trenches.	Rs. 3000/- per occasion.

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	9	Not providing shoring/strutting/proper slope and not keeping the excavated earth at least 1 .5M away from excavated area.	Rs. 5,000/- per occasion
	10	Non display of scaffold tags, caution boards, list of hospitals, emergency services available at work locations.	Rs. 1000/- per occasion per day

15.0 OTHER HSE 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 sub-contractor suitably.
- If the Sub-contractor fails to improve the standard s of safety in its operation to the satisfaction of BHEL after being given reasonable opportunity to do so and/or if the sub-contractor 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 sub-contractor after giving a notice of not less than 7 days indicating the steps that would be taken by BHEL.
- If the Sub-contractor succeeds in carrying out its job in time without any fatal or disabling injury incident and with out any damage to property BHEL may, at its sole discretion, favorably consider to reward the sub-contractor 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 sub-contractor after holding an appropriate enquiry.
- The su-contractor 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 Sub-contractor be paid to compromise any claim by any such person, should such claim proceeding be filed against BHEL, the Sub-contractor hereby agrees to indemnify BHEL against the same.
- The Sub-contractor 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 Sub-contractor to the workmen and adequate facilities shall be provided to enable the working painters to wash during the cessation of work.
- The sub contractor 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 sub-contractor shall adhere to such instructions.

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15.1 BEHAVIOUR BASED SAFETY

The contractor shall develop a system to implement Behaviour-Based Safety (BBS) through which work groups can identify measure and change the behaviours of employees and workers. **The BBS process shall include the following:**

- A. Identify the behaviours critical to obtaining required safety performance.
- B. Communicate the behaviours and how they are performed correctly to all.
- C. Observe the work force and record safe/at risk behaviours. Intervene with workers to give positive reinforcement when safe behaviours are observed. Provide coaching/correction when risky behaviors are observed.
- D. Collect and record observation data.
- E. Summarize and analyze observation data.
- F. Communicate observation data and analysis results to all employees.
- G. Provide recognition or celebrate when safe behaviour improvements occur.
- H. Change behaviours to be observed or change activators or change consequences as appropriate.
- I. Communicate any changes to workforce

Contractor through its own HSE committee shall implement the above process. The necessary procedures and reporting formats shall be developed by the contractor for approval by Owner. The HSE committee of contractor shall observe individual's behavior for safe practices adapted for utilization/execution of work for following as a minimum:

- PPE
- Tools & equipment
- Hazard Identification & control
- House keeping
- Confined space entry
- Hot works
- Excavation
- Loading & unloading
- Work at height
- Stacking & storage
- Ergonomics
- Procedures

15.2 SLIPS, TRIPS & FALLS

The contractor shall establish a regular cleaning and basic housekeeping programme that covers all aspects of the workplace to help minimize the risk of slips, trips & falls. The contractor shall take positive measures like keeping the work area tidy, storing waste in suitable containers & harmful items separately, keeping passages, stairways, entrances & exits especially emergency ones clear, cleaning up spillages immediately and replacing damaged carpet/floor tiles, mats & rugs at once to avoid slips, trips & falls.

15.3 RADIATION EXPOSURE

- All personnel exposed to physical agents such as ionizing & non-ionizing radiation, including ultraviolet rays or similar other physical agents shall be provided with adequate shielding or protection commensurate with the type of exposure involved.
- For Open Field Radiography works, requirements of Bhabha Atomic Research Centre (BARC)/Atomic Energy Regulatory Board (AERB) shall be followed.

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- The Contractor shall implement an effective system of control (as described in the AFRB regulations) at site for handling radiography-sources & for avoiding its misuse & theft.
- The contractor shall generate the Format No: HSE-8 "Permit for radiation work" before start of work.
- In case the radiography work has to be carried out at day time, suitable methodology to be used so that other works, people are not affected

15.4 DEMOLITION/ DISMANTLING

- The contractor shall adhere to safe demolishing/dismantling practices at all stages of work to guard against unsafe working practices.
- The contractor shall disconnect service lines (power, gas supply, water, etc.)/make alternate arrangements prior to start of work and restore them, if required as directed by DASTUR/Owner at no extra cost.
- Before carrying out any demolition/dismantling work, the contractor shall take prior approval of Owner and generate the Format No.HSE-9. For revamp jobs in operating plants where location of underground utilities is not known with certainty, the contractor shall depute an experienced engineer for supervision and shall make adequate arrangements for Fire fighting & First-Aid during the execution of these activities.
- The Contractor shall arrange approved Job Safety Analysis (JSA) / Method Statement for the specific demolition / dismantling task. In no case any activity related to demolition/dismantling shall be carried out by the Contractor without engaging own supervision / field engineer.

15.5 HSE AWARENESS AND MOTIVATION

- The Contractor shall promote and develop awareness on Health, Safety and Environment protection among all personnel working for the Contractor.
- Regular awareness programs and fabrication shop / work site meetings at least on monthly basis shall be arranged on HSE activities to cover hazards/risks involved in various operations during construction.
- Contractor to motivate & encourage the workmen & supervisory staff by issuing / awarding them with tokens/gifts/mementos/monetary incentives/certificates, etc.

15.6 INTOXICATING DRINKS & DRUGS AND SMOKING

- The Contractor shall not allow any workman to commence any work at any locations of project activity who is/ are influenced / effected with the intake of alcohol, drugs or any other intoxicating items being consumed prior to start of work or working day.
- Awareness about local laws on this issue shall form part of the Induction Training and compulsory work-site discipline.
- The Contractor shall ensure that all personnel working for him comply with "No-Smoking" requirements of the Owner a notified from time to time. Cigarettes, lighters, auto ignition tools or appliances as well as intoxicating drugs, dry tobacco powder, etc. shall not be allowed inside the project/plant complex.
- Smoking shall be permitted only inside smoking area exclusively designated for.

15.7 ADDITIONAL SAFETY REQUIREMENTS FOR WORKING INSIDE A RUNNING PLANT

As a minimum, the contractor shall ensure adherence to following safety requirements while working in or in the close vicinity of an operating plant. Contractor shall obtain permits for Hot work, Cold work, Excavation and Confined Space from Owner in the prescribed format.

- A. The contractor shall monitor record and compile list of his workers entering the operational plant/unit each day and ensure & record their return after completing the job.

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- B. Contractor's workers and staff members shall use designated entrances and proceed by designated routes to work areas only assigned to them. The workers shall not be allowed to enter units' area, tanks area, pump rooms, etc. without work authorization permit.
- C. Work activities shall be planned in such a way so as to minimize the disruption of other activities being carried out in an operational plant/unit and activities of other contractors.
- D. The contractor shall submit a list of all chemicals/toxic substances that are intended to be used at site and shall take prior approval of the Owner.
- E. Specific training on working in a hydrocarbon plant shall be imparted to the work force and mock drills shall be carried out for Rescue operations/First-Aid measures.
- F. Proper barricading/cordoning of the operational units/plants shall be done before starting the construction activities. No unauthorized person shall be allowed to trespass. The height and overall design of the barricading structure shall be finalized in consultation with the Owner and shall be got approved from the Owner.
- G. Care shall be taken to prevent hitting underground facilities such as electrical cables, hydrocarbon piping during execution of work.
- H. Barricading with water curtain shall be arranged in specific/critical areas where hydrocarbon vapors are likely to be present such as near horton spheres or tanks. Positioning of fire tenders (from owner) shall also be ensured during execution of critical activities.
- I. Emergency evacuation plan shall be worked out and all workmen shall be apprised about evacuation routes. Mock drill operations may also be conducted.
- J. Flammable gas test shall be conducted prior to any hot work using appropriate measuring instruments. Sewers, drains, vents or any other gas escaping points shall be covered with flame retardant tarpaulin.
- K. Respiratory devices shall be kept handy while working in confined zones where there is a danger of inhalation of poisonous gases. Constant monitoring of presence of Gas/ Hydrocarbon shall be done.
- L. Clearance shall be obtained from all parties before starting hot tapping, patchwork on live lines and work on corroded tank roof.
- M. Positive isolation of line/equipment by blinding for welding/cutting/grinding shall be done. Closing of valve will not be considered sufficient for isolation.
- N. Welding spatters shall be contained properly and in no case shall be allowed to fall on the ground containing oil. Similar care shall be taken during cutting operations.
- O. The vehicles, cranes, engines, etc. shall be fitted with spark arresters on the exhaust pipe and got it approved from Safety Department of the Owner.
- P. Plant air should not be used to clean any part of the body or clothing or use to blow off dirt on the floor.
- Q. Gas detectors should be installed in gas leakage prone areas as per requirement of Owner's plant operation personnel.
- R. Experienced full time safety personnel shall be exclusively deployed to monitor safety aspects in running plants.

15.8 CONFINED SPACE ENTRY

The sub-contractor shall generate a work before entering a confined space. People, who are permitted to enter into confine space, must be medically examined & certified by registered doctor, confirming their 'medical fitness for working in confined space. All necessary precautions mentioned therein shall be adhered to. An attendant shall be positioned outside a confined space for extending help during an emergency. All appropriate PPEs and air quality parameters shall be checked before entering a confined space. It shall be ensured that the piping of the equipment which has to be opened is pressure-free by checking that blinds are in place, vents are open and volume is drained. Inside confined space works, only electrical facilities / installations of 24V shall be permitted. Contactor shall ensure usage of safe & suitable arrangement of oxygen supply for individual workmen (during the course of work in confined space), if oxygen concentration is found to be less than 19.5% (v/v) there.

15.9 SCAFFOLDINGS & BARRICADING

Suitable scaffoldings shall be provided to workmen for all works that cannot be safely done from the ground or from solid construction except such short period work that can be safely done using ladders or certified (by 3rd

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party competent person) man-basket. When a ladder is used, an extra workman shall always be engaged for holding the ladder.

The Contractor shall ensure that the scaffolds used during construction activities shall be strong enough to take the designed load. All scaffolds shall be inspected by a competent Scaffolding Inspector of the Contractor. He shall paste a GREEN tag (duly signed by competent Scaffolding Inspector) on each scaffold found safe and a RED tag (duly signed by competent Scaffolding Inspector) on each scaffold found unsafe. Scaffolds with GREEN tag only shall be permitted to be used and Scaffolds with RED ones shall immediately be made inaccessible. Work being found continuing on scaffolds with RED tag shall be considered unauthorized work by Contractor and may invite penalization from BHEL/Owner. For every 120-125 m² /m³ area / volume or its parts thereof minimum one TAG shall be provided.

The Contractor shall ensure positive barricading (indicative as well as protective) of the excavated, radiography, heavy lift, high pressure hydrostatic & pneumatic testing and other such areas. Sufficient warning signs shall be displayed along the barricading areas.

Scaffolding shall be constructed using foot seals or base plates only.

15.10 ELECTRICAL INSTALLATIONS

- All electrical installations/ connections shall be carried out as per the provisions of latest revision of following codes/standards, in addition to the requirements of Statutory Authorities and IE/applicable international rules & regulations:
- O1SD STD 173:- Fire prevention & protection system for electrical installations
- SP 30 (BIS):- National Electric Code
- All electrical installations shall be approved by the concerned statutory authorities.
- All temporary electrical installations / facilities shall be regularly checked by the licensed/competent electricians of the Contractor and appropriate records shall be maintained in format no: HSE-12" Inspection of temporary electrical booth/installation at project construction site". Such inspection records are to be made available to BHEL/Owner, whenever asked for.

15.11 WELDING/ GAS CUTTING

- Contractor shall ensure that flash back arrestors conforming to BS: 6158 or equivalent are installed on all gas cylinders as well as at the torch end of the gas hose, while in use.
- All cylinders shall be mounted on trolleys and provided with a closing key. Empty & filled-up gas cylinders shall be stored separately with TAG, protecting them from direct sun or rain. Minimum 2 nos. of Portable DCP type fire extinguishers (10 kg) shall be maintained at the gas cylinder stores. Stacking & storing of compressed gas cylinders shall be arranged away from DG set, hot works, Elect. Panels / Elec. boards, etc
- The burner and the hose placed downstream of pressure reducer shall be equipped with Flash Back Arrester/Non Return Valve device.
- The hoses for acetylene and oxygen cylinders must be of different colours. Their connections to cylinders and burners shall be made with a safety collar.
- At end of work, the cylinders in use shall be closed and hoses depressurized.
- Cutting of metals using gases, other than oxygen & acetylene, shall require written concurrence from Owner.
- All welding machines shall have effective earthing at least at distinctly isolated two points.
- In order to help maintain good housekeeping, and to reduce fire hazard, live electrode bits shall be contained safely and shall not be thrown directly on the ground.
- The hoses of Acetylene and Oxygen shall be kept free from entanglement & away from common pathways / walkways and preferably be hung overhead in such a manner which can avoid contact with cranes, hydra or other mobile

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construction machinery.

- Hot spatters shall be contained / restricted appropriately (by making use of effective fire- retardant cloth/fabric) and their flying-off as well as chance of contact with near-by flammable materials shall be stopped.
- The Contractor shall arrange adequate systems & practices for accumulation / collection of metal & other scraps and remnant electrodes and their safe disposal at regular interval so as to maintain the fabrication and other areas satisfactorily clean & tidy.
- All gas cylinders must have a cylinder cap on at all times when not in use.

15.12 ERGONOMICS OF TOOLS & TACKLES

- The Contractor shall assign to his workmen, tasks commensurate with their qualification, experience and state of health.
- All lifting tools, tackles, equipment, accessories including cranes shall be tested periodically by statutory/competent authority(TPI) for their condition and load carrying capacity. Valid test & fitness certificates from the applicable authority shall be submitted to Owner/DASTUR for their review/acceptance before the lifting tools, tackles, equipment, accessories and cranes are used.
- The contractor shall not be allowed to use defective equipment or tools not adhering to safety norms.
- Contractor shall arrange non-sparking tools for project construction works in operating plant areas / hydrocarbon prone areas.
- Wherever required the Contractor shall make use of Elevated Work Platforms (EWP) or Aerial Work Platforms (mobile or stationary) to avoid ergonomical risks and workmen shall be debarred to board such elevated platform during the course of their shifting / transportation.
- Contractor shall ensure installation of Safe Load Indicator (SLI) on all cranes (while in use) to minimize overloading risk. SLI shall have capability to continuously monitor and display the load on the hook, and automatically compare it with the rated crane capacity at the operating condition of the crane. The system shall also provide visual and audible warnings at set capacity levels to alert the operator in case of violations.
- The contractor shall be responsible for safe operations of different equipments mobilized and used by him at the workplace like transport vehicles, engines, cranes, mobile ladders, scaffoldings, work tools, etc.
- The Contractor shall arrange periodical training for the operators of hydra, crane, excavator, mobile machinery, etc. at site by utilizing services from renowned manufacturers.

15.13 HSE IMPLEMENTATION, INSPECTION AND MONITORING

- The Contractor shall be fully responsible for planning, reporting, implementing and monitoring all HSE requirements and compliance of all laws & statutory requirements.
- The Contractor shall also ensure that the HSE requirements are clearly understood & implemented conscientiously by their site personnel at all levels at site.
- The Contractor shall ensure physical presence of their field engineers, supervisors, during the continuation of their contract works/site activities including all material transportation activities. Physical absence of experienced field engineers/supervisors of Contractor at critical work spot during the course of work, may invite severe penalization as per the discretion of EIC, including halting /stoppage of work.
- The Contractor shall regularly review inspection report internally and implement all practical steps / actions for improving the status continuously.
- The Contractor shall ensure important safety checks right from beginning of works at every work site locations and to this effect format No: HSE-.10 "Daily Safety Check List" shall be prepared by field engineer & duly checked by safety personnel for conformance.
- The Contractor shall carry out inspection to identify various unsafe conditions of work sites/machinery/equipments as well as unsafe acts on the part of workmen/supervisor/ engineer while carrying out different project related works.

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- G. Adequate records for all inspections shall be maintained by the Contractor and the same shall be furnished to, whenever sought.
- H. The Contractor shall not carry-out work by engaging single worker anywhere without any supervisor anytime during day or night.
- I. As a general practice lifting tools/tackles, machinery, accessories etc. shall be inspected, tested and examined by competent people (approved by concerned State authorities-TPI) before being used at site and also at periodical interval (e.g. during replacement, extension, modification, elongation/ reduction of machine/parts, etc.) as per relevant statutes. Hydra, cranes, lifting machinery, mobile equipments / machinery / vehicles, etc. shall be inspected regularly by only competent / experienced personnel at site and requisite records for such inspections shall be maintained by every contractor. Contractor shall also maintain records of maintenance of all other site machinery (e.g. generators, rectifiers, compressors, cutters, etc.) & portable tools/equipments being used at project related works (e.g. drills, abrasive wheels, punches, chisels, spanners, etc.). The Contractor shall not make use of arbitrarily fabricated 'derricks' at project site for lifting / lowering of construction materials.
- J. Site facilities /temporary. installations, e.g. batching plant, cement godown, DG-room, temporary electrical panels/distribution boards, shot-blasting booth, fabrication yards, etc. and site welfare facilities, like labour colonies, canteen/pantry, rest-shelters, motor cycle/bicycle-shed, site washing facilities, First-aid centers, urinals/toilets, etc. should be periodically inspected by Contractor (preferably utilizing HR/Admin. personnel to inspect site welfare facilities) and records to be maintained.

15.14 LOTO (HAZARDOUS ENERGY CONTROL) PROCEDURES

Hazardous Energy Control Procedures, known as "Lockout/ Tag Out (LOTO)" refers to specific practices and procedures to safeguard employees from the unexpected energization or startup of machinery and equipment, or the release of hazardous energy during service or maintenance activities.

Contractors must develop and submit a written LOTO program This requires that a designated qualified individual turns off and disconnects the machinery or equipment from its energy source(s) before performing service or maintenance and that the authorized employee(s) either lock and tag the energy- isolating device(s) to prevent the release of hazardous energy and test the machine or equipment to verify that the energy has been isolated effectively. Locks should be used as per requirement or job.

MINIMUM REQUIREMENTS:

The following are minimum requirements that must be included in the Contractor's LOTO program:

Inspection of equipment by a trained individual who is thoroughly familiar with the equipment operation and associated hazards. Identification and labeling of lockout devices. Purchase of locks, tags, and blocks Development of a standard written operating procedure, permitted through a controlling authority that is followed by all workers.

GENERAL REQUIREMENTS

The following steps must be taken to protect workers that install or service equipment and systems:

Follow the hazardous energy procedures and statutory regulations. Follow the manufacturer's service/repair instructions. Identify and label all sources of hazardous energy. Before beginning work, accomplish the following:

- De-energize all sources of hazardous energy:
- Disconnect or shut down engines or motors.
- De-energize electrical circuits.
- Block fluid (gas or liquid) flow in hydraulic or pneumatic systems.
- Block or secure machine parts against motion.
- Block or dissipate stored energy.
- Discharge capacitors.
- Release or block springs that are under compression or tension.
- Vent fluids from pressure vessels, tanks, or accumulators—but never vent toxic, flammable, or explosive substances directly into the atmosphere.

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- Lockout and tag out all forms of hazardous energy including electrical breaker panels, control valves, etc. Make sure that only one key exists for each of your assigned locks and that access to the key is controlled. Verify by test and/or observation that all energy sources are de-energized.
- After completion of the work, accomplish the following:
- Inspect repair work before removing the lock and activating the equipment.
- Make sure that only the worker that installed the lock removes his/her assigned lock.
- Make sure that all workers are clear of danger points before re-energizing the system.

LOTO PROCEDURE PURPOSE AND SUMMARY

This procedure provides the requirements and responsibilities of Hazardous Energy Control and the process for Lockout / Tag out (LOTO) of energy isolating devices (valves, circuit breakers, disconnect, etc.). Its use shall ensure that machinery, equipment, or systems are isolated from all potentially hazardous energy to prevent unexpected energization, startup, or release of stored energy which may cause personnel injury or property damage.

This procedure applies to all BHEL personnel and Sub-contractor working on the Nalco projects where equipment must be taken out of service for the performance of work activities such as installation, maintenance, repair, construction, or equipment removal. The procedure may also be used to isolate equipment of which the energization or operation may present danger to personnel or property.

Lockout / tag out are not required for electrical equipment that can be unplugged from the source and the person performing the work has control of the plug.

This procedure shall be applied to prevent injury or damage caused by the unexpected release of active or stored energy. Hazardous energy sources could be in the form of the following:

- Electrical
- Hydraulic
- Chemical
- Thermal
- Mechanical
- Pneumatic

Preplanning of work activities includes the identification of all potential hazardous energy sources so that they may be properly controlled and isolated, locked, and tagged out.

Prior to initiating work activities on or around locked out / tagged out equipment, the equipment must be tested and tried by or in the presence of the person(s) performing the work activities.

LOTO RESPONSIBILITIES

- The Engineers in Charge is responsible for implementing and enforcing this procedure and approving lockouts /tag outs that impact the operation of the project.
- The Engineer in Charges responsible for authorizing Lockout /Tag out Requests.
- The Lockout / Tag out Coordinator is responsible for maintaining the Lockout / Tag out Log. Each shift should have a designated Lockout / Tag out Coordinator.
- The Isolator is responsible for determining the proper isolation devices and device positions required to isolate all potential energy sources so that the work stated on the Lockout /Tag out Request Permit may be safely performed. The Isolator must be familiar with the equipment and energy type(s) that require isolation. For this reason, in some cases the Isolator may be more than one person (i.e. Engineer, System Operator and/or Electrician). The Isolator shall position the specified device points, and apply locks and tags, and sign the tags and the LOTO Permit isolation point blocks.
- The Safety Manager is responsible for conducting an annual audit that is documented to ensure all procedures and requirements are current and being followed as written.

DEFINITIONS OF LOTO RELATED TERMS

AFFECTED EMPLOYEE:-

An employee whose job requires him/her to operate or use machinery or equipment on which servicing or maintenance is being performed under a lock out/tag out procedure or whose job requires him/her to work in an area

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in which servicing or maintenance is being performed under a lockout/tag out procedure

AUTHORIZED EMPLOYEE:-

An employee who implements a lockout/tag out procedure on machinery, equipment, or systems in order that servicing or maintenance may be performed. Often an authorized employee and an affected employee may be the same person.

DANGER “DO NOT OPERATE” TAG

A tag used to identify energy isolation devices and specify the required position of the device. The tag should be affixed to the isolation device such that it is in plain view of anyone attempting to operate the device. The tags shall be sequentially numbered and shall specify the lockout/ tag out request number. The tag shall also state the purpose, and the expected duration of the lockout /tag out

ISOLATION DEVICE

A device that is designed and intended to prevent the passage of energy. These devices, usually located at the energy source, are typically valves, circuit breakers, etc. Isolation devices should have a means of being locked in position

LOCKOUT DEVICE

A device that uses a positive physical means such as a lock, either key or combination type to maintain an energy isolation device in the safe position and prevent the inadvertent energization of machinery, equipment, or systems. Device locks should serve no other purpose other than hazardous energy control isolation

LOCKOUT TAG OUT REQUEST PERMIT

A pre numbered form used to request that machinery, equipment or systems be taken out of service. A Lockout/Tagout Request Permit may be initiated by any one requiring energy isolation for work activities or for taking faulty equipment out of service

LOCKOUT / TAG OUT REQUEST LOG

A record of all Lockout /Tag out Request Permits shall be maintained by the Lockout /Tag out Coordinator.

PROCEDURE FOR REQUESTING A LOCK OUT / TAG OUT PERMIT

- A. When machinery, equipment, or systems are partially or completely taken out of service for work activities or equipment protection, a lockout / tag out shall be requested. The requestor shall be familiar with scope of work required and shall provide a brief description of the work on the Lockout / Tag out Request Permit. The requestor shall also provide the proposed start time and estimated duration of lockout / tag out. If familiar with the machinery, equipment, or system to be taken out of service, the requestor may identify the devices that are required to be isolated. The LOTO Request Permit shall be forwarded to the Authorized Lockout / Tag out Coordinator for reviewed and signature, along with Permit to Work number to be entered on the LOTO Request Permit.
- B. The Lockout / Tag out Coordinator shall record the necessary information on the Lockout / Tag out Request Log and forward the request to the Engineer in Charge for approval.
- C. The Safety Manager or Engineer in Charge shall review the Lockout / Tagout Request Permit for impact on project operations. Project operations could be impacted by the equipment being taken out of service or by the required isolation to take the equipment out of service. If project operations are impacted by the Lockout / Tagout, the request shall be forwarded to the Engineer in Charge for approval. The Engineer in Charge shall provide the lockout / tag out isolation points necessary to perform the task stated on the request. The device identification, device location, device position, and locking mechanism shall be entered into the appropriate blocks on the Lockout / Tag out Request Permit.
- D. The Engineer in Charge indicates approval of the Lockout / Tagout Request Permit by signing in the appropriate space on the request. If the Lockout /Tag out Request Permit is rejected, the Engineer in Charge shall return it to the requestor, via the Lockout / Tagout Coordinator with a written explanation of the rejection.
- E. Once approved, the Lockout / Tag out Request Permit shall be forwarded to the Lockout / Tag out Coordinator to assign tags and locks.
- F. The log shall show current status of all Lockout / Tag out Request Permits from submittal to approval, through lifting of locks and tags to final closeout. The log shall be maintained by the Lockout / Tag out Coordinator in their office.

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PLACEMENT OF LOCKS AND TAGS

- A. The tags shall be filled out to match the information on the LOTO Request Permit. Appropriate locks for the types of isolation devices specified shall be collected and placed with the tags and the Lockout / Tag out Request Permit.
- B. The isolator(s) shall take the device locks, tags, and the Lockout / Tag out Request Permit to position the specified isolation devices, sign and hang the tags, and place the locks. If the isolator does not agree with or understand the Lockout / Tag out Request Permit, or has a problem performing the isolation, the problem should be brought to the attention of the Safety Representative or Area Supervisor immediately and the lockout / tag out should be postponed until the situation is resolved.
- C. Once the Isolator has placed all "locks" on isolation points, they will "test" and "try" the machinery, equipment, or system to ensure all hazardous energy has been completely removed and the isolation is one totally accomplished, and has initialed and signed the Lockout / Tag out Request Permit indicating all isolation points have been confirmed. Examples of "lock", "test" and "try"; by checking that all locks on the LOTO Request Permit have been applied and are in the specified position open/closed, on/off, etc.; metering test of electrical circuits, opening of drain valves, checking pressure gauges or indicators; and try by pushing start buttons and on/off switches, etc.
- D. Testing shall be performed by person(s) knowledgeable of the energy source(s) being isolated (e.g., an electrician should meter electrical circuits). A copy of the completed Lockout / Tag out Request Permit shall remain with the Work Package and used as part of the daily Pre Job Briefings

WORKING UNDER A LOCK OUT / TAG OUT REQUEST

- Prior to starting the work activity, the person(s) performing the work shall review the Lockout / Tag out Request Permit and place the necessary tags and personal locks on the identified isolation devices. Personal locks may be placed only on devices that have already been locked and tagged in accordance with the Lockout / Tag out Request Permit.
- All personal locks shall be accompanied by a tag that is signed and dated by the worker(s) and specifies the work activity being performed. Personal locks should be of a different color than device locks for ready identification.
- Verification of the effectiveness of the isolation by the Isolator shall be performed for Worker's working under the lockout / tag out, by demonstrating the checks on "lock", "test" and "try",
- When the work activity is finished, personal locks and tags shall be removed and the Safety Representative shall be notified that the Lockout / Tag out is no longer required. If work under a lockout / tag out is to be delayed or interrupted for a period in excess of 24 hours, personal locks shall be removed until the work restarts. Personal locks shall be removed prior to the worker(s) leaving the project at the end of shift unless the key(s) are maintained at the project.

REMOVAL OF LOCKS AND TAGS

- When the lockout / tag out is no longer required, the Safety Representative or Area Supervisor shall obtain the Lockout / Tag out Request Permit from the work package for LOTO removal. Prior to removing locks or tags that may allow equipment to be energized, a check shall be made to verify that the equipment is free to safely operate (i.e., will not cause damage or injury). The locks and tags shall be removed and returned to the Lockout / Tag out Coordinator. Isolation devices may be repositioned at the discretion of the Engineer in Charge according to operational requirements. The Isolator shall complete the Lockout / Tag out Request Permit indicating each lock and tag has been removed and the Safety Representative or Area Supervisor forward to the Lockout / Tag out Coordinator.
- The Lockout / Tag out Coordinator shall discard the tags and maintain the completed Lockout / Tag out Request Permit for future reference.
- In the event that an employee leaves the job site without removing the personal lock I tag, the following measures shall be taken and documented. The measures listed below are a minimum set of guidelines and under all circumstances, refer to the site specific safe work plan for detailed procedures
- Attempt calling / contacting the employee to return to the site for removal.
- In the event an employee cannot be contacted, the Site Manager and Safety Manager shall sign an Emergency Lockout/Tag out Removal Form, (see Attachment 5), which has been completed by the Area Supervisor.

Employee shall be notified upon returning to the site, prior to beginning any work.

INTERRUPTION OF A LOCKOUT / TAGOUT

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OPERATIONAL EMERGENCY

The Engineer in Charge / Safety Manager /Area Supervisor may deem it necessary to temporarily remove the locks and tags from isolation devices, prior to the end of the work activity. The standard procedure for removal of locks and tags shall be followed. Extreme caution shall be taken by the Isolator removing the locks and tags to prevent personnel injury.

TESTING

When the performance of a work activity requires the functional testing of a machine, component, or system, the locks and tags may be temporarily removed in accordance with the tag removal, to perform the test. As a result of the testing, if it is determined that the equipment needs further work, the locks and tags shall be positioned back on to the device. If it is not necessary to replace all the locks and tags, then the unnecessary locks and tags may be returned to the Lockout / Tagout Coordinator. The Engineer in Charge shall initial the Lockout / Tag out Request Permit in the removal block to indicate that these locks and tags have been removed. When testing has been satisfactorily completed, the locks and tags shall be removed.

ISOLATION DEVICES

- A. In most industrial applications, there are isolation devices that were not designed to accommodate a locking device. In these instances, an acceptable alternative that physically obstructs or prevents the use of the isolation device shall be found. Chains shall be placed on valves or electrical panels. Wires shall be determinate, pulled back, taped, and secured.
- B. If an isolation device does not accept a lock, a tag only is acceptable; however, all possible precautions shall be undertaken to provide a level of safety for the workers. The tag shall be readily visible to anyone attempting to operate the device.
- C. If more than one Lockout / Tagout Request Permit requires that a single isolation device be locked and tagged, a lock and tag for each request shall be placed. Each lock in itself prevents the inadvertent operation of the device.

GROUP / COMPLEX LOCKOUT

- A. isolating device. If the energy isolating device will not accept multiple locks or tags, a hasp (a multiple lockout In a multiple lockout / tag out procedure, each person working on the machinery or equipment must place a lock or tag on the energy
- B. device, may be used. The locks or tags must be placed in such a way that energy cannot be restored to the machinery or equipment until every lock or tag is removed. As each employee involved no longer needs to maintain lockout / tag out protection that employee removes his - her lock and/or tag. The employee attaching the lock or tag is the only person authorized to remove the lock or tag.

LOTO TRAINING

The training must include recognition of hazardous energy source, type and magnitude of energy available, methods and means necessary for energy isolation and control. Each authorized employee shall receive adequate training. The training should address that all affected employees are instructed in the purpose and use of the energy control procedure. There should be training provisions included for any other employee whose work operations are or may be in an area where energy control procedures may be utilized. The employee training should also address when tag out systems are used including the limitations of a tag (tags are warning devices and do not provide physical restraint). The training should also include that a tag is not to be removed without authorization. The tag is never to be ignored or defeated in any way. Retraining is required when there is a change in job assignments, in machines, a change in the energy control procedures, or a new hazard is introduced. All training and I or retraining must be documented with employee's name and dates of training.

ATTACHMENTS

1. Danger (DO NOT OPERATE) Tags
2. Device & Personal Locks and Multi Lock Hasp:

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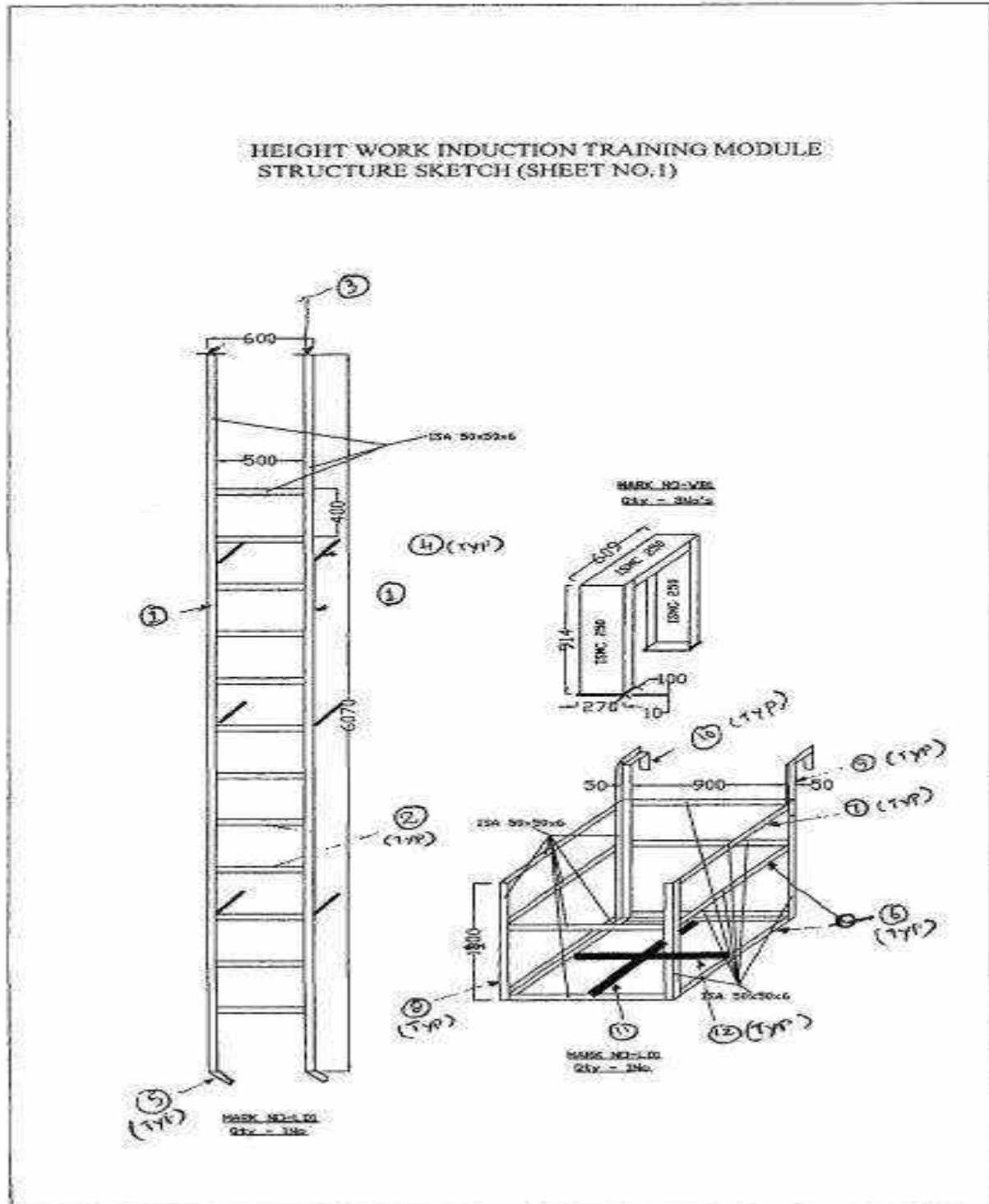
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15.15 VERTIGO TRAINING STRUCTURE FOR HEIGHT WORK







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BOM FOR HEIGHT WORK INDUCTION TRAINING MODULE

Sl. No.	Description	Width (mm)	Legth (mm)	Qty(No's)	Unit Wt(Kgs).	Total Wt.(Kgs)
MKD NO. WB1						
1	ISMC250		609	3	34.20	62.483
2	ISMC250		914	6	34.20	187.553
3	ISMC100		3655	1	9.56	34.942
4	PL10	100	270	6	78.50	12.717
				Total weight(Kgs)		297.695
MKD NO. RP1						
1	ISMC250		4570	4	34.20	625.176
2	ISMC250		3655	1	34.20	125.001
3	PL25	225	330	2	196.25	29.143
4	PL25	200	275	2	196.25	21.588
				Total weight(Kgs)		800.908
MKD NO. HP1						
1	ISMC250		4570	4	34.20	625.176
2	ISMC250		3655	1	34.20	125.001
3	ISMC150		3655	1	16.80	61.404
4	PL25	300	400	2	196.25	47.100
5	PL25	240	350	2	196.25	32.970
						891.651
MKD NO. LD1						
1	ISA50X50X6		6070	2	4.50	54.630
2	ISA50X50X6		500	12	4.50	27.000
3	PL12	75	75	2	94.20	1.060
4	ISA50X50X6		300	6	4.50	8.100
5	ISA50X50X6		255	2	4.50	2.295
6	ISA50X50X6		1000	8	4.50	36.000
7	ISA50X50X6		910	3	4.50	12.285
8	ISA50X50X6		1100	4	4.50	19.800
9	ISA50X50X6		650	2	4.50	5.850
10	ISA50X50X6		350	2	4.50	3.150
11	PL8	75	900	1	62.80	4.239
12	PL8	75	410	2	62.80	3.862
						178.271
				Total weight(Kgs)		2168.525



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Guidelines for conducting the Height work Induction Training:

1. Walking Bench Training:

- Person should walk over the channel. He should maintain balance & walk without much problem.
- If the person has problem to balance himself on repeated chances, he may be having flat foot or some other problem. So, he may not be fit for height work.

2. Rope Climb Training:

- Person should be able to climb the rope up to the top channel for ensuring that in case of fall, a person hanging on the safety harness, will be able to safely climb back to the platform within minimum time period before the safety harness start breaking down under the load.

3. Height Work Training:

- Person should walk freely on the middle channel while holding the top channel with the help of safety harness.

4. Ladder for vertical fall arrestor Training:

- Vertical fall arrestor rope is fixed from top to bottom of the ladder. It will ensure:
 - a) Usage of vertical fall arrestor.
 - b) Usage of two lanyards of a safety harness.
 - c) Ensure 3(three) point contact on the ladder while climb.

5. Chair for work at height Training:

- Climb through vertical ladder with two lanyard ropes.
- Hooking of two lanyard ropes to life line. With this safe arrangement, He can walk to chair.
- Sits in the chair safely, comes out & walks back to the vertical ladder & come down from vertical ladder.

Those who pass the above training are fit for height work.

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- 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.

16.0 NON COMPLIANCE (HSE PENALTY BY BHEL)

Non-conformity of safety rules and safety appliances will be viewed seriously and BHEL has right to impose fines on the sub-contractor as under for every instance of violation noticed:

SL.NO	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 Sliding 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 Sub-contractor will pay 2 times the penalty compared to previously paid in case there are repeated cases of fatal incidents under the same Sub-contractor 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 (RA) of the sub contractor.
- 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.

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17.0 HSE AUDIT/ INSPECTION

- Regular HSE Audit shall be carried out by Sub contractor as per Site 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.
- Regular HSE inspection shall be carried out by Sub contractor on daily basis.

18.0 MONTHLY/ WEEKLY / HSE COMMITTEE REVIEW MEETING

- Site shall hold HSE review meeting every week/ 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 In-charge of Sub-contractors and HSE officer of Sub-contractors.
- MOM on the discussion will be circulated to the concerned for implementation.
- The Contractor shall ensure participation of his top most executive at site (viz. Resident Construction Manager/Resident Engineer/ Project Manager / Site-in-Charge) in Safety Committee / HSE Committee meetings arranged by BHEL/Owner usually on monthly basis or as and when called for. In case Contractor's top most executive at site is not in a position to attend such meeting, he shall inform BHEL/Owner in writing before the commencement of such meeting indicating reasons of his absence and nominate his representative failure to do so may invite very stringent penalization against the specific Contractor, as deemed fit in Contract. The obligation of compliance of any observations during the meeting shall be always time bound. The Contractor shall always assist BHEL/Owner to achieve the targets set by them on HSE management during the project implementation.
- In addition, the Contractor shall also arrange internal HSE meetings chaired by his top most executive at site on weekly basis and maintain records. Such internal HSE meetings shall essentially be attended by field engineers/ supervisors (& not by safety personnel only) of the Contractor and its associates.
- Records of such internal HSE meetings shall be maintained by the Contractor for review by BHEL/Owner or for any HSE Audits.

AGENDA OF INTERNAL HSE MEETING SHOULD BROADLY COVER:

- A. Confirmation of record notes / minutes of previous meeting
- B. Discussion on outstanding subjects of previous points /subjects, if any
- C. Incidents / Accidents (of all types) at project site, if any
- D. Current topics related to site activities/subjects of discussion
- E. House keeping
- F. Behavioral Safety
- G. Information / views / deliberations of members / site sub Contractors

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- H. Report from Owner /Client
- I. Status of Safety awareness, Induction programs & Training programs
- J. The time frame for such HSE meeting shall be religiously maintained by one and all.

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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

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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

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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.



**HEALTH, SAFETY AND ENVIRONMENT
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(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.

	HEALTH, SAFETY AND ENVIRONMENT PLAN FOR 1x18.5 MW SPP BHEL PSSR NALCO DAMANJODI SITE	Doc No.: HSEP:14 REV: 01
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ANNEXURE 02

HSE AUDIT/ INSPECTION CHECKLIST CUM COMPLIANCE REPORT				
PROJECT: _____		SUBCONTRACTOR: _____		
DATE: _____		OWNER : _____		
_____INSPECTIONBY:				
Note : write 'NA' wherever the items is not applicable				
Item	Y e s	N o	Remarks	Action
HOUSEKEEPING				
Waste containers provided and used				
Passageways and walkways clear				
General neatness of working area				
Other				
PERSONNEL PROTECTIVE EQUIPMENTS				
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				



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Angle + 70° 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				



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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.				

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ANNEXURE 03

REFERENCES

- Contract documents
- Relevant legislations
- HSE MSM
- 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

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(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 2003)	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

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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.		



POWER SECTOR

INSPECTION OF FIRST AID BOX

FORMAT NO: HSEP:14-F01
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Sl. No.	Item	No. Available	Remarks
17	Whether 120 ml 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 Sub contractor's Site I/C:

	POWER SECTOR	FORMAT NO: HSEP:14-F02 REV NO.: 00
	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
<u>General Physical Examination</u>		
Height	:	
Weight	:	
BMI	:	
Built And nourishment	:	
Pallor	:	
Temperature	:	
Chest Expansion	:	Inspiration Expansion
Lymph Node Enlargement	:	
<u>Ear, Nose, Throat</u>	:	
Ear	:	
Nose	:	
Throat	:	

	POWER SECTOR	FORMAT NO: HSEP:14-F02 REV NO.: 00
	HEALTH CHECK UP	

EXAMINATION	OBSERVATION
<u>Cardiovascular System Examination :</u>	
Inspection :	
Palpation :	Pulse BP
Auscultation (Heart Sounds) :	
<u>Respiratory System :</u>	
Inspection :	Respiratory Rate
Palpation:	
Percussion :	
Auscultation (Breath Sounds) :	
<u>Examination of Abdomen :</u>	
Inspection :	
Palpation :	
Auscultation (Bowel Sounds) :	
Any Other :	
Clinical Impression	

Signature of the examining doctor

	POWER SECTOR	FORMAT NO: HSEP:14-F03 REV NO.: 00 PAGE NO. 01 OF 01
	HSE INDUCTION TRAINING	

Name of Site :	
Name of Sub-Contractor :	
Date :	
Name of Training Co -ordinator	

Sl No.	Name	Designation	Organization	Signature

Signature of Training coordinator :

	POWER SECTOR	FORMAT NO: HSEP:14-F04 REV NO.: 00 PAGE NO. 01 OF 01
	TOOL-BOX TALK	

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 Sub-contractor :

	POWER SECTOR	FORMAT NO: HSEP:14-F06 REV NO.: 00 PAGE NO. 01 OF 01
	PERSONAL PROTECTIVE EQUIPMENTS	

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 Sub-contractor :

	POWER SECTOR	FORMAT NO: HSEP:14-F07 REV NO.: 00 PAGE NO. 01 OF 01
	INSPECTION OF T&Ps	

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/ Safety Officer Subcontractor's

	POWER SECTOR	FORMAT NO: HSEP:14-F08 REV NO.: 00 PAGE NO. 01 OF 01
	STATUS OF T&Ps	

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	FORMAT NO: HSEP:14-F09 REV NO.: 00
	INSPECTION OF CRANES AND WINCHES	
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, Overload and SLI of crane/Hydra		
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 fully extendable		
20	Tyre pressure		
21	Condition of Battery And Lamps		



POWER SECTOR

INSPECTION OF CRANES AND WINCHES

FORMAT NO: HSEP:14-F09

REV NO.: 00

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?				



POWER SECTOR

INSPECTION OF CRANES AND WINCHES

FORMAT NO: HSEP:14-F09
REV NO.: 00

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 Sub-contractor :

	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?		

	POWER SECTOR	FORMAT NO: HSEP:14-F10
	INSPECTION OF HEIGHT WORKING	REV NO.: 00 PAGE NO. 02 OF 02

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 Sub-contractor :



POWER SECTOR

INSPECTION OF WELDING AND GAS CUTTING

FORMAT NO: HSEP:14-F11
REV NO.: 00

Name of Site	
Name of Sub-Contractor	
Inspected by	
Date of Inspection	

Welding				
Sl.no.	Description	Y e s	N o	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			



POWER SECTOR

INSPECTION OF WELDING AND GAS CUTTING

FORMAT NO: HSEP:14-F11
REV NO.: 00

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 Sub-contractor :

	POWER SECTOR	FORMAT NO: HSEP:14-F12 REV NO.: 00 PAGE NO. 01 OF 02
	INSPECTION OF ELECTRICAL INSTALLATION	

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?		

	POWER SECTOR	FORMAT NO: HSEP:14-F12 REV NO.: 00 PAGE NO. 02 OF 02
	INSPECTION OF ELECTRICAL INSTALLATION	

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 Sub-contractor :

	POWER SECTOR	FORMAT NO: HSEP:14-F13 REV NO.: 00 PAGE NO. 01 OF 01
	INSPECTION OF ELEVATOR	

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)

**POWER SECTOR****HSE PENALTY**

FORMAT NO: HSEP:14-F14

REV NO.: 00

PAGE NO. 1 OF 02

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 Slings 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 Sub-contractor will pay 2 times the penalty compared to previously paid in case there are repeated cases of fatal incidents under the same Sub-contractor for the same package in the same unit.

**POWER SECTOR****HSE PENALTY**

FORMAT NO: HSEP:14-F14

REV NO.: 00

PAGE NO. 2 OF 02

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_____

Distribution: 1 Copy: to Sub- contractor,
1 Copy to Site Construction Manager (BHEL)

	POWER SECTOR- HQ	FORMAT NO: HSEP:14-F15 REV NO.:00 PAGE NO. 01 OF 01
	Incident Report (To be submitted within 24 hours of time of incident)	

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	
	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 for Monthly HSE Planning & Review**

FORMAT NO: HSEP:14-F3o

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: Fo1	Areas 1.	
2	Health check-up as per Format: Fo2	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: Fo3	Minimum No. of workers:	
4	Toolbox talks (TBT) conducted before start of work as per Format: Fo4	Locations of TBTs & No. of workers 1. ...	
5	PPE usage and issue as per Format: Fo6		
6	Inspection of T&Ps as per Format: Fo7	List of T&Ps to be inspected 1.	
7	Identification & Inspection Status of T&Ps as per Format: Fo8		
8	Inspection of Cranes & Winches as per Format: Fo9	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. ...	



POWER SECTOR

Format for Monthly HSE Planning & Review

FORMAT NO: HSEP:14-F30

REV NO.: 00

PAGE NO. 02 OF 3

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 ...	

**POWER SECTOR****Format for Monthly HSE Planning & Review**

FORMAT NO: HSEP:14-F30

REV NO.: 00

PAGE NO. 03 OF 3

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 for Daily HSE Reporting

FORMAT NO: HSEP:14-F31A

REV NO.: 00

PAGE NO. 01 OF 1

Note: Following format to be submitted (preferably) in excel/ soft copy by Sub-contractor daily at the end of each shift. Any photographs/ records to attached

Night		Day	SHIFT	Year	Site
			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		
NA			T&P Inspection (Names & Nos. Inspected)		
			Safety Walk (Designation, Areas)		
NA			HSE Meeting		
NA			Safety Reward (Details)		
NA			Housekeeping/ Dust Suppression/ Tree Pruning		
			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		

**POWER SECTOR****Job Safety Analysis Format**FORMAT NO: **HSEP:14-F32B**

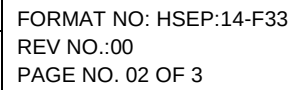
REV NO.: 00

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)						

	POWER SECTOR- HQ		FORMAT NO: HSEP:14-F33 REV NO.:00 PAGE NO. 01 OF 3		
	Checklist for Evaluation of HSE Performance				
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	



**POWER SECTOR- HQ****Checklist for Evaluation of HSE Performance**FORMAT NO: HSEP:14-F33
REV NO.:00
PAGE NO. 03 OF 3

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.



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



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 and 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



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 issue)

Original at BHEL site

Second Copy – BHEL SAFETY

Third Copy : Contractor

CONFINED AREA WORK PERMIT

Exact Location of Work: _____

Nature / Description of Work: _____

Duration of Work Execution *: From Date: _____ to Date: _____ Daily from _____ hrs. to _____ hrs.

Name of Agency Performing the Work: _____

Name of Agency's Site Engineer (Permit Requesting Authority): _____ Sign: _____

Name of Agency's Package In-charge: _____ Sign: _____ Date: _____

The above described work will be done under all the safety precautions mentioned on this permit to work as under during the currency of the Permit.

No.	Item	Yes	Not required / Remarks
1.	Has the equipment been Isolated from Power/Steam/Air?		
2.	Has the equipment been Isolated from liquid or gasses?		
3.	Has the equipment been de-pressurized &/or drained?		
4.	Has the equipment been Blanked/blinded or disconnected?		
5.	Has the equipment been water flushed &/or steamed?		
6.	Whether man ways open and ventilated?		
7.	Whether constant Inert gas flow arranged?		
8.	Whether mechanically ventilated and adequately cooled?		
9.	Whether 24 V lighting provided inside the confined space?		
10.	Whether Radiation sources removed?		
11.	Whether training on confined space provided to the group?		
12.	Whether required PPEs used?		
13.	Whether Dust/Gas/Air Line mask used?		
14.	Whether attendant with SCBA/Air mask available?		
15.	Whether grounded air Exhaust/Blower/ AC provided?		
16.	Whether Personal Gas alarm provided?		
17.	Whether communication Equipment Provided?		
18.	Whether rescue equipment/team available?		
19.	Whether firefighting arrangement done		
20.	Emergency response team & Medical Facilities available.		
21.	Work hazards are identified, controlled and communicated to the worker.		
22.	Method Statements/ Job Safety Analyses attached:		
23.	Other:		
24.	List of Other Permits Required for the Activity (Attached):		

The conditions mentioned in the above checklist are sufficient for safe completion of this activity. These have been checked and found complied before issuing the Permit, and shall be monitored and ensured throughout the currency of this Permit.

A. Permit Requester/ Receiver (Agency):

Site Engineer:
Signature: _____
Name: _____ Designation: _____

Site HSE Officer:
Signature: _____
Name: _____ Designation: _____

B. Permit Issuer (BHEL):

Site HSE Officer / Authorized Representative:
Signature: _____
Name: _____ Designation: _____

Site Engineer / Authorized Representative:
Signature: _____
Name: _____ Designation: _____

C. Package-in-charge (BHEL):

Signature: _____
Name: _____ Designation: _____

(* Permit valid for 14 days as per overleaf format)

Original: Permittee

2nd Copy: Agency Deptt. HDS

3rd Copy: BHEL Site HSE

P.T.O.

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LOCKOUT TAGOUT WORK PERMIT

Exact Location of Work: _____

Nature / Description of Work: _____

Duration of Work Execution *: From Date: _____ to Date: _____ Daily from _____ hrs. to _____ hrs.

Name of Agency Performing the Work: _____

Name of Agency's Site Engineer (Permit Requesting Authority): _____ Sign: _____

Name of Agency's Package In-charge: _____ Sign: _____ Date: _____

The above described work will be done under all the safety precautions mentioned on this permit to work as under during the currency of the Permit.

Tag No.	Device to be Tagged / Locked I.D. No.	Device Location	Device Position OPEN / CLOSED - ON/OFF	Lock No.	Tag Lock Placed by Name/Sign - Date/Time	Tag/Lock Removed by Name/Sign - Date/Time

No.	Item	Yes	Not required / Remarks
1.	Emergency response team & Medical Facilities available.		
2.	Work hazards are identified, controlled and communicated to the worker.		
3.	Method Statements/ Job Safety Analyses attached:		
4.	Other:		
5.	List of Other Permits Required for the Activity (Attached):		

The conditions mentioned in the above checklist are sufficient for safe completion of this activity. These have been checked and found complied before issuing the Permit, and shall be monitored and ensured throughout the currency of this Permit.

D. Permit Requester/ Receiver (Agency):

Site Engineer:
Signature:
Name: _____ Designation: _____

Site HSE Officer:
Signature:
Name: _____ Designation: _____

E. Permit Issuer (BHEL):

Site HSE Officer/ Authorized Representative:
Signature:
Name: _____ Designation: _____

Site Engineer/ Authorized Representative:
Signature:
Name: _____ Designation: _____

F. Package-in-charge (BHEL):
Signature:
Name: _____ Designation: _____

(* Permit valid for 14 days as per overleaf format)

Original: Permittee

2nd Copy: Agency Deptt. HOS

3rd Copy: BHEL Site HSE



**HEALTH, SAFETY AND ENVIRONMENT PLAN
FOR 1x18.5 MW SPP
BHEL PSSR NALCO DAMANJODI SITE**

Doc no: HSEP:14

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Date: 31.03.2021

POWER SECTOR

DEMOLISHING/ DISMANTLING WORK PERMIT

Project : Sr. No. :
Name of the work : Date :
Name of contractor : Job No. :
Name of sub-contractor : No. of workers to be engaged:
(List enclosed with name & gate
pass numbers)

Line No./Equipment No./Structure to be dismantled:

Location details of dismantling/demolition with sketch: (clearly indicate the area)

The following items have been checked & compliance shall be ensured during currency of the permit:

Sl. No.	Item Description	Done	Not Applicable
1.	Services like power, gas supply, water, etc disconnected		
2.	Dismantling/Demolishing method reviewed & approved		
3.	Usage of appropriate PPEs ensured		
4.	Precautions taken for neighbouring structures		
5.	First-Aid arrangements made		
6.	Fire fighting arrangements ensured		
7.	Precautions taken for blasting		

(Contractor's Supervisor)

(Contractor's Safety Officer)

Permission is granted.

(Permit issuing authority)

Name :

Date:

Completion report:

Dismantling/Demolishing is completed on Date at Hrs.

Materials/debris transported to identified location
(as applicable)

☐

Tagging completed

☐

Services like power, gas supply, water, etc restored

☐

(Permit issuing authority)

CONTRACTOR'S NAME



HEALTH, SAFETY AND ENVIRONMENT PLAN
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SAFETY WALK-THROUGH REPORT

(Name & signature of walk through performer to be inserted
at the bottom of each page)

Project : _____ Report no. : _____
Date : _____ Contractor : _____
Inspection by : _____ Owner : _____
Frequency : Monthly Job no. : _____

Note: Write 'NA' wherever the item is not applicable.

Sl. No.	Item	Satis- factory/Yes	Non- satis- factory/No	Remarks	Action
1.	Housing Keeping				
a)	Waste containers provided and used				
b)	Sanitary facilities adequate and clean				
c)	Passageways and walkways clear				
d)	General neatness of working areas				
e)	Other				
2.	Personnel Protective Equipment				
a)	Goggles; Shields				
b)	Face protection				
c)	Hearing protection				
d)	Foot protection				
e)	Hand protection				
f)	Respiratory masks etc.				
g)	Full body harness conforming to CC, EN 361				
h)	Hard hat (HDPE)				
i)	Other				
3.	Excavations/Openings				
a)	Openings properly covered or barricaded				
b)	Excavations shored				
c)	Excavations barricaded				
d)	Overnight lighting provided				
e)	Other				

Safety walk-through performer (Name & Signature).....



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(continued)

S1. No.	Item	Satis- factory/Yes	Non- satis- factory/No	Remarks	Action
4.	Welding & Gas Cutting				
a)	Gas cylinders chained upright				
b)	Cables and hoses not obstructing				
c)	Screens or shields used				
d)	Flammable materials protected				
e)	Live electrode bits contained properly				
f)	Fire extinguisher (s) accessible				
g)	Other				
5.	Scaffolding & Barricading				
a)	Fully decked platforms				
b)	Guard and intermediate rails in place				
c)	Toe boards in place				
d)	Adequate shoring				
e)	Adequate access				
f)	Positive barricading for critical activities				
g)	Installation of warning signs				
h)	Other				
6.	Ladders				
a)	Extension side rails 1 m above				
b)	Top of landing				
c)	Properly secured				
d)	Angle $\pm 70^\circ$ from horizontal				
e)	Other				
7.	Hoists, Cranes and Derricks				
a)	Condition of cables and sheaves OK				
b)	Condition of slings, chains, hooks and eyes OK				
c)	Inspection and maintenance log-books maintained				
d)	Outriggers used				
e)	Reverse horn installed/ active/coupled with gear				

Safety walk-through performer (Name & Signature)



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(continued)

Sl. No.	Item	Satisfactory / Yes	Non satisfactory / No	Remarks	Action
f)	Signs/barricades provided				
g)	Signals observed and understood				
h)	Qualified operators				
i)	Other				
8.	Machinery, Tools and Equipment				
a)	Proper instruction				
b)	Safety devices				
c)	Proper cords				
d)	Inspection and maintenance				
e)	Other				
9.	Vehicle and Traffic				
a)	Rules and regulations observed				
b)	Inspection and maintenance				
c)	Licensed drivers				
d)	Other				
10.	Temporary Facilities				
a)	Emergency instructions posted				
b)	Fire extinguishers provided				
c)	Fire-aid equipment available				
d)	Secured against storm damage				
e)	General neatness				
f)	In accordance with electrical requirements				
g)	Other				
11.	Fire Prevention				
a)	Personnel trained & instructed to make use of facility				
b)	Fire extinguishers checked periodically & record maintained				
c)	No smoking in Prohibited areas				
d)	Fire Hydrants not obstructed				
e)	Regular fire drill conducted				



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(continued)

Sl. No.	Item	Satisfactory / Yes	Non-satisfactory/ No	Remarks	Action
12.	Electrical				
a)	Use of 3-core armored cables everywhere				
b)	Usage of 'All insulated' or 'double-insulated' electrical tools				
c)	All electrical connection are routed through ELCB				
d)	Natural Earthing at the source of power (Main DB)				
e)	Continuity and tightness of earth conductor				
f)	Effective covering of junction boxes, panels and other energized wiring places				
g)	Ground fault circuit interrupters provided				
h)	Prevention of tripping hazards maintained				
i)	DCP extinguishers arranged & licensed electrician engaged at site				
13.	Handling and Storage of Materials				
a)	Safely stored or stacked				
b)	Passageways clear/free from obstructions				
c)	Fire fighting facility in place				
14.	Flammable Gases and Liquids				
a)	Containers clearly identified/protected from fire				
b)	Safe storage & transportation arrangement made				
c)	Fire extinguishers positioned nearby				
d)	Facilities kept away from electric spark, hot spatters & ignition source				



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(continued)

Sl. No.	Item	Satisfactory /Yes	Non-satisfactory/ No	Remarks	Action
15.	Working at Height				
a)	Approved Erection plan and work permit in place				
b)	Safe access, Safe work platform & Safety nets provided				
c)	Life lines, Fall arrester, Full body harness with double lanyards used				
d)	Health Check record available for workers going up?				
e)	Protective handrails arranged around floor openings				
16.	Confined Space				
a)	Work Permit obtained from requisite authority				
b)	Test for toxic gas and sufficient availability of oxygen conducted & status				
c)	Supervisor present at site & at least one person outside the confined space for monitoring deputed				
d)	Availability of safe means of entry, exit and ventilation (register for entry & exit maintained)				
e)	Fire extinguisher and first-aid facility ensured				
f)	Lighting provision made by using 24V Lamp				
g)	Proper usage of PPEs ensured				
17.	Radiography				
a)	Proper storage and handling of source as per BARC/AERB guidelines (authorized radiographer available)				
b)	Work permit obtained				
c)	Cordoning of the area done				



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Sl. No.	Item	Satis- factory/Yes	Non- satis- factory/No	Remarks	Action
d)	Use of appropriate PPE's ensured				
e)	HSE training to workers/supervisors imparted during the fortnight (indicate topic)				
f)	Minimum occupancy of workplace ensured				
18.	Health Checks				
a)	All Workers medically examined and found be fit for working at heights (slinging, rigging, painting etc.) in confined space in excavation/trenching in shot blasting				
b)	Availability of First Aid box with contents				
c)	Proper sanitation at site, office and labour camps				
d)	Arrangement of medical facilities				
e)	Measures for dealing with illness at site &labour camps				
f)	Availability of Potable drinking water for workmen & staff				
g)	Provision of crèches for children				
h)	Stand by vehicle / ambulance available for evacuation of injured				
19.	Environment				
a)	Chemical and Other Effluents properly disposed				
b)	Cleaning liquid of pipes disposed off properly				
c)	Sea water used for hydro-testing disposed off as per agreed procedure				
d)	Lubricant Waste/Engine oils properly disposed				

	HEALTH, SAFETY AND ENVIRONMENT PLAN FOR 1x18.5 MW SPP BHEL PSSR NALCO DAMANJODI SITE	Doc no: HSEP:14 REV: 01
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Sl. No.	Item	Satis- factory/Yes	Non- satis- factory/No	Remarks	Action
e)	Waste from Canteen, offices, sanitation etc disposed properly				
f)	Disposal of surplus earth, stripping materials, Oily rags and combustible materials done properly				
g)	Green belt protection				

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ACCIDENT/INCIDENT REPORT

(To be submitted by Contractor after every Incident/Accident within 24 hours to DASTUR/Owner)

Report No. : _____ Date : _____

Project site : _____ Name of work : _____

Contractor's name : _____ Contractor's Job
Engineer (Name) : _____

Non-disabling injury (Non-LTA)	Hospitalized but resumed duty before end of 48 hrs	
Disabling injury (other LTA)	Hospitalized & failed to resume duty within next 48 hrs	
Fatal (LTA)	Death/Expiry	
First Aid case (non LTA)	Resume duty after first aid	

Name of the injured: Father's name of victim:

Sub-contractor's Name:

Gate Pass No.: Age: Yrs.

Victim's medical fitness exam. (Pre-empl.) date:

Date & time of Accident/Incident:

Name of Witness: (1) (2) (3)

Profession of victim:

Bar Bender		Carpenter		Meson	
Fitter		Helper		Gas Cutter	
Grinder		Welder		Electrician	
Driver		Rigger		M/c. Operator	
Engineer		Manager		Others (specify)	

Qualification:

No formal education		Non-Matriculate		Matriculate	
Graduate		Post-graduate		Others (specify)	

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Job Experience:

NIL		Less than 2 yrs		2-5 yrs	
5-10 yrs		11-15 yrs		15 years and above	

Location where the incident happened:

Activity/works that was continuing during incident/accident:

Excavation		Demolition		Concrete carrying	
Concrete pouring		Transportation of materials (manually)		Transportation of materials (mechanically)	
Work on or adjacent to water		Work at height (+2.0mts)		Scaffold preparation	
Scaffold dismantling		Piling works		Welding	
Grinding		Gas cutting		Pipe fit-ups & fabrication	
Structural fabrications		Machine works		Hydro-testing works	
Electrical works		Erection activities		Others (specify)	

What exactly the victim was doing just before the incident/accident ?

.....
.....

Nature of Injury:

Bruise or Contusion		Abrasion (superficial wound)		Sprains or strains	
Cut or Laceration		Puncture or Open wound		Burn	
Inhalation of toxic or Poisonous fumes or gases		Absorption		Amputation	
Fracture		Others (specify)			

Parts of body involved in incident/accident:

Head		Face		Eyes	
Throat		Arm (above wrist)		Hand (including wrist)	
Fingers		Trunk (Abdomen/ Back/ Chest/ Shoulder)		Throat	
Leg (above ankle)		Foot (incl. ankle)		Toes	
Multiple				Others (specify)	

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Accident type:

Struck against		Struck by		Fall from elevation	
Fall on same level		Caught in		Caught under	
Caught in between		Rubbed or abraded		Contact with (Electricity)	
Contact with (Temp./Extremes)		Contact with chemicals or oils		Vehicle accident	
Others (specify)					

Medical Aid provided (indicate specific aids/treatment etc):

.....

Actions taken to prevent recurrence of similar incident/accident:

.....

Intimation to local authorities (Dist. Collector/Local Police Station/ESI Authority)
 : Yes/No/NA. If yes, to whom

.....

Safety Officer
 (Signature and Name)
 Stamp of Contractor

Site Head/Resident Construction Manager
 (Signature and Name)

To: Owner
 RCM/Site-in-Charge DASTUR (3 copies)

Divisional Head (Construction) through RCM



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Project Manager, DASTUR, through RCM

**SUPPLEMENTARY INCIDENT/ACCIDENT INVESTIGATION REPORT
TICK THE APPROPRIATE ONE AS APPLICABLE (Furnish within 72 hours)**

Supplementary to Incident/Accident Report No. (Copy enclosed)

Report No.: _____ Date: _____

Project site: _____ Name of work: _____

Contractor's name : _____ Contractor's Job
Engineer (Name): _____

Non-disabling injury (Non-LTA)	Hospitalized but resumed duty before end of 48 hrs	
Disabling injury (other LTA)	Hospitalized & failed to resume duty within next 48 hrs	
Fatal (LTA)	Death/Expiry	
First Aid case (non LTA)	Resume duty after first aid	

Name of the injured: Father's name of victim:

Sub-contractor's Name:

Gate Pass No.: Age: Yrs.

Victim's medical fitness exam. (Pre-empl.) date:

Date & time of Accident/Incident:

Name of Witness: (1) (2) (3)

Profession of victim:

Bar Bender		Carpenter		Meson	
Fitter		Helper		Gas Cutter	
Grinder		Welder		Electrician	
Driver		Rigger		M/c. Operator	
Engineer		Manager		Others (specify)	

Qualification:

No formal education		Non-Matriculate		Matriculate	
Graduate		Post-graduate		Others (specify)	

Job Experience:

NIL		Less than 2 yrs		2-5 yrs	
5-10 yrs		11-15 yrs		15 years and above	

Location where the incident happened:

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Activity/Works that was continuing during incident/accident:

Excavation		Demolition		Concrete carrying	
Concreting pouring		Transportation of materials (manually)		Transportation of materials (mechanically)	
Work on or adjacent to water		Work at height (+2.0 mts)		Scaffold preparation	
Scaffold dismantling		Piling works		Welding	
Grinding		Gas cutting		Pipe fit-ups & fabrication	
Structural fabrications		Machine works		Hydro-testing works	
Electrical works		Erection activities		Others (specify)	

What exactly the victim was doing just before the incident/accident ?

.....
.....

Particular of tools & tackles being used and condition of the same after incident/accident:

.....

Description of incident/accident (how the incident was caused):

.....
.....

Nature of Injury:

Bruise or Contusion		Abrasion (superficial wound)		Sprains or strains	
Cut or Laceration		Puncture or Open wound		Burn	
Inhalation of toxic or Poisonous fumes or gases		Absorption		Amputation	
Fracture		Others (specify)			

Parts of body involved in incident/accident:

Head		Face		Eyes	
Throat		Arm (above wrist)		Hand (including wrist)	
Fingers		Trunk (Abdomen/Back/Chest/Shoulder)		Throat	



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Leg (above ankle)		Foot (incl. ankle)		Toes	
Multiple				Others (specify)	

(continued)

Accident type:

Struck against		Struck by		Fall from elevation	
Fall on same level		Caught in		Caught under	
Caught in between		Rubbed or abraded		Contact with (Electricity)	
Contact with (Temp./Extremes)		Contact with chemicals or oils		Vehicle accident	
Others (specify)					

Name & Designation of person who provided First-Aid to the victim:

Name & Telephone number of Hospital where the victim was treated:

Mode of transport used for transporting victim – Ambulance/Private car/Tempo/Truck/Others:

How much time taken to shift the injured person to Hospital:

In case of FATAL incident, indicate clearly the BOCW Registration No. of the Victim/Company:

Comments of Medical Practitioner, who treated/attended the victim/injured (attached/described here):

What actions are taken for investigation of the incident, please indicate clearly – (Video film/Photography/Measurements taken etc:)

Immediate cause (Please tick the right applicable):

Hazardous methods or procedures inadequately guarded		Poor housekeeping		Inadequate or improper PPE	
Environmental hazards (excess noise/space constraint/inadequate ventilation)		Improper illumination/moving on oval surface		Working on dangerous equipment	
Failure to secure		Horse-play		Failure to use PPE	
Inattention to surroundings		Improper use of hands & body parts		By-passing safety devices	



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Unsafe mixing or placement of tools & tackles		By-passing standard procedures		Failure in communication	
Operating without authority		Improper use of equipment or tools & tackles		Drug or alcoholic influence	
Excessive haste		Others (specify)			

(continued)

Basic cause:

Over confidence		Impulsiveness		Over exertion	
Faulty Judgment or poor understanding		Failing to keep attention constantly		Nervousness & fear	
Fatigue		Defective vision		Ill health or sickness	
Slow reaction		Others (specify)			

Root cause:

Inadequate Engg		Improper Design		Inadequate planning & organization	
Inadequate knowledge		Inadequate skill		Inadequate training	
Inadequate supervision		Improper work procedure		Inadequate compliance with standard	
Substandard performance		Inadequate maintenance		Improper inspection	
Others (specify)					

Loss of man days and impact on site works, (if any):

Remarks from Contractor(s) Safety Officer/Engineer:

- Was the victim performing relevant tasks for which he was engaged/employed ? .. Yes / No
- Was the Supervisor present on work-site during the incident .. Yes / No
- Have the causes of incident rightly identified ? .. Yes / No

Cause of Accident was

Remedial measures recommended by **Safety Officer of Contractor** for avoiding similar incident in future:

Intimation to local authorities (District Collector/Local Police Station/ESI authority): Yes / No / NA. If Yes, to whom



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Safety Officer
(Signature and Name)
Stamp of Contractor

Site Head/Resident Construction Manager
(Signature and Name)

To:
Owner
RCM/Site-in-Charge DASTUR (3 copies)
Divisional Head (Construction) through RCM
Project Manager, DASTUR, through RCM



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**NEAR MISS INCIDENT/DANGEROUS OCCURRENCE SUGGESTED
PROFORMA (To be submitted within 24 hours)**

- **Near Miss:** Human injury escaped and no damage to property, equipment or interruption to work.
- **Dangerous Occurrence:** Damage to property, equipment or interruption of work, but not resulting in personal injury/illness, e.g. fire incident, collapse of structure, crane failure, etc.

Report No.:

Name of Site: Date:

Name of Work: Contractor:

Incident reported by :

Date & Time of incident :

Location :

Brief description of incident:

Probable cause of incident:

Suggested corrective action:

Steps taken to avoid recurrence: Yes No. ☐ ☐

To: Owner

- RCM/Site-in-Charge DASTUR (3 copies)
- Divisional Head (Construction) through RCM
- Project Manager, DASTUR, through RCM



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MONTHLY HEALTH, SAFETY & ENVIRONMENT (HSE) REPORT

(To be submitted by each Contractor)

Actual work start Date:..... For the Month of:
 Project: Report No.:
 Name of Contractor: Status as on:
 Name of Work: Job No.:

Item	Upto Previous Month	This Month	Cumulative
1. Average no. of Staff & Workmen (average daily headcount, not man days)			
2. Man-hours worked			
3. No. of induction programmes conducted			
4. No. of HSE meetings organized at site			
5. No. of HSE awareness programmes conducted at site			
6. No. of Tool Box Talks conducted			
7. No. of Lost Time Accidents (LTA):			
- Fatal			
- Other LTA			
8. No. of Loss Time Injuries (LTI):			
- Facilities			
- Other LTI			
9. No. of Non-Loss Time Accidents			
10. No. of First Aid Cases			
11. No. of Near Miss Incidents			
12. No. of unsafe acts/practices detected			
13. No. of disciplinary actions taken against staff/workmen			
14. Man-days lost due to accidents			
15. LTA Free man-hours i.e. LTA free man-hours counted from last LTA (enter date:)			
16. Frequency Rate (No. of LTA per 2 lakhs man-hours worked)			
17. Se verity Rate (No. of man-days lost per 2 lakhs man-hours worked)			
18. Loss Time Injury Frequency (No. of LTI per 2 lakhs man-hours worked)			
19. No. of activities for which Job Safety Analysis (JSA) completed			
20. No. of incentives/awards given			
21. No. of occasions on which penalty imposed by DASTUR/Owner			
22. No. of Audits conducted			
23. No. of pending NCs in above Audits			
24. Compensation cases raised with Insurance			
25. Compensation cases resolved and paid to workmen			
26. Whether workmen compensation policy taken		Yes	No
27. Whether workmen compensation policy is valid		Yes	No
28. Whether workmen registered under ESI Act, as applicable		Yes	No
Remarks, if any:			

Date:

Prepared by Safety Officer
(Signature and Name)

Approved by Site Head/Resident Construction Manager
(Signature and Name)

To: - Owner
- RCM DASTUR (2 copies)



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DAILY SAFETY CHECKLIST

(To make use of before start of day's work)

Project : Sr. No. :

Name of the work : Date :

Name of contractor : Job No. :

Description of Job decided to perform:

● **Use of PPE/Safety Gadgets**

Sl. No.	PPEs	Compliance (Yes/No)	Sl. No.	PPEs	Compliance (Yes/No)
1	Safety Helmets		6	Face Shield	
2	Safety Shoes		7	Full body harness	
3	Hand Gloves		8	Fall Arrest System	
4	Dust Musk		9	Safety Net	
5	Safety Goggles		10	Horizontal life-line made of steel wire (dia not less than 8.0 mm)	

(Sl. No. 1 & 2 are compulsory for everyone. Specify and ensure use of other safety gadgets as required for the job).

● **Identify following important unsafe conditions:**

Sl. No.	Conditions	Yes/No
1	Access to work site/emergency escape clear	
2	Soil/Loose earth kept away from excavated pit/slope/ladder provided	
3	Electrical wire/welding lead lying entangled on ground/welding m/c. booth accessible	
4	Elevated Work platform/open ends are protected	
5	Ground area cordoned-off before lifting works or erection at height/ground area checked and cordoned-off before start of height works	
6	Structural members/erected pipes/wooden boards/pieces etc are safely anchored at heights and are not likely to fall down on people when working beneath	
7	Rope ladders tied-up on tall steel structures, long before are removed to get rid of their use	
8	Any other	

● Indicate actions taken, if status of any of the above items is found No ☐

● Specific Safety Guidelines/Precautions, if any (communicated through TBT)

● Above conditions and PPE compliances are checked by undersigned and correct status are indicated after verification.



**HEALTH, SAFETY AND ENVIRONMENT PLAN
FOR 1x18.5 MW SPP
BHEL PSSR NALCO DAMANJODI SITE**

Doc no: HSEP:14

REV: 01

POWER SECTOR

Date: 31.03.2021

*******END OF DOCUMENT*******



GENERAL GUIDELINES FOR INSULATION WORKS

This booklet is given as a general guideline to this tenderers about insulation works, However instructions given in the drawings & other schedule issued during execution of the work shall be final and binding of the contractor.



**Bharat Heavy Electricals Limited
(A Govt. Of India Undertaking)
Power Sector Southern Region
690, Anna Salai , Nandanam,
Chennai – 600 035**

GENERAL NOTES ON ERECTION OF INSULATION

1. It is important that the sheet metal covering is done, by a experienced and competent tinsmith.
2. Person, who is doing the actual job, can alter the following said methods of fixing the sheet metal, as and when necessary, only after consulting the BHEL Erection Engineer.
3. Fixing pin of corresponding thickness of insulation shall be welded by **STUD WELDING** process.
4. Circumferential and axial overlapping of outer casing should be 50 mm unless specified otherwise.
5. **FOR HORIZONTAL AND INCLINED DUCT AND PIPE:**
 - 1) All overlapping in axial direction should be at the bottom of the duct and pipe. Provision of beading and Sealing compound is not required.
 - 2) For circumferential overlapping of inclined duct and pipe, provision of beading and Sealing compound is not required.
 - 3) For circumferential overlapping of horizontal pipe and duct, provide beading. Apply Sealing compound if necessary.
- 5A. **FOR VERTICAL DUCT AND PIPE:**
 - 1) For overlapping in the axial direction provide beading. Apply Sealing compound if necessary.
 - 2) For circumferential overlapping provision of beading and Sealing compound is not required.
6. The joints of wool mattresses should be staggered in both circumferential and axial direction. The Wire netting at the joints of Wool mattresses are to be sewn together by G.I. sewing wire dia 0.71 mm.
7. In case more than one layer of Wool mattress is to be applied for pipe insulation the inner layer should be tied by two turns of G.I binding wire dia 1.22 mm at a pitch of 240 mm, and the outer layer should be tied by two turns of G.I. binding wire dia 1.22 mm at a pitch of 160 mm. The ends of the wire should be twisted and pressed in to the insulation.

8. All the overlapping of outer casing should be made such that no rain water enters into the insulation through the joints.
9. In case of insulation fixing pin welding to tubes, equal circumferential pitch is to be maintained. Use a minimum number of 4 pins, at 90 degree radial spacing.
10. The inner side of the Aluminum / G.I sheet of outer casing should be painted with two coats of anticorrosive Paint (IS:158). Retainer – Type A must be coated with Aluminum paint to avoid bi-metal corrosion or Neoprene strip must be provided between Retainer – Type A and Casing support.

The above mentioned paints are not in BHEL scope of supply

11. Self tapping screws should be fixed over the circumferential overlapping. The axial joints should be on the Casing supports and outer casing should be fixed to Casing supports with Self tapping screws at a pitch of 150 mm approximately.
12. The outer casing should be wound tightly around the insulation and then fixed with Self tapping screws when there is not any Fixing pin for insulation.
13. Loose wool can be taken from the Wool mattresses wherever required.
14. Clean the surface to be insulated of rust, dust, grease, loose scale, oil, moisture, etc.
15. Care shall be taken that flexible insulation is not unduly compressed.
16. After insulating the equipment with Calcium silicate / Mineral wool mattress, all voids in the joints shall be filled with Moldable insulation / loose mineral wool respectively.
17. Each day application of insulation should be weather proofed overnight by either with the final protective casing or with some temporary weatherproof covering so that it does not get drenched in rain.
18. The indicated thickness of insulation is the minimum requirement which should be provided. Any alteration in the thickness of insulation should be done only after getting the prior approval from the Design Engineer.
19. The layers of Wool mattresses are to be taken as indicated below:

THICKNESS IN mm	LAYER IN mm				
	1 st	2 nd	3 rd	4 th	5 th
250	50	50	50	50	50
230	50	60	60	60	
210	50	50	50	60	
200	50	50	50	50	
190	40	50	50	50	
180	60	60	60		

160	50	50	60
150	50	50	50
140	40	50	50
120	60	60	
100	50	50	
80	40	40	

20. Where junctions between two or three bodies or different dia, occur and different insulation thickness is specified the greater thickness shall be continued for a length equal to one dia of the smaller body then smoothly tapered to the required smaller thickness over a length equal to two dia of the smaller body. When there is a differential thermal expansion between these bodies, they should be insulated individually.

21. The required fixing components and outer casing sheets have been released under PG_32. The insulation materials have been released under PG-33.

22. **STORAGE INSTRUCTIONS:**

22a) Mineral wool mattress:

These materials should be stored under fully covered sheds. Stocking must be done over planks and must be out of contact with ground. Height of stacking should not exceed 3 Meters.

Once drenched in water these materials loose all the desired properties and become unsuitable for use. Drying the material does not restore the desired properties.

22b) Outer casing sheets:

Outer surfaces are meant for improving the appearances also scratch marks, dents, etc, spoil the appearance.

23. Typical insulation arrangement drawings are indicated below.

1)	Tees	4-00-235-08546
2)	Elbows	4-00-235-08547
3)	Flanges	4-00-235-08548
4)	Expansion joint for pipe	4-00-235-08549
5)	Expansion piece for duct	3-00-235-06258 & 3-00-235-06259
6)	Manhole door for duct	3-00-235-06260

INSULATION OF DRUM END

MATERIAL:

- 1) FLAT 50 X 6
- 2) FIXING PIN INSLN DIA – 6
- 3) RETAINER TYPE – A
- 4) G.L. BINDING WIRE DIA – 1.22 / 0.914
- 5) WOOL MATTRESS
- 6) OUTER CASING
- 7) SELF TAPPING SCREW – M4 X 13
- 8) G.L. SEWING WIRE DIA – 0.71 / 0.914

APPLICATION:

Install Flat 50 x 6 circumferential bands to fit snugly around the drum.

Flat 50 x 6 lattice bar 8 numbers should be radially placed over the dished end and contouring the same and it is to be welded over circumferential bands.

Weld the Fixing pins to the lattice bars circumferential bands.

Fix the Wool mattress.

Position the Retainer and tack weld to the Pin.

Tie with Binding wire across the Pins.

Fix the outer casing strips by Self tapping screws.

INSULATION OF PIPES AND BUNCH OF TUBES

MATERIAL:

- 1) WOOL MATTRESS
- 2) G.L. SEWING WIRE DIA-0.71 / 0.914
- 3) G.L. BINDING WIRE DIA – 1.22 / 0.914
- 4) OUTER CASING
- 5) SELF TAPPING SCREW – M4 x 13

APPLICATION:

Fix the insulation over the bunch of tubes / pipes.

Tie the insulation with G.I. binding wire circumferentially.

Fix the outer casing sheet with self-tapping screws.

**INSULATION OF VERTICAL PIPES
(WELDING OF FIXING PINS NOT PERMITTED ON PIPES)**

MATERIALS:

1) FIXING PIN INSLN DIA – 6	9) FLAT 50 x 6
2) RETAINER TYPE – A	10) PACKING CLOTH – 3 MM TK
3) CASING SUPPORT – 850MM	11) HEX HD BOLT M8X40
4) OUTER CASING	12) HEX NUT M8
5) WOOL MATTRESS	13) PNCHD WASHER A9
6) SELF TAPPING SCREW – M4X13	14) GI BINDING WIRE DIA – 1.22 /0.914
7) CLAMP	15) GI SEWING WIRE DIA – 0.71 / 0.914
8) SUPPORTING SHEET	16) SHEET 3.15x30x3000

APPLICATION:

At every three meters provide the Clamps over the pipe with bolt but and washer by using packing cloth in between the pipe and clamp. Fix the sheet 3.15x30x3000 over the pipe and weld to the clamps. Weld the fixing pin over the sheet. Consult the Welding engineer before welding.

Weld the Flat to the Clamps.

Weld the Supporting sheets to the Flats.

Fix the insulation.

Position the Retainer Type – A and tack weld to the Pins.

Tie the insulation to the pipe with GI biding wire circumferentially.

Fix the casing support to the Retainer by using two numbers of Self tapping screws, fixed diagonally for each Retainer.

Fix the outer casing sheet with self tapping screws.

INSULATION OF VALVE

MATERIAL:

- 1) SM CLAMP FOR DETACHABLE INSULATION TYPE – A (To be used up to 200 mm overall dia)
- 1)a SM CLAMP FOR DETACHABLE INSULATION TYPE – B (To be used above 200 mm overall dia)
- 2) WOOL MATTRESS
- 3) OUTER CASING
- 4) SELF TAPPING SCRES – M4 x 13
- 5) G.I SEWING WIRE DIA – 0.71
- 6) SNAP HD RIVET 3 x 8
- 7) CHS SCREW M4 x 20
- 8) HEX NUT M4

APPLICATION:

The sheeting shall be made in two halves and the Sheet metal clamp mounted.

Wool mattress thickness according to adjacent pipe lines shall be pressed in to two halves.

The two halves shall be fitted over the valve to be insulated and locked by Sheet metal clamp.

Self tapping screws shall be used for clamping the two edges of the outer sheet casing when the length of the valve is more.

After assembling the Clamp put a bit of GI Binding wire as a pin through 1.6 mm hole provided.

INSULATION OF DUCT / FLAT SURFACE

MATERIALS:

1) FIXING PIN INSLN DIA – 6	5) GI BINDING WIRE DA – 1.22 / 0.914
2) WOOL MATTRESS	6) CASING SUPPORT – 650 MM
3) OUTER CASING	7) SELF TAPPING SCREW M4 x 13
4) RETAINER TYPE – A	8) GI SEWING WIRE DIA – 0.71 / 0.914

APPLICATION:

Weld the Fixing pin over the Duct / Flat surface.

Fix the insulation.

Position the Retainer Type – A and tack weld to the Fixing pins.

The GI Binding wire dia 1.22 shall be wound across the Fixing pins diagonally underneath the Retainer Type – A.

Fix the Casing support – 650 long to the Retainer Type – A by using two numbers of Self tapping screws, fixed diagonally for.

Retainer Type – A.

Fix the outer casing by using Self tapping screws.

DUCT STIFFENERS

When the stiffeners protrudes through the insulation and are exposed to atmosphere, provide an additional 40 mm insulation over the stiffener.

DUCT DAMPER & GATE

Insulation thickness shall be as per the adjacent duct insulation. The stuffing boxes should not be insulated. A clear gap of 50 mm (minimum) should be maintained all around the stuffing boxes.

AIR HEATERS

DO NOT insulate over the axial seal, adjuster seal access covers and basket removal doors insulation should be applied in a manner to permit a free circulation of ambient air around the bearing.

INSULATION OF DUCT (CLEARING STIFFENERS)

MATERIALS:

1) FIXING PIN INSLN DIA – 6	7) OUTER CASING
2) RETAINER TYPE – A	8) SELF TAPPING SCREW M4X13
3) RETAINER TYPE – C	9) WOOL MATTRESS
4) CASING SUPPORT – 650 MM	10) WELD MESH
5) GI BINDING WIRE DIA – 1.22/0.914	11) CORNER SUPPORT
6) GI SEWING WIRE DIA – 0.71 / 0.914	12) ANGLE 40X40X5 – 100

APPLICATION:

Weld the Fixing pin over the Duct.

Position the Retainer Type – C so that it will be in the same plane as that of the top surface of the stiffener.

Tack weld the Retainer – Type – C to the Fixing pin.

For the top plate of the horizontal duct, spread the Weld mesh over the Retainer Type – C.

This serves as the additional support where people walk over the insulation.

Weld the Corner support to the bottom corners of the duct.

Weld the Angle to the corner support.

This arrangement will help to achieve a sharp corner for the insulation and outer casing.

Fix the insulation.

Position the Retainer Type – A and tack weld to the Fixing pin.

The Binding wire shall be wound across the pins diagonally underneath the Retainer Type – A.

Fix the Casing support - 650 mm long to the Retainer by using 2 numbers of Self tapping screws, fixed diagonally for each Retainer.

Fix the outer casing by using Self tapping screws.

PROCEDURE FOR CURING OF CASTABLE REFRECTORY

CURING OF REFRACTORY WORK

Curing of refractory means retaining the moisture for a minimum period in order to ensure the proper hydration of the binder. Curing of exposed castable surfaces should start after the surface has become firm. This can be tested when a finger rubbed across the surface comes away clean or when the surface feels warm to the touch. Moisture loss for the first 24 hours, after the material has been installed shall be retarded. Initial set occurs within one or two hours.

Castables should be cured for 24 hours. Moist conditions can be maintained by protection with damp sacking or plastic sheet which should not come into immediate contact with the refractory or alternatively by dry coating the castable with an impervious organic based sealing compound. In some instances, satisfactory results can be obtained by sparkling water over the surface. It should be watered for a period of 20 to 24 hours after 4 to 5 hours of construction. The rate of water applicable should be carefully controlled to prevent washing of the fines and to prevent collection of pools in low spots. Shield the surface from direct sunlight at least for about 48 hours. 8 hours after casting and pouring, remove the wooden frames which have no load bearing function in order to permit watering of the lateral parts of the structures. In case of steel frames apply water without stripping them. On completion of the curing period the application of moisture should be stopped. The exposed castable should be allowed to air dry for 24 hours. Naturally air drying of castable after curing will actually cause slight increase in strength. The castable can be all dried indefinitely without adverse effect. Optimum results can be obtained with a drying period of 48 hours.

Before lighting the boiler for drying the setting the following shall be attended.

1. All dirt and foreign objects sticking to tube surface are to be removed to ensure a thoroughly clean surface.
2. Expansion joints are to be cleaned and inspected for the proper functioning of expansion during operation.
3. Test sample of castable refractory is to be taken from entry door regions to determine the moisture content in the laboratory.

Sample of castable are to be taken for the determination of moisture content before and after drying. When the moisture content drops below 0.58 the castable is considered to be dry and the boiler is ready for commissioning. All result of measurement should be duly recorded.

CARE OF THE REFRACTORY WORK

The refractory work is subjected to considerable thermal stresses during boiler operation. Sudden application of heat or cooling introduces severe stresses and endangers the refractory work. Even when the boiler is operated in the recommended regime possibilities of damage occurring to the refractories (due to severed reasons such as bad workmanship, poor quality, slag deposition, corrosive atmosphere etc) must be kept in mind. The following simple rules to be observed.

- (i) Avoid sudden cooling of the furnace after a shut down. A cooling rate of 20° to 30° per hour for the refractory lining in the initial period is recommended. This means that FD fans must be stopped after a shut down of the boiler. Ventilation of the furnace by natural draft is permissible only after six hours of shut down. Forced cooling can be started only after 16 hours.
- (ii) Avoid quick heating of the furnace. Boiler starting diagram is usually a reliable guide.
- (iii) Thoroughly examine the refractory work during shut downs for cracks, chipping off spelling etc. During operation also this can be checked periodically by visual examination through observation holes.

Whenever defects are noticed arrange for their quick elimination, by shutting down the boiler at the earliest depending on the scarceness of the defect.

- (iv) Abnormal heating of outside metal sheet covering of the boiler and hot spots are usually a good indication of damaged refractory and insulation in this area. The leakage of flue gas will spoil the property of good mattresses within a short time.
- (v) Keep the access door, observation doors, etc. properly shut. They are entry points for cold air and this cold air can damage the refractory work by localized cooling.
- (vi) Sufficient quantity of water is to be added to the castable refractory for mixing before application as per supplier's recommendations.

METHOD OF APPLICATION AND CURING OF POURABLE INSULATION

- (i) Typical application are for insulating behind buckstays and areas such as roofs having multiplicity of hangers, rods and other penetrations.
- (ii) The application of pourable insulation can be pumping and gunning.
- (iii) Density of the pourable insulation installed and cured is around 600 to 650 Kgs/M
- (iv) Pourable insulation is a hydraulic setting insulation additive or air entrainment agents shall not be used.
- (v)
 - (a) Empty the entire bag at a time and mix the whole material so that segregated particles get mixed.
 - (b) The pourable insulation should be thoroughly mixed with clean water to develop casing and pump consistencies.
 - © The correct quantity of water shall be placed in the mixer before adding the dry pourable insulation normally about 70 to 100 by weight. However this has to be confirmed from the supplier while purchasing this material.
 - (d) Mixing time shall not be less than the minutes or more than five minutes.
 - (e) Dried out material shall not be remixed.
 - (f) Pourable insulation once mixed must be in place within half an hour.
- (vi)
 - (a) All areas where pourable insulation will be placed must be free of scale, rust, dust or other loose materials.
 - (b) All porous forms used such as wood etc shall be oiled before pouring.
 - © All absorbent surface such as insulation brick, concrete, shall be wet down thoroughly to prevent water absorption.
 - (d) Waiting of wall insulation used as forms at buckstay levels is not required.
- (vii)
 - (a) The surface of pourable insulation once in place will become firm in approximately two hours. The surfaces should be kept damp with an occasional light spray or covering with a cloth that is kept damp for the entire 24 hours curing period.
 - (b) For mixing and spraying the water should be clean and cold.
 - © Application of moisture after 24 hours should be stopped forms etc should be removed and the materials allowed to air dry for 24 hours.
- (viii) The shuttering scaffolding moulds should be removed after about 36 hours of casing.

**APPLICATION OF INSULATION FOR BOILER PIPING,
PIPING AND EQUIPMENTS / VESSELS AND ACCESSORIES.**

Bonded mattress having standard thickness to 25, 40, 50, 60, 75 mm confirming IS 8103 having a density of 150 kg/cubic meter and light bonded mattress having a density of 150 kg/cubic meter and light bounded mattress having standard thickness of 25, 40, 50, 60, 75 mm conforming to IS 9842 having a density of 144 kg/cubic meter and pipe section in the standard thickness of 25, 40, 50, 60, 75 mm confirming IS 9842 having density of 144 kg/cubic meter will be 100 kg/cubic Mtr.

The application of insulation will be done as per general notes/ drawings enclosed. The application commissioning shall be as per latest editions of IS 7413 code of practice for application and finishing of thermal insulation materials between 40° C to 700° C of Bs 5970 code for practice for thermal insulation of pipe work and equipment (in the temperature range – 100° C to + 870° C).

Inspection before application, during the application and after the application of insulation will be carried out by BHEL Field Quality Engineer as per BHEL Field Quality Plan. Every layer of insulation shall be got approved by BHEL Engineer / FQA Engineer.

Prior to applying insulation the surfaces to be insulated shall be made clean and dry and free from dirt and grease. Where cladding is attached to carbons steel or low alloy steels the steel shall be first prime painted with zinc chromate and then painted with Aluminum paintings. Wherever required to provide aluminum foil as protective covering for bolts and other fittings shall be arranged by contactor. The prints wherever required for preservation coating shall be supplied by contractor.

For insulation of piping with performed pipe sections the came shall be applied over pipe and finally be held in position with 15 mm wide aluminum band at greater than 300 mm spacing for mineral wool insulation.

For insulation of piping with mattresses having backing GI wire netting, the required lengths and shapes are to be cut from the blankets and wrapped on the piping and held in position with proper support by fastening the binding to be done circumferential at not greater than 300 mm spacing.

Performed insulation on vertical or near vertical piping must be supported in position by means of metal ring at interval not greater than 960 mm.

The support attachment may be welded or clamped to the pipe, subject to the approval of BHEL Site Engineer Necessary fabrication of support rings to be done as per site requirement.

Piping bends shall be insulated to the same specification as adjacent straight piping and should form a smooth external surface. Where performed material is used it should be cut lobster-back fashion and wired or strapped into position.

Pipe insulation shall be cut to fit nearly around hangers and supports. On horizontal lines which are supported directly on pipe racks the insulation and weather proofing shall be sufficiently cut away at the support to accommodate pipe movement.

Protrusions through insulations which themselves do not required insulations such as pipe clamps supports of small pipings instrument take offs etc shall be covered to the same thickness as the adjacent insulation expect for hanger rods.

At outdoor location the hanger rod protrusion shall be shielded with metal flashing to deflect rain and protect the insulation from moisture while permitting the movement of the hanger rod.

Arrangement of securing the metal finish even the insulation shall ensure that direct metal contact between the insulated surface and outer metal cladding is avoided. 4mm thick asbestos board packing shall be used at interface to thermally isolate the metal covering from supporting arrangement. All cladding joints shall be vapours tight and shall be able to accommodate thermal movements. Paste type self setting vapours sealing compound shall be used.

Metal cladding on piping shall be screwed with self tapping screws. These joints should be arranged approximately 30° below horizontal centre line so as to shed water on any horizontal pipe line. The screws shall be flat or round head types of 12mm size and overlapping of 50 mm on both longitudinal and circumferential joints. The screws shall be provided at not greater than 150 mm spacing.

Insulation expansion joints shall be provided in all pipelines to allow movements and expansion of the pipe. The recommended intervals of expansion joints are.

Pipe Temperature	Spacing of Insulation Expansion joints
Below 200°C	5.5 M
201° - 300°C	3.5 M
301°C - 400°C	3.0 M
Above 400°C	2.0 M

All joints in the insulation shall be staggered. For multiple layer of insulation the different layers shall be applied so that the butt joints of one layer do not coincide with those of the other layers. At the joint of each layer of insulation loose insulation shall be packed firmly.

Equipments Insulation Application Procedure

For equipment and shells a matrix of insulation support shall be developed by:-

- (a) Welding the insulation support lugs on a frame work prepared with 20 mm x 3 mm size MS Straps where direct welding of lugs to the sheet is not permitted.
- (b) Welding the directly on shell after written permission by Site Engineer. The material of the support shall be similar to the material of the shell in this case.

The support shall be pitched at 300 mm for vertical and underside surfaces and 500 mm for oppressed surfaces. A support shall be located above each vessel flange at a sufficient distance above the flange bolts to allow for easy removal. The top and bottoms supports shall be slotted suitably for attachments of straps and wires.

The support lugs shall be 6 mm

Insulation with back up GI wire noting, shall be cut to fit the equipments and shall be wrapped on the equipment and held in position with proper support and tie wires. All joints between course shall be staggered and tightly butter and adjacent edges laced together with lacing wire.

Insulation shall be fastened in place with MS Straps of 20 x 3 mm, on approx., 300 mm centers where contour of equipment permits. Straps shall be tightened with a banding machine and champed with seals.

Insulation on top of horizontal heads shall be cut to fit the curvature of the head and shall be secured in place with the help of radial straps fixed in between circumferential rings. Insulation on bottom heads shall be wired to nuts welded to head. Insulation shall also be strapped to bottoms insulation support. For outdoor equipments insulation shall be arranged to be weather proof.

Metal jacketing shall be applied directly over the met insulation and neatly fitted to place. All gaps shall be arranged so as to shed water. Suitable flashing and weather proofing shall be provided at all nozzles, manholes and other projections to prevent the entrance of water.

VALVES & FLANGES INSULATION APPLICATION

The insulation on all valves and flanged joints shall be enclosed in a removable jacketing so that it may be removed without disturbing the concerned equipment or piping. The thickness of insulation shall be same as that of the pipe line in which these valves and fittings are located.

The layout of wool mattresses to be adopted to obtain the specified insulation thickness are as per be on unless otherwise specified:

Thickness of Insulation (mm)	Layer			
	I	II	III	IV
25	25			
40	40	-	-	-
50	50	-	-	-
60	60	-	-	-
65	40	25	-	-
75	75	-	-	-
80	40	40	-	-
100	50	50	-	-
110	60	50	-	-
125	75	50	-	-
135	75	60	-	-
150	75	75	-	-
155	75	40	40	-
160	75	60	25	-
165	75	50	40	-

The material density of boned mineral wool used for pipe having outside diameter more than 355.6 mm is 150 kg/cubic meter IS 8183.

The material density of bonded mineral wool used for pipe having outside diameter less than or equal to 355.6 mm is 144 kg/cubic meter IS 9842.

Cladding material used is galvanised steel sheet as per IS 277 GRADE 375.

Cladding material gauge for pipe outside diameter less than or equal to 300 mm is 24 SWG.

Cladding material gauge for pipe outside diameter greater than 300 is 22 SWG.

For piping up to including 355.6 mm OD, first layer shall be pipe sections and subsequent layer shall be bonded. Wherever pipe sections are not supplied the first layer has to be wrapped using bonded wool material for piping 355.6 mm OD, bonded mattress shall be used on all the layers.

Description of type of insulation and the method of Application for Boiler Feed Pumps

1. Type of insulation

The pumps should be insulated with 125 mm thick flexible wire backed mineral wool mattress of 150 kg/ density.

2. Method of Application

The above insulation is to be applied to 2.0 mm thick flats aluminum sheeting (18 SWG) and secured by 19 mm wide aluminum retaining dips and 1/8 inch diameter aluminum pop rivets, all to be secured by 2 inch long X No.8 spacing to a 40 mm wide x 3 mm thick angle iron frame work of all welded construction bound by 40 mm PVC tape.

<u>SECTION</u>	<u>TITLE</u>	<u>NO. OF SHEETS</u>
A	METHOD OF APPLICATION OF THERMAL INSULATION FOR PIPING AND EQUIPMENTS AND MATERIAL SPECIFICATIONS (ANNEXURE-1)	4
B	THERMAL INSULATION APPLICATION DRAWINGS	13

SECTION - A

THERMAL INSULATION FOR PIPING AND EQUIPMENTS

1.0 INTRODUCTION

In a thermal power station or process plant, thermal insulation or heat lagging of piping and equipment's carrying hot fluids is essential for best economy and protection of operating personnel. Any pipe which is at a temperature higher than its surroundings will lose heat and the amount of heat lost will depend upon the temperature of the fluid and the thermal conductivity of the piping material/covering.

The heat lost through bare pipe increases with

- a) Increase in the temperature of fluid conveyed
- b) Decrease in ambient temperature and
- c) Increase in wind velocity of the surroundings.

The heat so lost has potential for work and rapidly increasing cost of fuel in the recent past has promoted to find all possible means to conserve energy. Providing proper and adequate insulation on to the piping and equipments controls heat transfer and maintains the required service temperature.

2.0 METHOD OF APPLICATION

The method of application is highly skilled job. Badly fitted/laid insulation can lead to greater heat loss, higher cold surface temperature than that estimated and frequent maintenance. Following are the important points to be considered in the application of the insulation.

- 2.1 Before applying insulation, it should be ensured that all instrument tappings, clamps, lugs and other connections on the surface to be insulated have been properly installed as per relevant drawings.
- 2.2 All surfaces to be insulated shall be cleaned of all foreign materials such as dirt, grease, loose scale, moisture etc.
- 2.3 Welding of lugs, attachments, clips etc. on the surface to be insulated for supporting insulation shall not be carried out without the permission of the authorized person.
- 2.4 All flanged joints shall be insulated only after final tightening and testing.
- 2.5 The insulation shall be applied to all surfaces when they are at ambient temperature.
- 2.6 Where more than one layer of insulation is involved, mattresses should have staggered joints (at 60 deg) and they must be held in close contact with face of

pipes/fittings by means of binding wires / Aluminum bands / seals. Circumferential joints of multilayer insulation should also be staggered by at least 150 mm.

(Refer Drg. No. PE-4-999-169-01).

- 2.7 For the first layer of insulation and in case of multi layer of insulation, mattresses with hexagonal wire netting will be facing on outer side.
- 2.8 Insulation mattresses shall be held in place by fastening over with binding wire. Care should be taken to see that the flexible insulation mattresses are not unduly compressed. The ends of binding wire shall be lightly twisted together, bent over and pressed into the insulation. For mattresses, binding wire shall be used at intervals of 300mm.

In the addition Aluminium bands shall also be provided at 300 mm intervals for diameters greater than 500mm. (Refer Drg No. PE-4-99-169-01.)

- 2.9 Where junctions between bodies of different diameters occur and difference in insulation thickness is specified, the greater thickness is to be continued for a length equal to one diameter of the smaller body and then smoothly tapered to the required smaller thickness over a length equal to two diameters of the small body.
- 2.10 The indicated thickness of insulation are minimum requirement which should be maintained. Any change in the thickness of the insulation should be done only after prior approval of the design engineer.
- 2.11 The day-to-day insulation work should be covered with suitable protective materials to prevent the rain water entry, if same is expected.
- 2.12 The insulation shall be cut to fit the piping O.D / equipment and shall be wrapped on the piping / equipments and held in position with proper support and wires. All the joints should be properly staggered and tightly butted and adjacent edges laced (Refer Drg No. PE-4-999/169/01)
- 2.13 The insulation of valves and flange joints shall be enclosed in a removable jacketing so that it may be removed without disturbing the concerned equipment or piping. The thickness of insulating shall be same as that of the pip line in which these valves and fittings are located. (Refer Drg No. PE-4-999-169-07.)
- 2.14 Steam / Air / Gas leakages in and around the pipes to be insulated with be attended before applying insulation.
- 2.15 In order to provide support to Aluminium cladding, support rings made out of 20 x 3 mm M.S. flats shall be fixed at equal intervals of approximately 850 mm spacing and at every circumferential joints. These rings shall be fixed with 'L'

type lugs and shall be fabricated from 20 x 3 mm M.S flats. To reduce that conductivity through these lugs 20 mm x 3 mm size Ceramic mill board shall be used between rings and lugs (Refer Drg No. PE-4-999-169-04 and PE-4-999-169-13).

- 2.16 Spacing between supporting rings for vertical piping shall be 3 mtrs. Support rings are to be provided only when the vertical height exceeds 3 mtrs. (Refer Drg No. PE-4-999-169-03-and PE-4-999-169-05).
- 2.17 For vertical pipes since support rings is provided at every 3 mtrs interval, only two spacer rings shall be provided in between support rings.
- 2.18 Spacer rings shall be provided at both ends of elbows/bends, valves and flanges pipe having dia more than 89mm.
- 2.19 Wherever the end of hanger clamp assembly protrudes out of the insulation at the bottom suitable box structure are to be provided. Pipe hangers and supports should be covered in such a way that the moisture cannot penetrate into the insulation.
- 2.20 It is very important that sheet metal cladding should be done by a well experienced and competent fabricator. Person doing the job can alter the method of fixing of cladding sheet after consulting the concerned design engineer.
- 2.21 The longitudinal joint in the outer cladding sheet should always be at the lower half of the circumference for horizontal piping so that no rain water enters the insulation through the joints. (Refer Drg No. PE-4-999-169-01).
- 2.22 The joints of outer cladding should be staggered axially.
- 2.23 Inside surface of all Aluminium sheet will have two coats of Bituminous paint applied uniformly.
- 2.24 Aluminium sheets covering on outdoor horizontal pipes will be provided with 3 mm drain hole at the bottom center line at 6 mtr intervals.
- 2.25 The cladding sheet shall provide directly over the insulation/finishing cement (IF APPLICABLE). Suitable flashing and weather proofing shall be provided at all nozzles, manholes and other projections to prevent the entrance of water.
- 2.26 Loose wool can be taken from wool mattresses. Wherever gaps and voids have to be filled.
- 2.27 Sealing compound to be applied on Aluminum cladding sheet joints.

- 2.28 Support rings/spacer rings shall be provided if the insulation thickness > 40mm and pipe diameter > 89mm.
- 2.29 Equipment's name plates shall not be insulated.
- 2.30 Clips made out of sheet be riveted inside the box for insulation of valves and flanges to hold the insulation in box. (Refer Drg No. PE-4-999-169-06).
- 2.31 The insulation local to the inspection points of the critical piping shall be removable.
- 3.00 For Thermal Insulation Material Specification related to the project refer Annexure – 1.

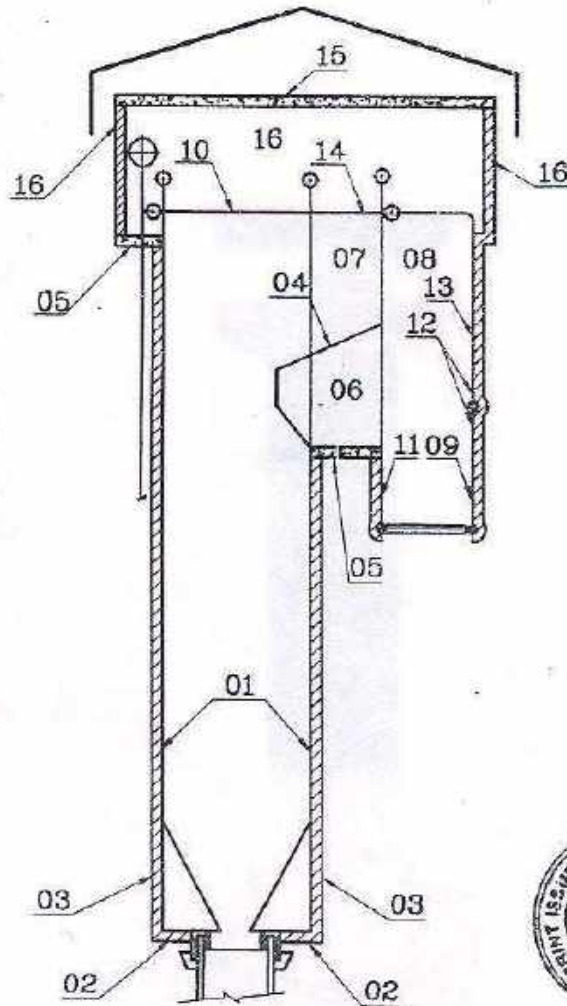
IMPORTANT POINTS TO BE TAKEN CARE DURING APPLICATION

- I) Binding wires for all layers of insulation will be at distance of 300mm.
- ii) In addition Aluminum bands/seals also to be provided at distance of 300 mm for sizes above 500mm.
- iii) Aluminum bands/seals to be provided over aluminum sheets at distance of 500mm.
- iv) Ceramic mill boards to be used between all 'L' type lugs and the support rings.
- v) Inside surface of Aluminum sheets to have 2 coats of bituminous paint applied uniformly.
- vi) Gaps to be properly filled with loose wool taken from mattresses.
- vii) End of hanger clamp assembly protruding out of insulation at the bottom should be suitably boxed with Aluminum sheets.
- viii) Valves to be insulated properly in box structure as given in enclosed drawings.
- ix) Multilayer longitudinal and circumferential joints should be staggered.

ANNEXURE – 1

- 1.0 **Thermal insulating materials shall be per the details given below:-**
- 1.1 **Lightly Bonded Mineral (Rock) wool Mattresses** of density 150 Kg / Cub. Mt with S.S. wire netting will be applied for the first layer of insulation where hot face temperature greater than 400 degree centigrade. For subsequent layers matters of density 150 Kg / Cub. Mtr with G.S. wire netting will be applied.
- 1.2 **Lightly Bonded Mineral (Rock) wool Mattresses** of density 100 Kg/Cub. Mt with G.S. wire netting will be applied for all layers of insulation for host face temperature less than and equal to 400 degree centigrade.
- 2.0 **Binding and lacing wires:** For insulation matters shall be of stainless steel for all insulation interface temperatures.
- 3.0 **Aluminum cladding sheet** shall be provided over the Mattresses ad per details given below.
- | | |
|-----------------------|---|
| 18 SWG (1.22 mm thk.) | For pipes with dia over insulation above 450 MM. |
| 20 SWG (0.91 mm thk.) | For pipes with dia over insulation above 150 MM and less than equal to 450MM. |
| 22 SEG (0.71 mm thk.) | For pipes with dia over insulation less than equal to 150mm. |

SECTION – B

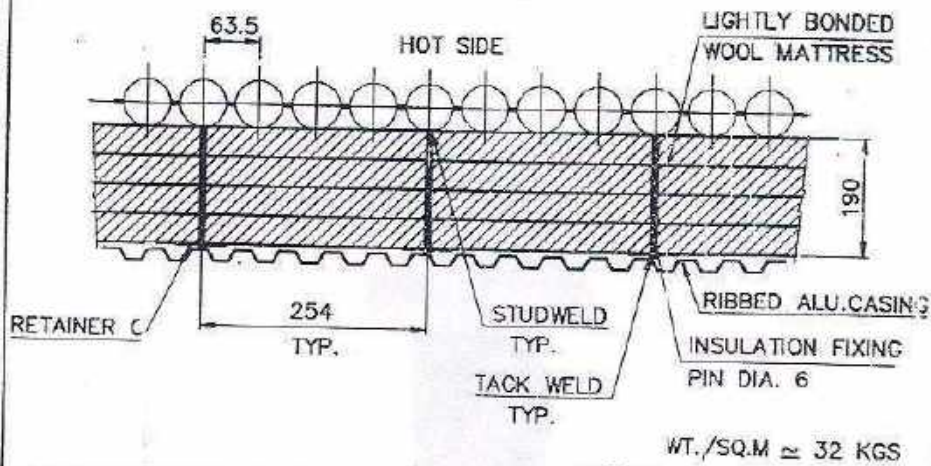


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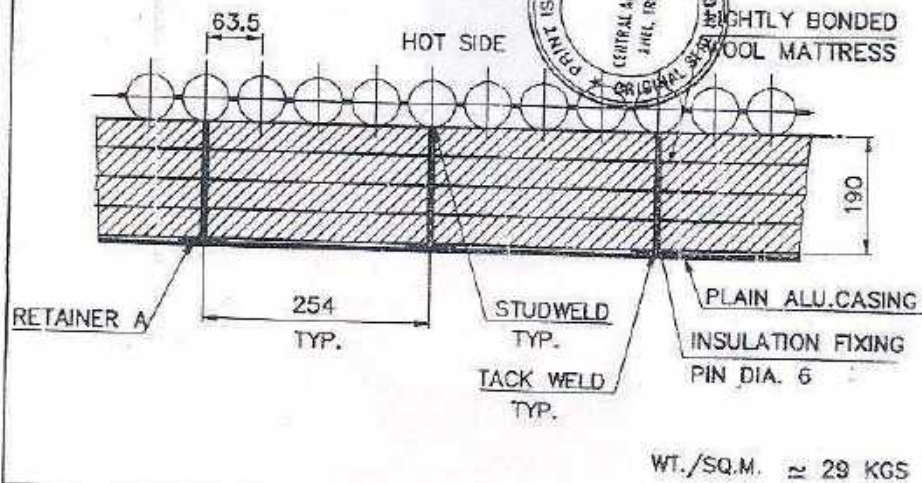
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DETAIL 01

SHEET 02 OF 09



DETAIL 02

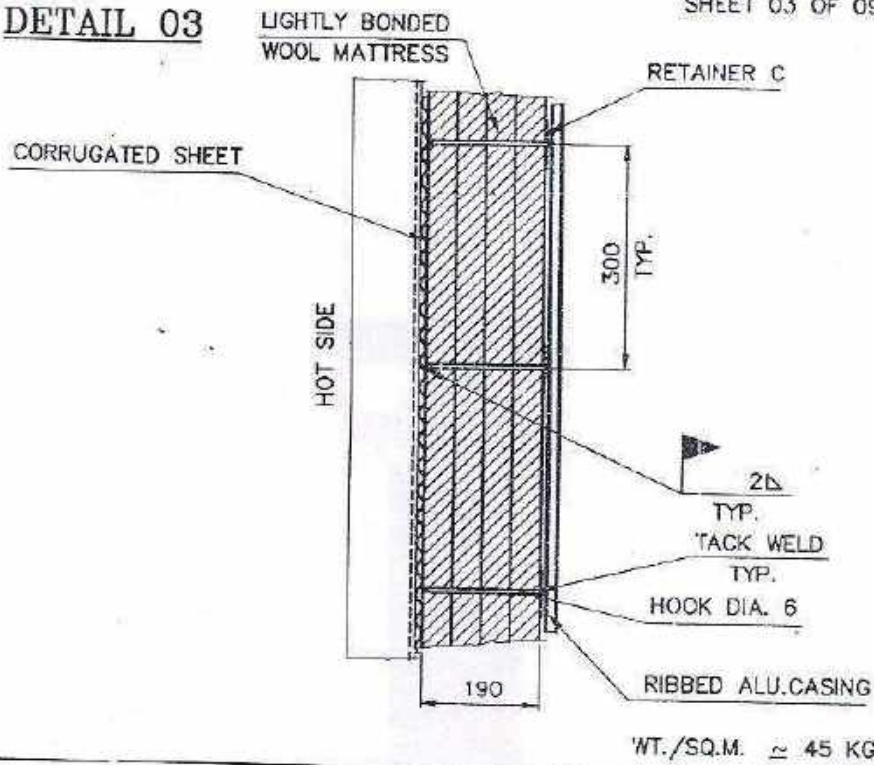


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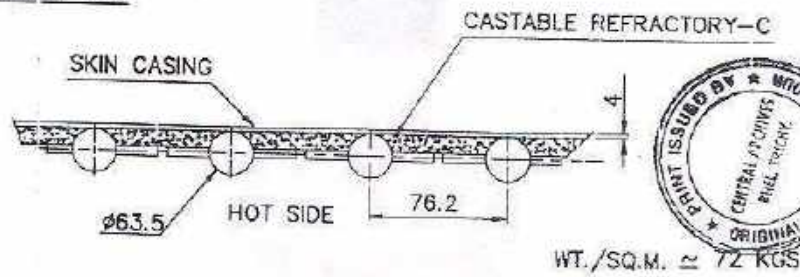
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DETAIL 03

SHEET 03 OF 09



DETAIL 04

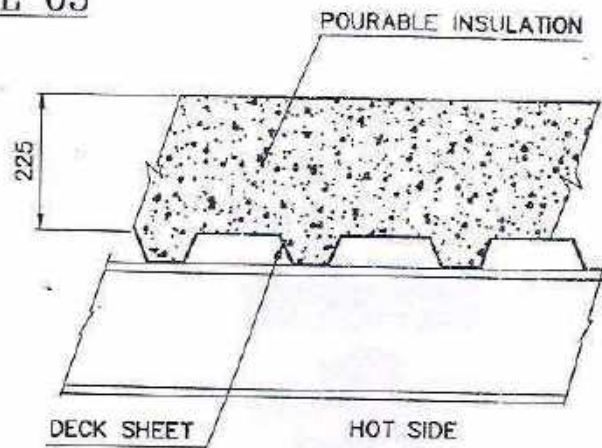


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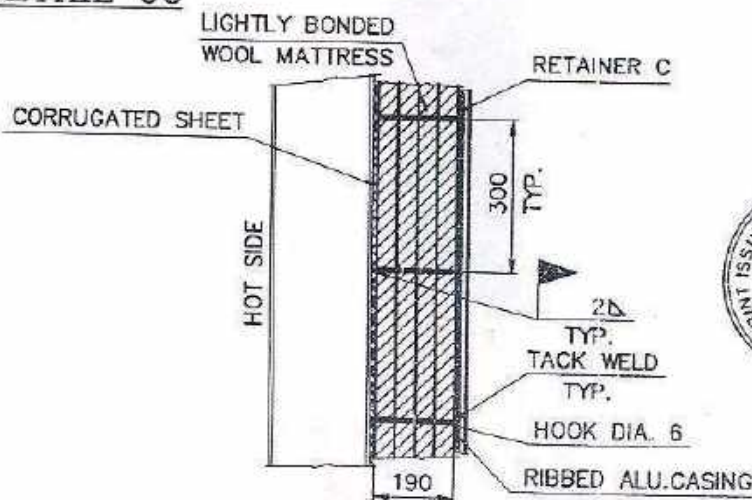
DETAIL 05

SHEET 04 OF 09



WT./SQ.M $\approx$ 193 KGS

DETAIL 06



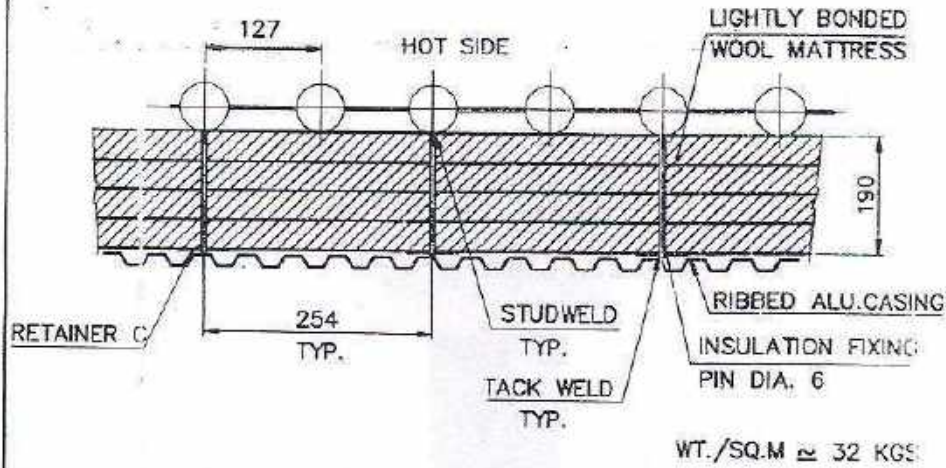
WT./SQ.M $\approx$ 45 KGS

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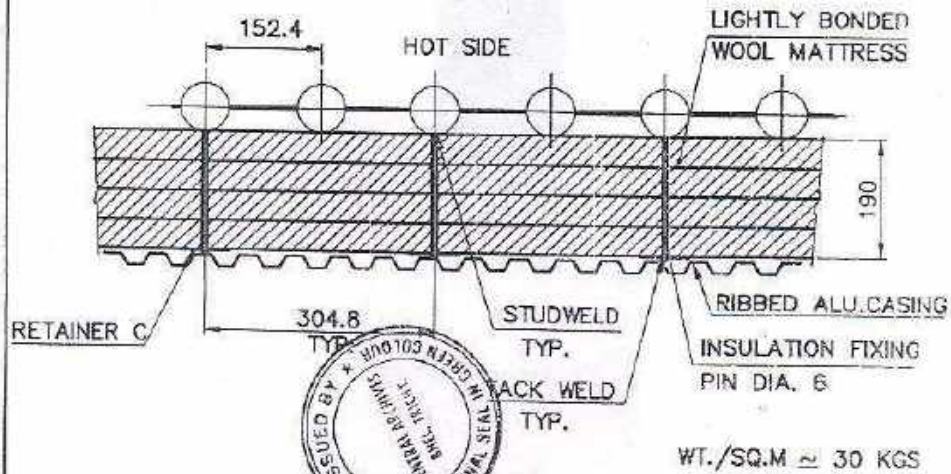
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DETAIL 07

SHEET 05 OF 08



DETAIL 08

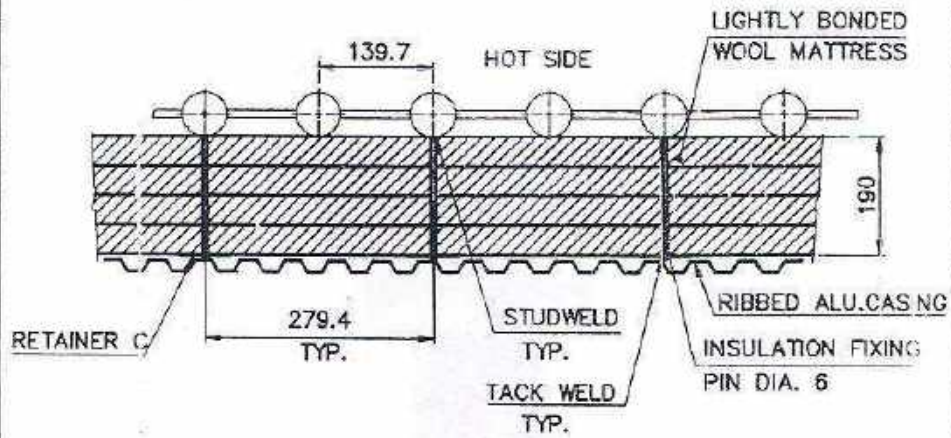


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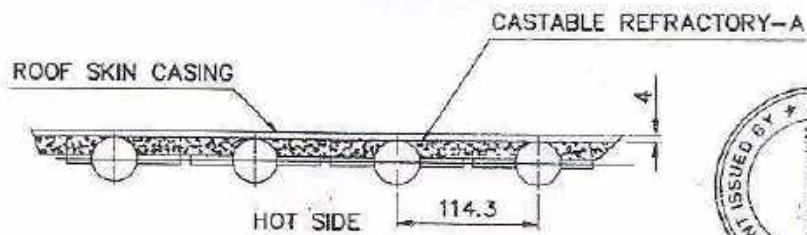
DETAIL 09

SHEET 06 OF 09



WT./SQ.M. $\approx$ 30 KGS

DETAIL 10



WT./SQ.M. $\approx$ 75 KGS

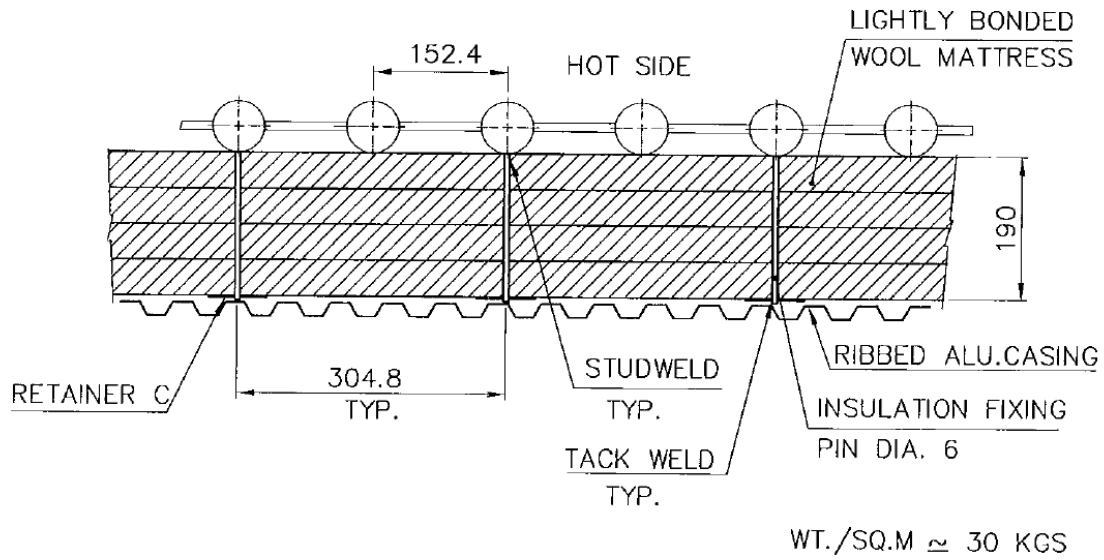


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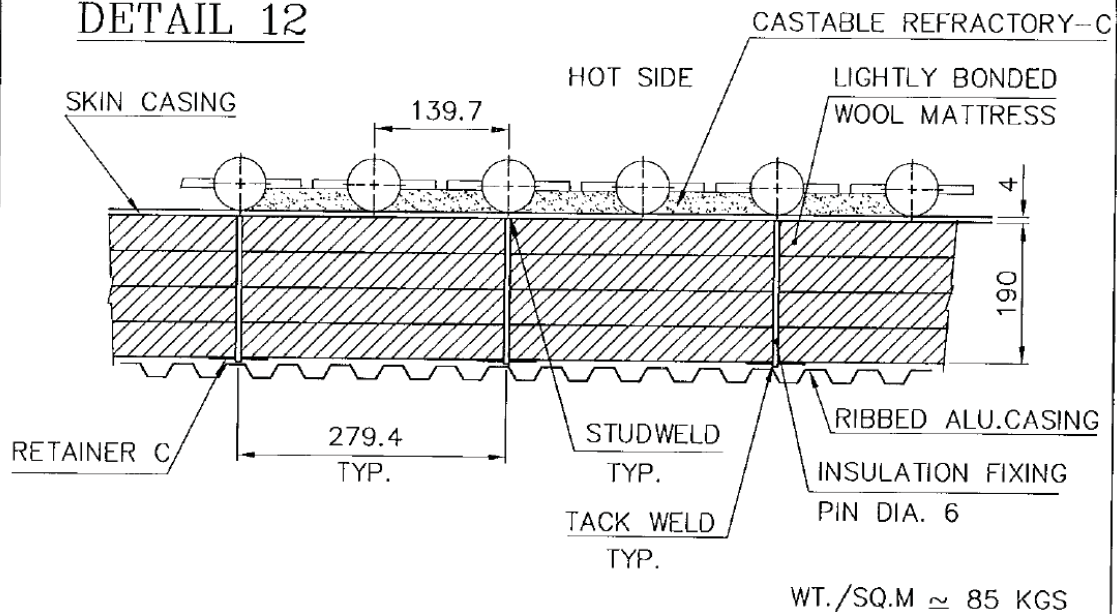
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DETAIL 11

SHEET 07 OF 09



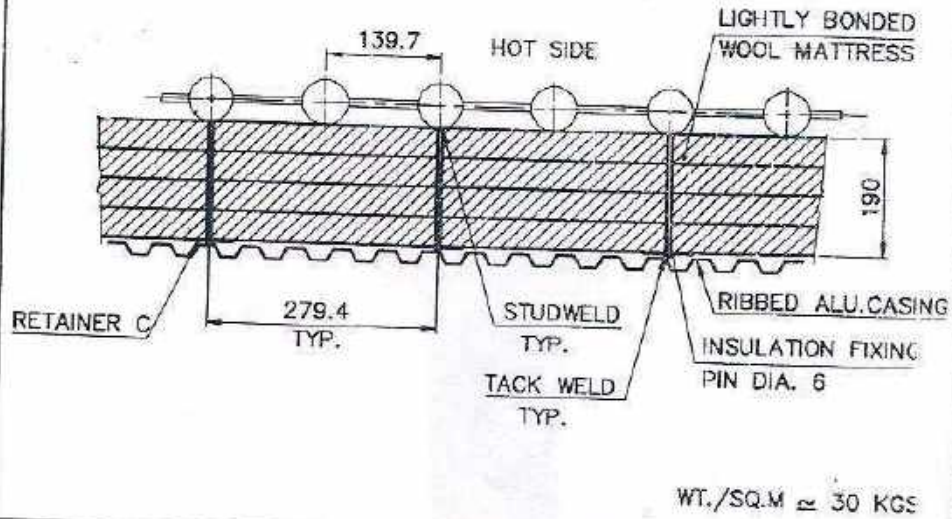
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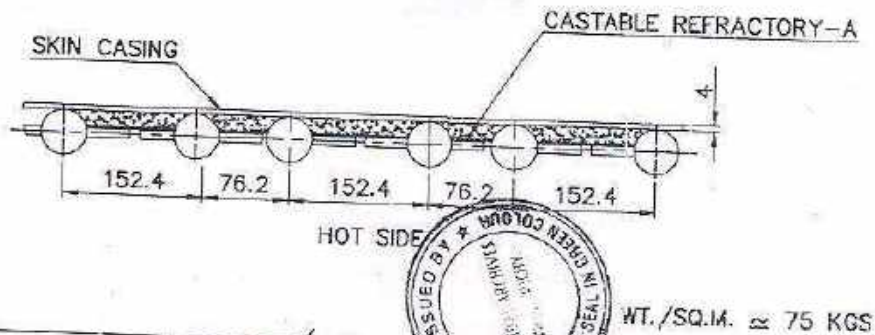
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	APPD	C.G.S		
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DETAIL 13

SHEET 08 OF 09



DETAIL 14



INSULATION

DRN	C.S
CHD	C.G.S
APPD	C.G.S

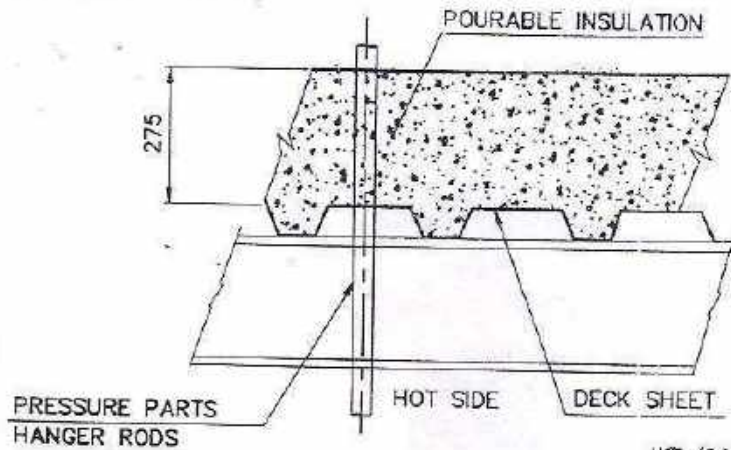
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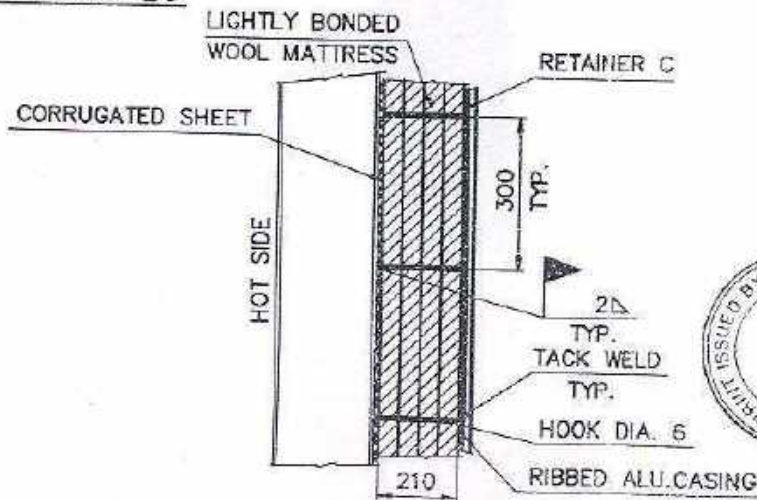
DETAIL 15

SHEET 09 OF 09



WT./SQ.M $\approx$ 233 KGS

DETAIL 16



WT./SQ.M $\approx$ 46 KGS

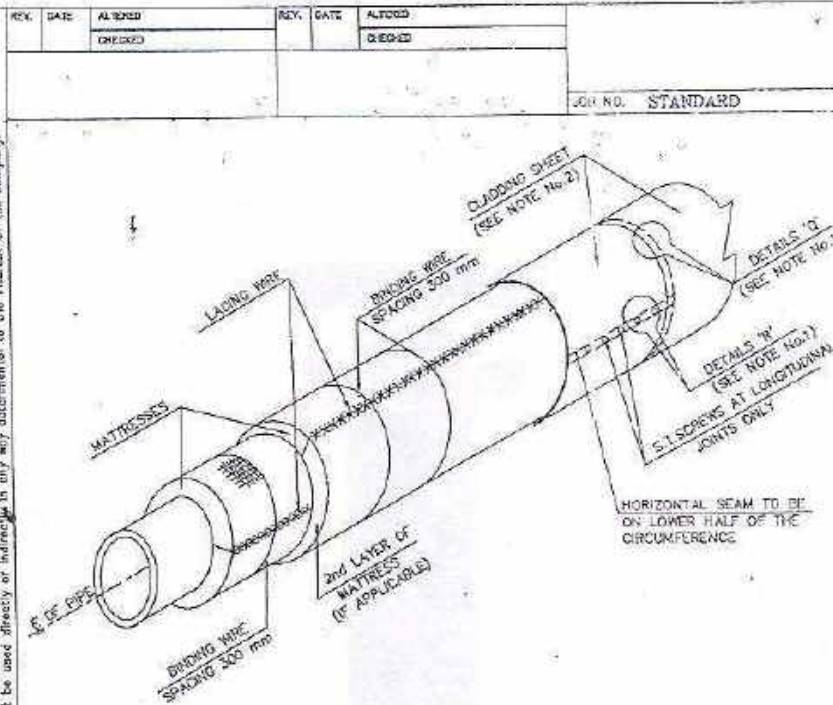


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CTSD01288.0

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FIRST ANGLE PRACTICE (ALL DIMENSIONS ARE IN MM)



NOTES: -

1. FOR DETAILS 'Q' AND 'R' REFER DRG No. PE-4-999-169-12
2. FOR SHEET SUPPORT REFER DRG No. PE-4-999-169-04
3. FOR GENERAL INFORMATION ON APPLICATION OF INSULATION REFER DOCUMENT "INSTRUCTIONS FOR APPLICATION OF THERMAL INSULATION FOR PIPING AND EQUIPMENTS".
4. IN ADDITION TO BRIDGING WIRE ALUMINIUM BANDS TO BE PROVIDED FOR DIAMETERS > 500 MM

MATERIALS REQUIRED: -

1. MATTRESSES
2. BANDS AND SEALS
3. CLADDING SHEET
4. S.T. SCREWS
5. SEALING COMPOUND
6. LACING WIRE
7. BRIDGING WIRE



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 NEW DELHI

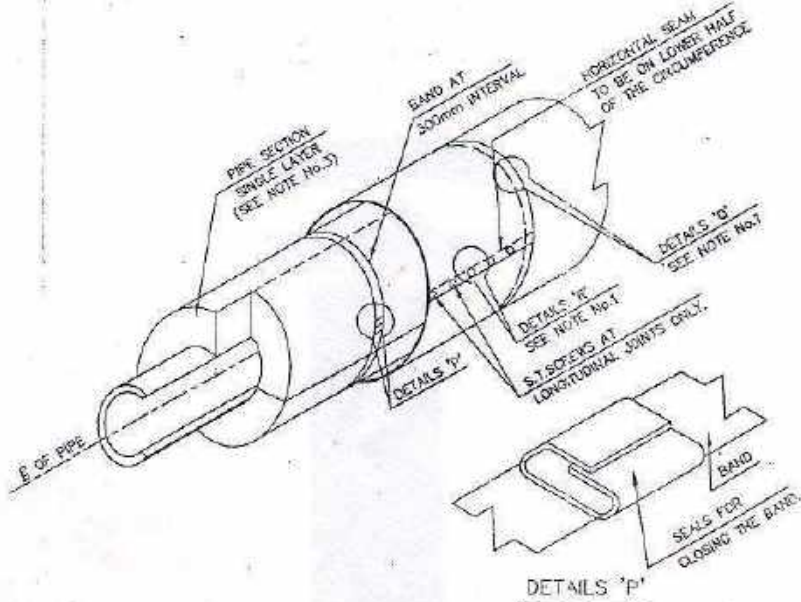
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CARD CODE				DRAWING NO. PE-4-999-169-01	
SHEET 1 OF 1				REV. 00	

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FIRST ANGLE PROJECTION (ALL DIMENSIONS ARE IN MM)

REV.	DATE	ALTERED	REV.	DATE	ALTERED
		CHECKED			CHECKED

JOB NO. STANDARD



NOTES:-

1. FOR DETAILS 'O' AND 'R' REFER DRG. No. PE-4-999-169-12
2. FOR CLADDING SHEET SUPPORT REFER DRG. No. PE-4-999-169-04
3. 2nd & 3rd LAYER IF ANY SHALL BE OF MATRESSES.
4. FOR GENERAL INFORMATION ON APPLICATION OF INSULATION REFER DOCUMENT "INSTRUCTIONS FOR APPLICATION OF THERMAL INSULATION FOR PIPING AND EQUIPMENTS"

MATERIALS REQUIRED:-

1. PIPE SECTIONS
2. BANDS AND SEAL
3. CLADDING SHEET
4. S.T. SCREWS
5. SEALING COMPOUND



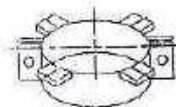
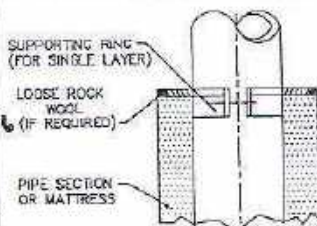
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NEW DELHI

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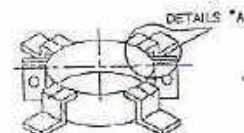
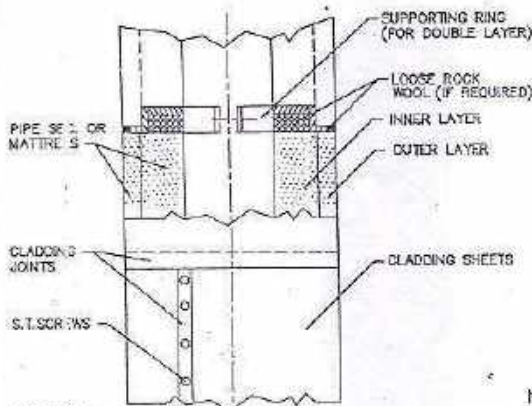
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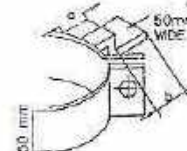
JOB NO. STANDARD



SUPPORT RING (FOR SINGLE LAYER)



SUPPORT RING (FOR DOUBLE LAYER)



DETAIL 'A'

NOTES:-

1. LENGTH 'a' & 'b' TO BE 12 TO 50mm LESS THAN SPECIFIED INSULATION THICKNESS.
2. SUPPORT RING TO BE FABRICATED OUT OF MS FLATS/STRAPS.
3. SUPPORT RING REQUIRED FOR PIPE 80 NB & LARGER IF INSULATION THICKNESS LARGER THAN 30mm.
4. SUPPORT RINGS REQUIRED FOR MATTRESS ONLY.
5. FOR GENERAL INFORMATION ON APPLICATION OF INSULATION REFER DOCUMENT 'INSTRUCTIONS FOR APPLICATION OF THERMAL INSULATION FOR PIPING AND EQUIPMENTS'.

MATERIALS REQUIRED:-

1. FLATS/STRAPS
2. MATTRESSES/PIPE SECTIONS
3. CLADDING SHEET
4. NUTS AND BOLTS
5. SELF TAPPING SCREWS
6. SEALING COMPOUND
7. SUPPORT RINGS (FOR MATTRESSES ONLY)

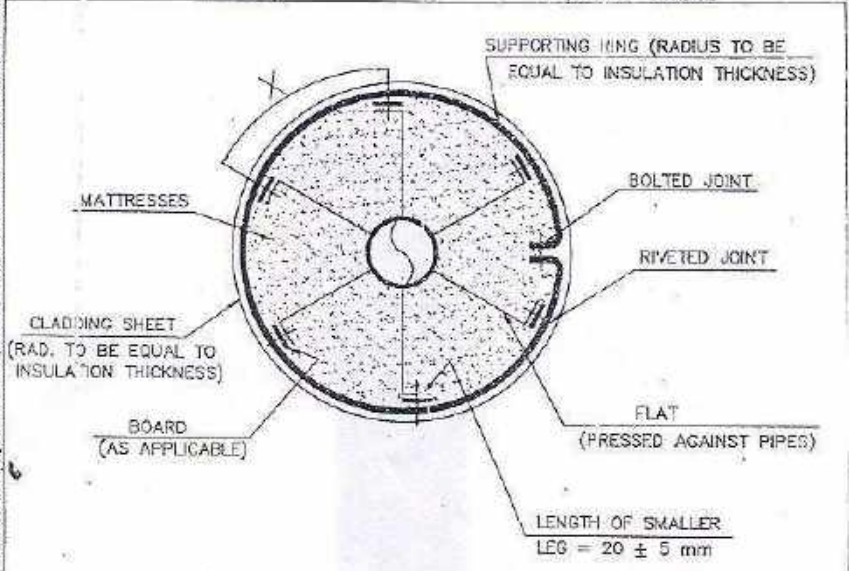


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NEW DELHI

DEPT. MPL	CODE M		SCALE N.T.S.	WEIGHT (KG.)	REF. TO ASSY. DRG	ITEM
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				CARD CODE	DRAWING NO. PE-4-999-169-03	
				SHEET 1 OF 1	REV. 00	

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REV.	DATE	ALTERED	REV.	DATE	ALTERED
		ENGINEER			CHECKED
			JOB NO. STANDARD		



X = 150 mm TO 200 mm SO THAT NUMBER OF WEBS IS EVEN NUMBER

MATERIAL REQUIRED:-

1. FLATS
2. RIVETS
3. BOLTS AND NUTS
4. BOARD

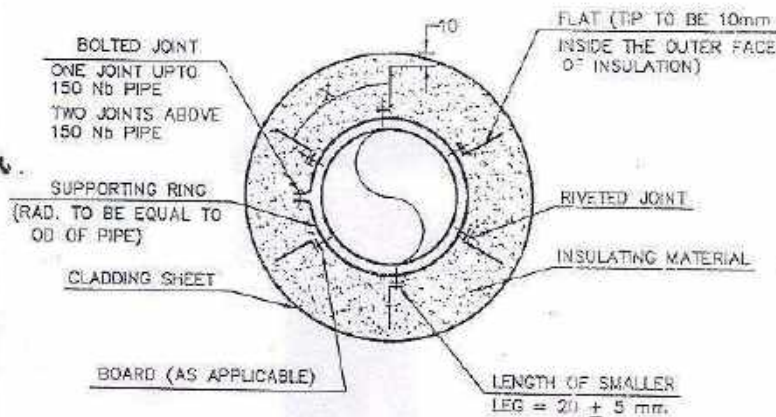
NOTE:-

1. FOR GENERAL INFORMATION ON APPLICATION OF INSULATION REFER DOCUMENT "INSTRUCTIONS FOR APPLICATION OF THERMAL INSULATION FOR PIPING AND EQUIPMENTS".

		BHARAT HEAVY ELECTRICALS LIMITED POWER SECTOR PROJECTS ENGINEERING MANAGEMENT NEW DELHI				
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TITLE:- INSULATION APPLICATION (CLADDING SHEET SUPPORT RING FOR HOR. PIPE O.D>114.3mm & HOR. EQUIPMENTS)			DRN. SCS DESN. SCS CHL. EBS APPD. SKJ	NAME SCS EBS SKJ	SIGN 	DATE 9.6.77 9.6.77 11.6.77
CARD CODE			DRAWING NO. PE-4-999-169-04			
SHEET 1 OF 1			REV. 00			

AL-11

A4



X = 150 mm TO 200 mm SO THAT NUMBER OF WEBS IS EVEN NUMBER
MATERIAL REQUIRED:-

1. FLATS
2. RIVETS
3. BOLTS AND NUTS
4. BOARD

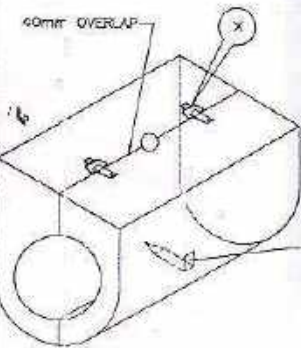
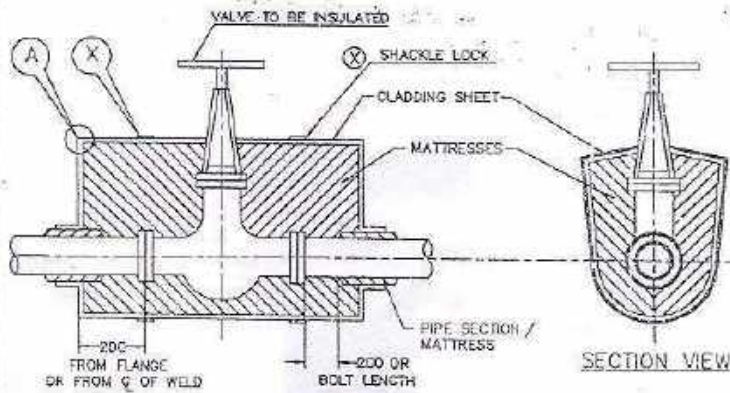
NOTES:—

1. INSULATION DETAILS ON VERTICAL PIPING SHALL BE SAME AS PER FOR HORIZONTAL PIPES.
2. SPACING BETWEEN SUPPORTING RINGS SHALL BE 3 Mtrs.
3. FOR INSULATION OF END OF VERTICAL EQUIPMENTS REFER DRG. No. PIC-4-199-199-09.
4. FOR GENERAL INFORMATION ON APPLICATION OF INSULATION REFER DOCUMENT "INSTRUCTIONS FOR APPLICATION OF THERMAL INSULATION FOR PIPING AND EQUIPMENTS."
5. FLATS/RINGS OF REQUIRED LENGTH/DIA SHALL BE MADE BY ERECTING AGENCY AT SITE FROM HIS FLATS/STRAPS.

		BHARAT HEAVY ELECTRICALS LIMITED POWER SECTOR PROJECTS ENGINEERING MANAGEMENT NEW DELHI				
DEPT. M.L.	CODE M	 	SCALE N.T.S.	WEIGHT (KGS)	REF. TO ASSY. DRG.	ITEM
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			CARD CODE	DRAWING NO. PE-4-998-169-05 SHEET 1 OF 1 REV. 00		

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FIRST ANGLE PROJECTION (ALL DIMENSIONS ARE IN MM)			
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JOB NO.		STANDARD	



MATERIALS REQUIRED:-

1. MATTRESSES
2. CUPS OF SHACKLE LOCKS FABRICATED OUT OF CLADDING SHEET
3. CLADDING SHEET
4. RIVETS
5. SHACKLE LOCKS CONNECTING BUCKLES. (REF. DRG. PE-4-939-169-10)
6. SELF TAPPING SCREWS
7. SEALING COMPOUND.

NOTE:-

1. FOR DETAIL A & X REFER DRG No. PE-4-999-169-10
2. FOR GENERAL INFORMATION ON APPLICATION OF INSULATION REFER DOCUMENT "INSTRUCTIONS FOR APPLICATION OF THERMAL INSULATION FOR PIPING AND EQUIPMENTS".

ASSEMBLED VALVE BOX

		BHARAT HEAVY ELECTRICALS LIMITED POWER SECTOR PROJECTS ENGINEERING MANAGEMENT NEW DELHI																				
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APPD	S.K.J.		11.6.97																			
CARD CODE —			DRAWING NO. PE-4-999-169-08																			
SHEET 1 OF 1			REV. 00																			

REV.	DATE	ALTERED	REV.	DATE	ALTERED
6		CHANGED			SPECIFIED
			JOB NO. STANDARD		

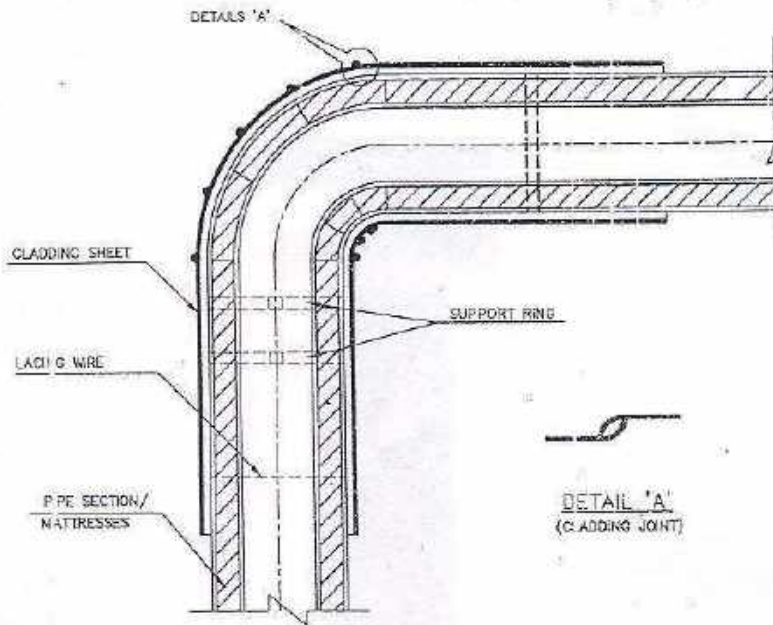
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TITLE - INSULATION APPLICATION (TEES AND FLANGE JOINTS)						DRN DESN CND APPD	NAME S.C.S. S.C.S. D.B.S. S.K.I.    	SIGN DATE 9-6-72 9-6-72 9-6-72 9-6-72
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SHEET			1	OF	1	REV.	00	

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FIRST ANGLE PROJECTION (ALL DIMENSIONS ARE IN MM)

REV.	DATE	ALTERED	REV.	DATE	ALTERED
		CHECKED			CHECKED
			JOB NO. STANDARD		



MATERIALS REQUIRED:-

1. MATRESSES
2. PIPE SECTION (IF APPLICABLE)
3. LACING WIRE
4. CLADDING SHEET
5. BINDING WIRE
6. SELF TAPPING SCREWS
7. SEALING COMPOUND

NOTES:-

1. TWO SELF TAPPING SCREWS TO BE USED FOR EACH SHEET SEGMENT AT INNER SIDE OF BEND.
2. FOR GENERAL INFORMATION ON APPLICATION OF INSULATION REFER DOCUMENT "INSTRUCTIONS FOR APPLICATION OF THERMAL INSULATION FOR PIPING AND EQUIPMENTS."



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PROJECTS ENGINEERING MANAGEMENT
NEW DELHI

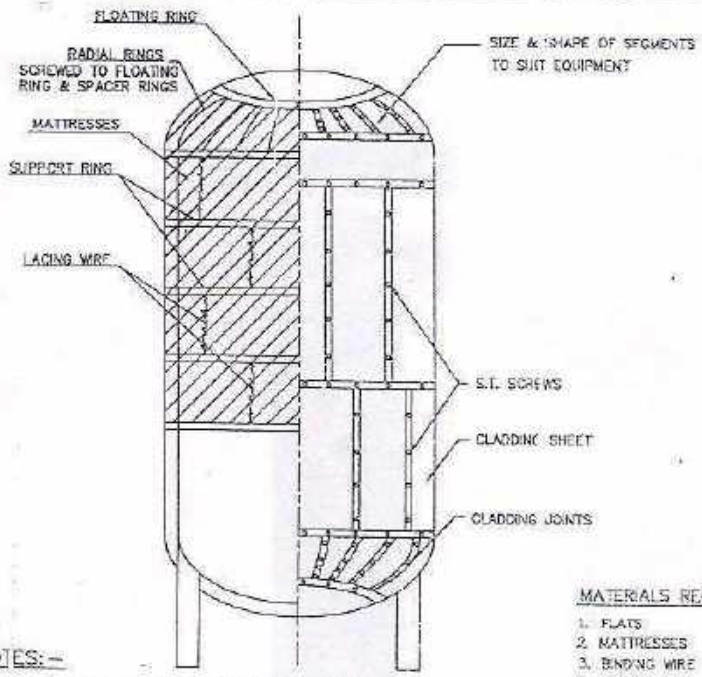
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MPL	M					
TITLE:-				DRN	NAME	SIGN
INSULATION APPLICATION (ELBOWS & BENDS SIZE EXCEEDING 150mm)				DESN	S.C.S.	DATE
				CHK	O.B.S.	4.6.92
				APPD	S.K.J.	4.6.92
				CARD CODE	DRAWING NO.	
					PE-4-999-169-08	
					SHEET 1 OF 1	REV. 00

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FIRST ANGLE PROJECTION (ALL DIMENSIONS ARE IN MM)					
REV.	DATE	ALTERED	REV.	DATE	ALTERED
		CHECKED			CHECKED
					JOB NO. STANDARD



NOTES:-

1. STRIPS/BANDS CUT FROM SHEET, WITH SEAL SHALL BE USED OVER FINAL LAYER AT 300mm INTERVALS.
2. INSULATION OF HOR. EQPTS. SHALL BE AS FOR HOR. PIPES. REFER DRG No. PE-4-999-169-01 & PE-4-999-169-02
3. FOR CLADDING SHEET SUPPORT REF. DRG. No. PE-4-999-169-04.
4. FOR INSULATION SUPPORT REF. DRG. No. PE-4-999-169-05.
5. INSULATION OF ENDS OF HOR. EQPTS. SHALL BE SIMILAR TO THIS DRG.
6. WELDING TO EQUIPMENT NOT PERMITTED.
7. FOR GEN. INF. ON APPLICATION OF INSULATION REF. DOC. "INSTRUCTIONS FOR APPLICATION OF THERMAL INSULATION FOR PIPING & EQPTS".

MATERIALS REQUIRED:-

1. FLATS
2. MATTRESSES
3. BENDING WIRE
4. LACING WIRE
5. CLADDING SHEET
6. GLASS FABRIC/BOARDS (AS APPLICABLE)
7. RIVETS
8. SELF TAPPING SCREWS
9. SEALING COMPOUND
10. STRIPS/BANDS

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DEPT. MPL	CODE M		SCALE N.T.S.	WEIGHT (KG)	REF. TO ASSY. DRG	ITEM
TITLE:- INSULATION APPLICATION (EQUIPMENT)			DRN S.G.S. DESN S.G.S. CHO D.B.N. APPD S.K.J.	NAME S.G.S. S.G.S. D.B.N. S.K.J.	SIGN DATE 9.6.99 11.6.99	
			CARD CODE	DRAWING NO. PE-4-999-169-09		
				SHEET 1 OF 1 REV. 00		

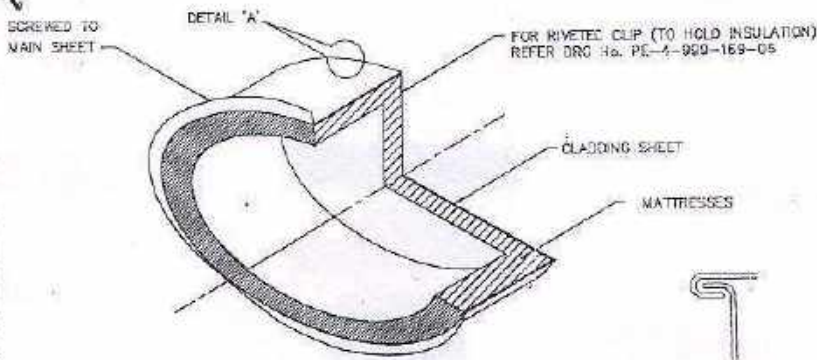
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FIRST ANGLE PROJECTION (ALL DIMENSIONS ARE IN MM)

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CHECKED			CHECKED		

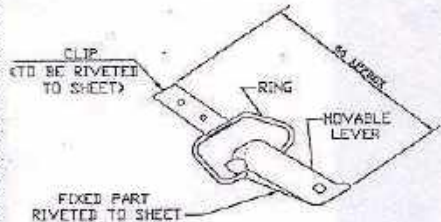
JOB NO. STANDARD

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INSULATING COVER FOR MAN HOLE

DETAILS 'A'
(LOCKING OF SHEETS)



G.I. SHACKLE LOCK CONNECTING BUCKLE
DETAILS 'X'

MATERIAL REQUIRED:-
(MAN HOLE)

1. MATTRESSES
2. CLADDING SHEET
3. SELF TAPPING SCREWS
4. RIVETS
5. CLIPS (TO BE MADE AT SITE)
6. SEALING COMPOUND

MATERIAL REQUIRED:-
(FOR SHACKLE LOCK)

1. CLIP (MADE FROM CLADDING SHT.)
2. RIVETS

NOTES:-

1. FOR GENERAL INFORMATION ON APPLICATION INSULATION REFER DOCUMENT "INSTRUCTIONS FOR APPLICATION OF THERMAL INSULATION FOR PIPING AND EQUIPMENTS".



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NEW DELHI

DEPT. NPL	CODE W	SCALE N.T.S.	WEIGHT (KG.)	REF. TO ASS'Y. DRG	ITEM																
TITLE:- INSULATION APPLICATION (FABRICATED HEAT INSULATING COVER FOR MAN-HOLE)				<table border="1"> <tr> <th>DRN</th> <th>NAME</th> <th>SIGN</th> <th>DATE</th> </tr> <tr> <td>DESN</td> <td>S.C.S.</td> <td>[Signature]</td> <td>11.6.77</td> </tr> <tr> <td>CHD</td> <td>S.C.S.</td> <td>[Signature]</td> <td>12.6.77</td> </tr> <tr> <td>APPD</td> <td>S.K.J.</td> <td>[Signature]</td> <td>16.6.77</td> </tr> </table>	DRN	NAME	SIGN	DATE	DESN	S.C.S.	[Signature]	11.6.77	CHD	S.C.S.	[Signature]	12.6.77	APPD	S.K.J.	[Signature]	16.6.77	
DRN	NAME	SIGN	DATE																		
DESN	S.C.S.	[Signature]	11.6.77																		
CHD	S.C.S.	[Signature]	12.6.77																		
APPD	S.K.J.	[Signature]	16.6.77																		
CARD CODE				DRAWING NO. PE-4-999-169-10																	
SHEET 1 OF 1				REV. 00																	

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FIRST ANGLE PROJECTION (ALL DIMENSIONS ARE IN MM)

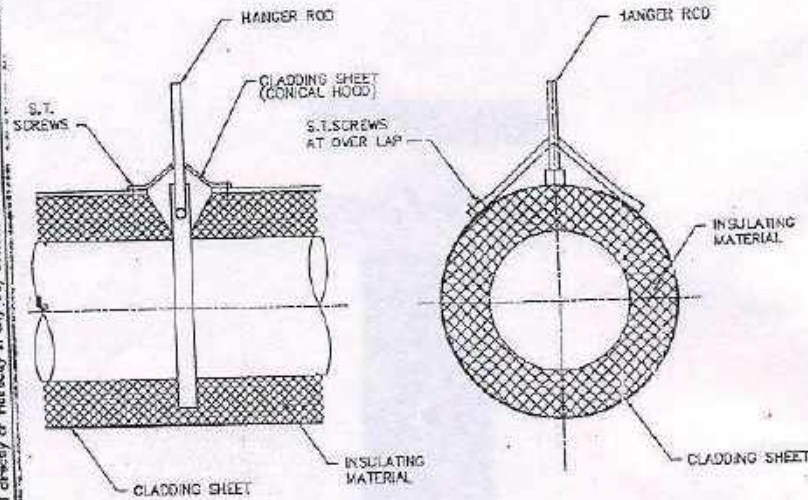
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01 10.5.82
CHECKED

REV. DATE ALTERED
CHECKED

NOTE 2 ADDED.

JOB NO. STANDARD

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MATERIALS REQUIRED:-

1. MATTRESSES/PIPE SECTIONS
2. CLADDING SHEET
3. SELF TAPPING SCREWS
4. SEALING COMPOUND

NOTES:-

1. FOR GENERAL INFORMATION ON APPLICATION OF INSULATION REFER DOCUMENT INSTRUCTIONS FOR APPLICATION OF THERMAL INSULATION FOR PIPING AND EQUIPMENTS.
2. WHEREVER THE END OF CLADDING PROTRUDS OUT OF INSULATION AT THE BOTTOM, SUITABLE BSA STRUCTURE TO BE PROVIDED AHEAD OF MINIMUM.



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DEPT. MPL	CODE M		SCALE N.T.S.	WEIGHT (KG.)	REF. TO ASSY. DRG	ITEM
TITLE:- INSULATION APPLICATION (METAL FLASHING ON HANGER ROD PROTRUSION)				DRN	NAME S.C.S.	SIGN [Signature]
				DESIGN	S.C.S.	DATE 10.5.82
				CHKD	D.B.S.	11.6.82
				APPRO	S.K.J.	11.6.82
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				REV. 00		

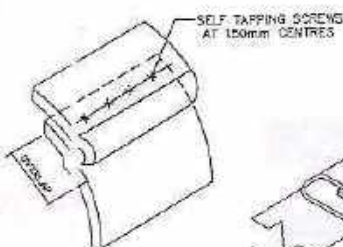
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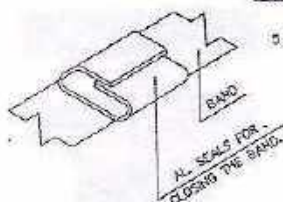
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REV.	DATE	ALTERED	REV.	DATE	ALTERED
		CHECKED			CHECKED

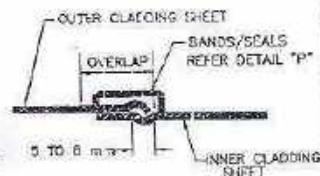
JOB NO. STANDARD



****DETAIL 'R'**
(LONGITUDINAL JOINT)



DETAIL 'P'



***DETAIL 'Q'**
(CIRCUMFERENTIAL JOINT)

1. JOINTS TO BE MADE AT 45° FROM BOTTOM
2. JOINTS TO BE ON LOWER HALF OF THE CIRCUMFERENCE FOR HORIZONTAL PIPES AND EQUIPMENTS.
3. SEALING COMPOUND WILL BE USED ON ALL LONGITUDINAL JOINTS.

*

1. TELESCOPIC SLIDING JOINTS SHALL HAVE 5 TO 8mm SPACING.
 2. THE OVERLAPPING OF TELESCOPIC JOINTS SHALL BE AS BELOW:-
- | CIRCUMFERENCE OF SHEET (mm) | LONGITUDINAL OVERLAP (mm) |
|-----------------------------|---------------------------|
| < 400 | 30 |
| 401 - 500 | 40 |
| > 500 | 50 |
3. TELESCOPIC JOINT SHALL BE PLAIN.

NOTE:-

1. ALL JOINTS NEAR OIL PIPING TO HAVE SEALING COMPOUND.
2. FOR GENERAL INFORMATION ON APPLICATION OF INSULATION REFER DOCUMENT "INSTRUCTIONS FOR APPLICATION OF THERMAL INSULATION FOR PIPING AND EQUIPMENTS".



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POWER SECTOR
PROJECTS ENGINEERING MANAGEMENT
NEW DELHI

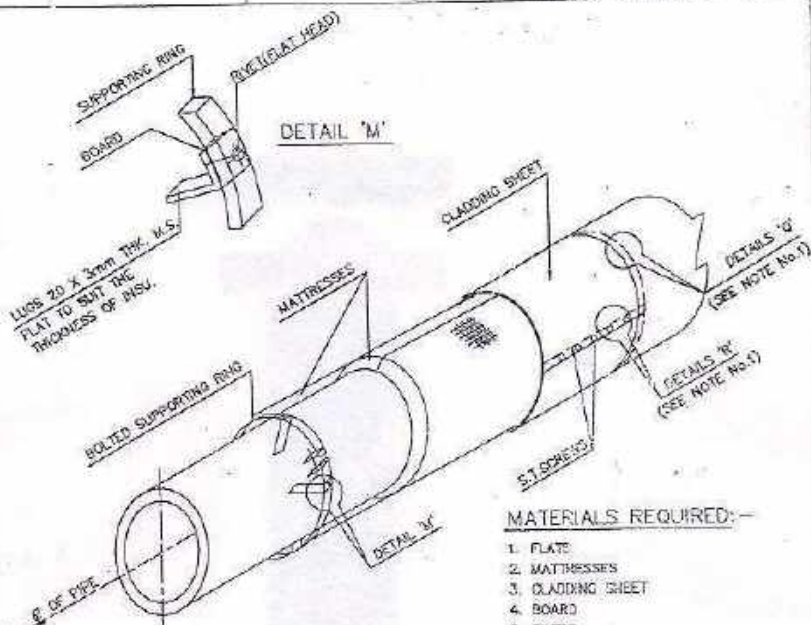
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TITLE -					DRN	NAME
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					CHKD	DATE
					APPD	
CARD CODE				DRAWING NO.		
				PE-4-899-169-12		
—				SHEET 1 OF 1	REV. DO	

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REV.	DATE	ALTERED	REV.	DATE	ALTERED
		CHECKED			CHECKED
			JOB NO. STANDARD		



PIPE No(mm)	No. OF LUGS
1. 33 - 150	4
2. 200 - 300	6
3. 350 - 450	8
4. 500 - 600	10

1. PLATE
2. MATTRESSES
3. CLADDING SHEET
4. BOARD
5. RIVETS
6. SELF TAPPING SCREWS
7. SEALING COMPOUND
8. BOLTS & NUTS.

1. FOR DETAILS 'Q' AND 'R' REFER DRG No. PE-4-999-169-12
2. FOR GENERAL INFORMATION ON APPLICATION OF INSULATION REFER DOCUMENT "INSTRUCTIONS FOR APPLICATION OF THERMAL INSULATION FOR PIPING & EQUIPMENTS".



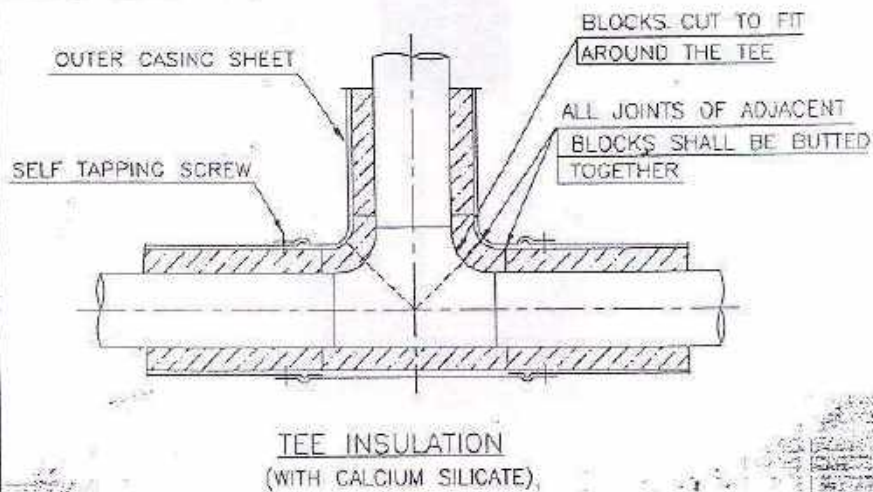
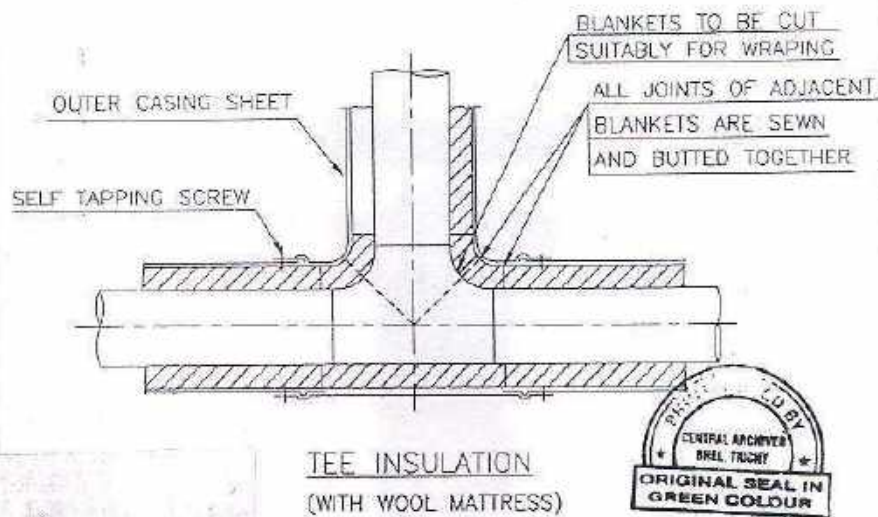
BHARAT HEAVY ELECTRICALS LIMITED
POWER SECTOR
PROJECTS ENGINEERING MANAGEMENT
NEW DELHI

DEPT. MPL	CODE M	SCALE N.T.S.	WEIGHT (KGS.)	REF. TO ASSY. BRO	ITEM
TITLES - INSULATION APPLICATION (SUPPORT RING FOR PIPE O.D. > 168.3mm)			DRN DES CHU APPD	NAME R.C.S. R.C.S. U.B.S. S.K.J.	DATE 1/1/84 1/1/84 1/1/84 1/1/84
CARD CODE			DRAWING NO.		
—			PE-4-999-163-13		
—			SHEET 1 OF 1 REV. 00		

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TEE INSULATION



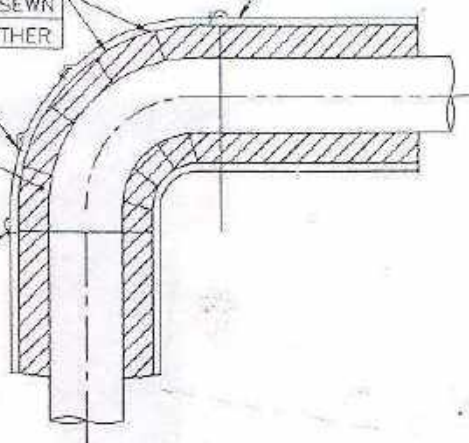
INSULATION	PREPARED	A. L. CHANDRANATHAN	DATE	04.12.00	DRAWING NO.	REV
	CHECKED	K. KALIRAJAN			4-00-235-08536	
	APPROVED	C. GUNASEKARAN				

ALL JOINTS BETWEEN ADJACENT
BLANKETS SHALL BE SEWN
AND BUTTED TOGETHER.

BLANKETS CUT FOR
WRAPPING AROUND
THE ELBOW

ALL SHEETS AT
JOINTS TO OVERLAP
BY 40 MM

OUTER CASING SHEET



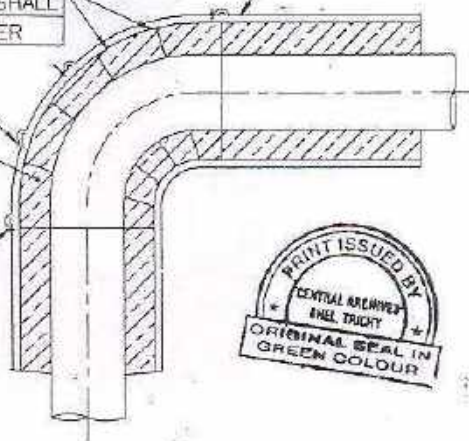
WITH WOOL MATTRESS

ALL JOINTS BETWEEN
ADJACENT BLOCKS SHALL
BE BUTTED TOGETHER

BLOCKS CUT TO FIT
AROUND THE ELBOW

ALL SHEETS AT
JOINTS TO OVERLAP
BY 40 MM

OUTER CASING SHEET



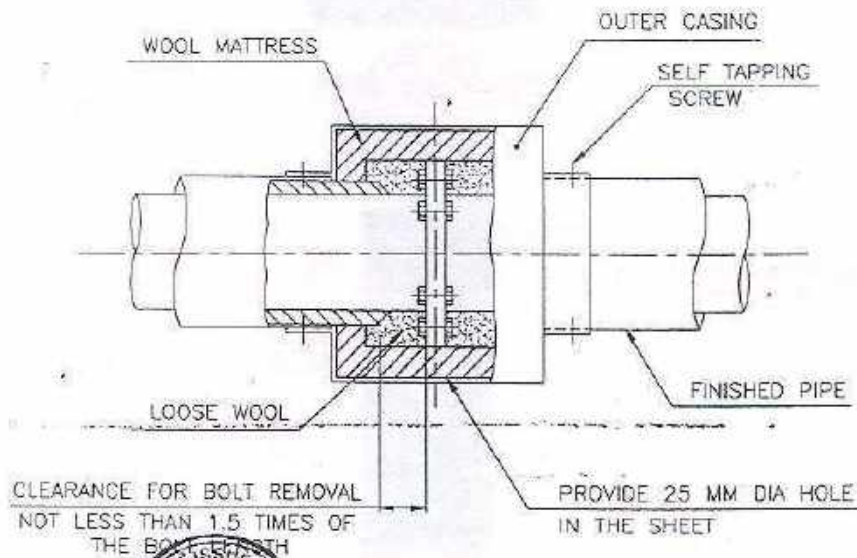
WITH CALCIUM SILICATE



INSULATION	PREPARED	AJITHA GUNASEKARAN	DATE	04.12.03	DRAWING NO : 4-00-235-08547	REV
	CHECKED	K. KALIRAJAN				
	APPROVED	C. GUNASEKARAN				



FLANGE INSULATION



NOTE:—

1. WHEREEVER THE FLANGES ARE ENVISAGED FOR DISMANTLING, THIS TYPICAL ARRANGEMENT IS TO BE FOLLOWED.

INSULATION

PREPARED: ARJUN K. CUNASEKARAN
 CHECKED: K. KALIRAJAN
 APPROVED: C. CUNASEKARAN

DATE: 04.12.23

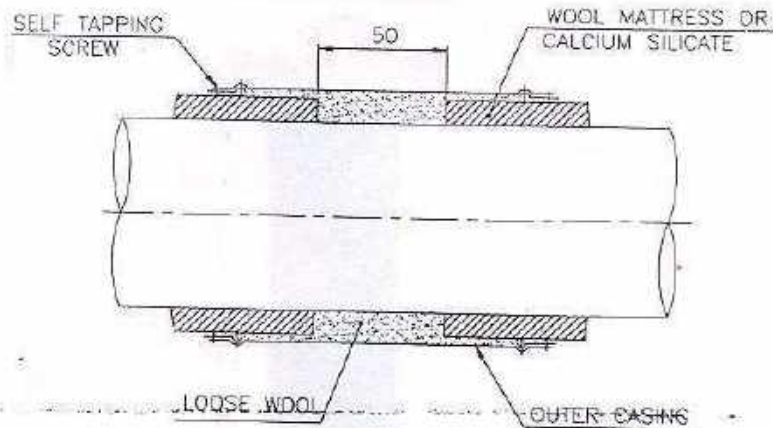
DRAWING NO.:

4-00-235-08548

REV



EXPANSION JOINT FOR PIPES

NOTE:-

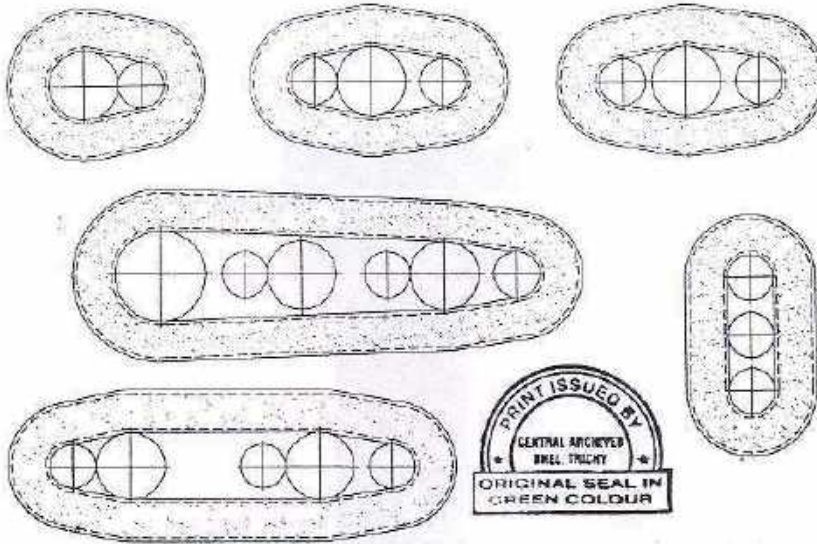
1. THIS ARRANGEMENT IS APPLICABLE FOR BOTH HORIZONTAL AND VERTICAL PIPE LINES, AT EVERY 5 METRES.
2. WHEN THE OPERATING TEMPERATURE IS BELOW 230°C, EXPANSION JOINTS ARE NOT REQUIRED.
3. FOR PIPES, WHERE THE FLOW IS ONLY INTERMITTENT, EXPANSION JOINTS ARE NOT REQUIRED.



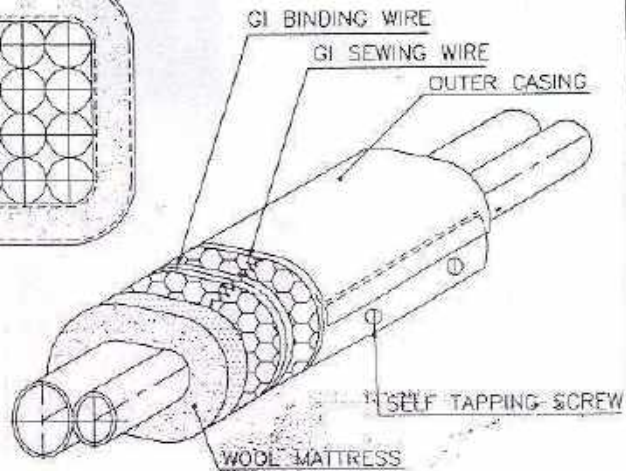
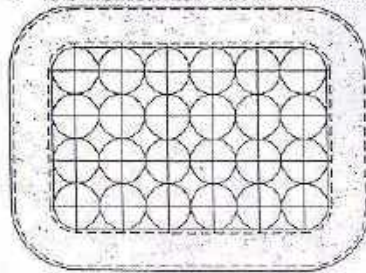
INSULATION	DESIGNED	A. GUNATHAN	REVISION	DATE	DRAWING NO.	REV
	CHECKED	K. KALIRAJAN		01.12.01		
	APPROVED	G. GUNASEKARAN				
					4-00-235-08549	



BUNCH INSULATION



FOR NOTES REFER DRG 4-00-235-08541.

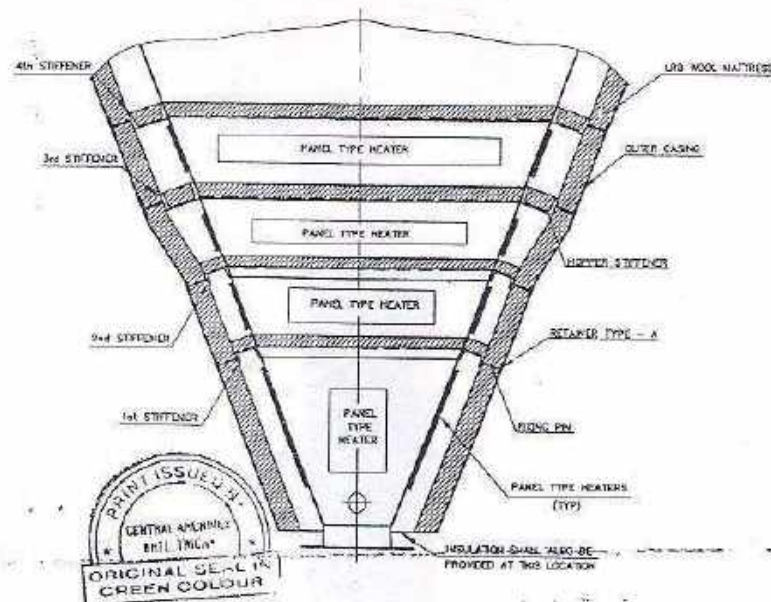


INSULATION	PREPARED	A. K. MOHANTHAN	DATE	04.12.11	DRAWING NO.	4-00-235-08550	REV
	CHECKED	K. KALIRAJAN					
	APPROVED	C. GUNASEKARAN					

REV	DATE	ALTERED	A.R.J.
01	01.10.05	CHD & APPD	C.G.S.
DRAWING ALTERED			

FOR TOLERANCES OF UNTOLERANCED
DIMENSIONS DURING MANUFACTURE
REFER PLANT STD. NO TP 023 0209

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IN ANY MANNER DETRIMENTAL TO THE INTEREST OF BHARAT HEAVY ELECTRICALS LTD.



NOTE:

01. THE INSULATION SHOWN IS FOR TYPICAL PANEL HEATER HOPPERS. THIS IS TO BE FOLLOWED WHERE EVER PANEL TYPE HEATERS ARE ENVISAGED.
02. INSULATION FIXING PINS AND RETAINERS SHOULD NOT FOLLY WITH THE PANEL HEATERS.
03. FOR OTHER INSULATION DETAILS, REFER DRG. 1-00-235-06554.

		Bharat Heavy Electricals Ltd		NAME	A.R.J.	SIGNATURE	DATE
355-006		UNIT: HIGH PRESSURE BOILER PLANT		CHD	C.G.S.		20.09.05
		TRUCHIRAPALLI - 620014		APPD	C.G.S.		22.09.05
DEPT	L&I	ALL DIMENSIONS ARE IN MM	PROJECTION	SCALE	WEIGHT (Kg)	REF TO ASSY / OLD DWG	
CODE	123						
TITLE						DRAWING NO	REV
HOPPER INSULATION DETAIL FOR PANEL TYPE HEATERS						4-00-235-08702	01

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 APPLICABLE AND SPECIAL INSTRUCTIONS, IF ANY, ISSUED BY RESPECTIVE MANUFACTURING UNITS SPECIFIC TO THE PROJECTS.

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	Important Note	2
	Table of Contents	3
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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/0111/ PART I-WM – Latest.

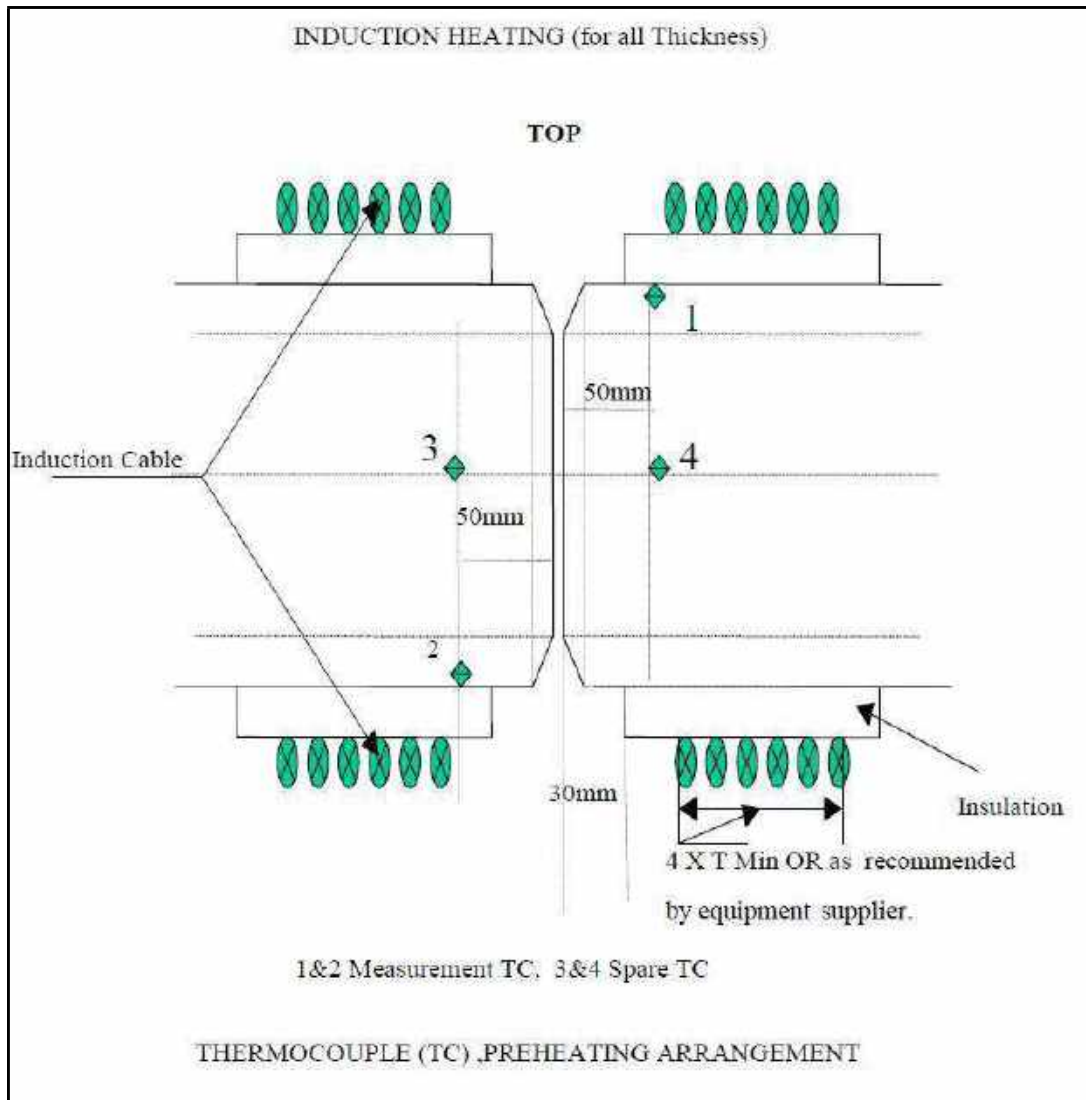


Figure 1.1: Placement of Thermocouples on P91/P92/F91/F92/C12A materials for Preheating

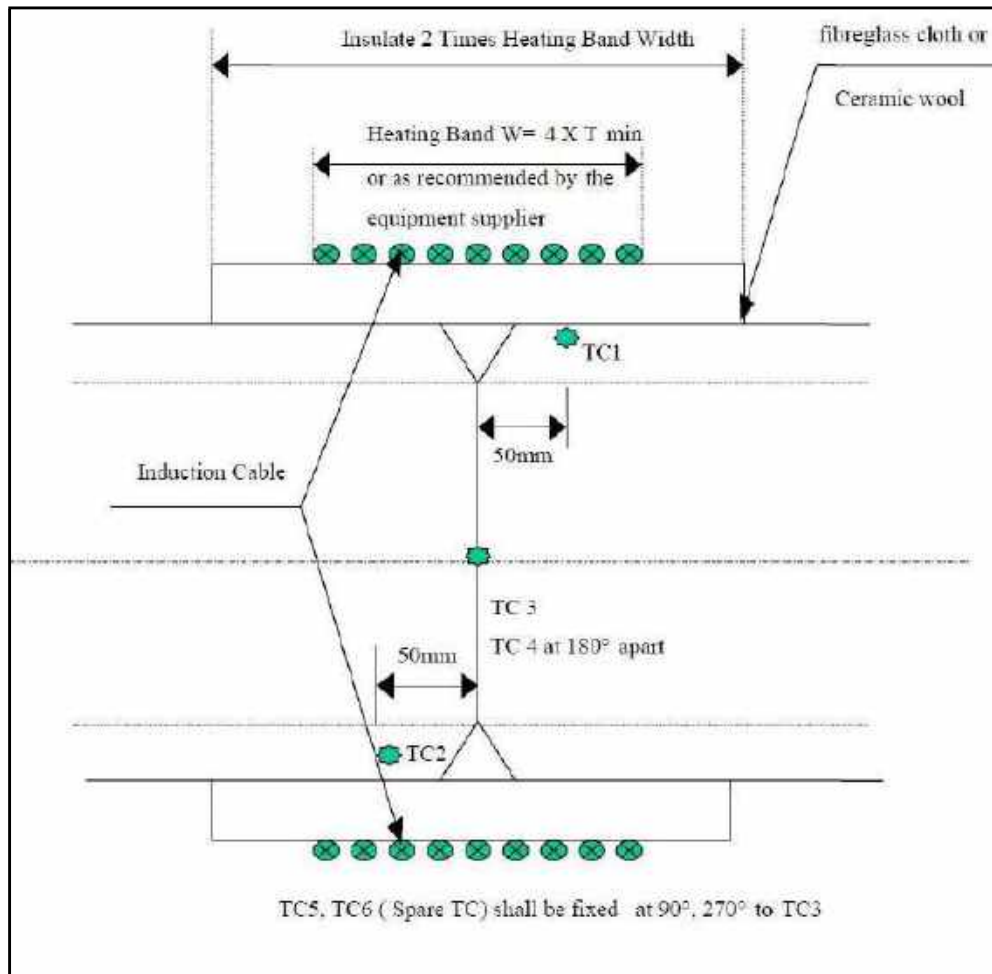


Figure 1.2: Placement of Thermocouples on P91/P92/F91/F92/C12A materials for PWHT

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.

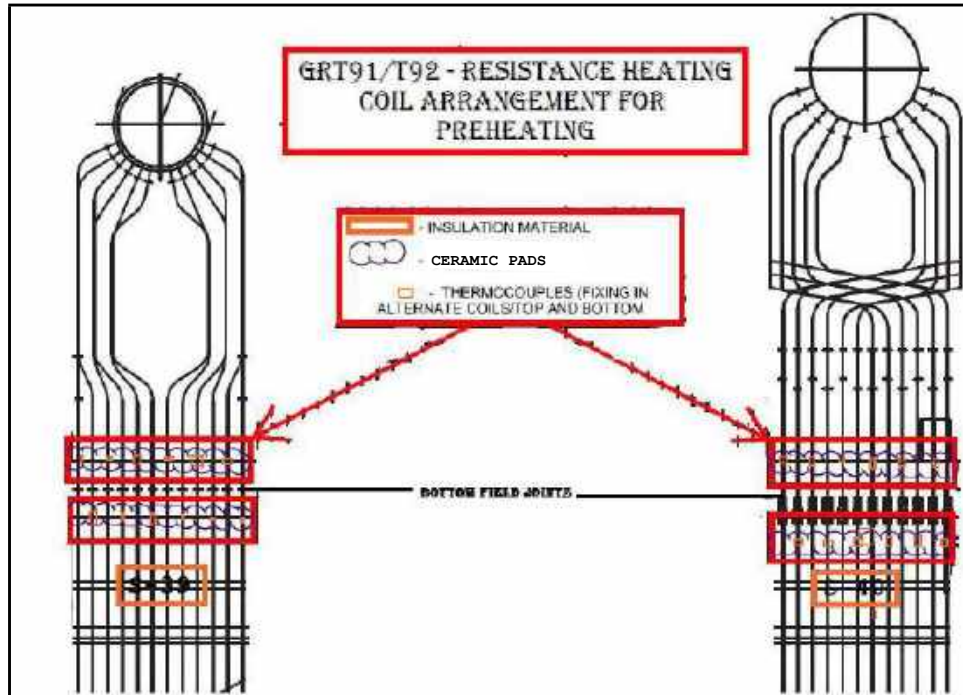


Figure 1.3: Resistance heating Coil arrangement for Preheating of T91/T92 tube assembly

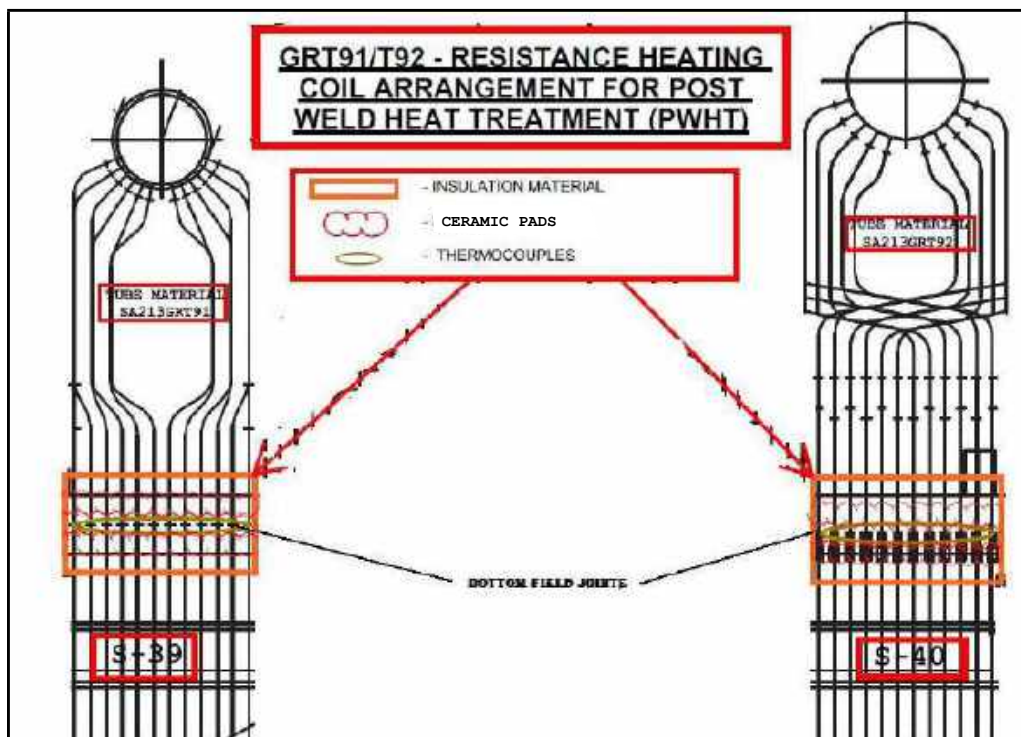


Figure 1.4: Resistance heating Coil arrangement for PWHT of T91/T92 tube assembly

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 $\leq 0.25\%$)	≤ 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 APPLICABLE AND SPECIAL 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 to concerned 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 m³ and pressure of 137 Kg/Cm² 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:

SI. 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-charge and handed over to the appropriate authority at the end of the project closure.

Annexure – I: Welding Job Card

Page 1 of 2

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

Page 2 of 2

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

<u>JOB CARD</u> <u>(WELDING, HEAT TREATMENT & ND EXAMINATION)</u> <u>FOR P91/P92 WELDS</u>													
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:													
<u>Contractor</u>				<u>BHEL</u>				<u>Customer</u>					

Annexure – III: Welding Job Card for T91/T92 Welds

<u>JOB CARD</u> <u>(WELDING, HEAT TREATMENT & ND EXAMINATION)</u> <u>FOR T91/T92 WELDS</u>									
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.		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:			
History of interruption if any, with time:									
<u>Contractor</u>				<u>BHEL</u>		<u>Customer</u>			

Annexure – IV: Welding Job Card for T23 Welds

<u>JOB CARD</u> <u>(WELDING, HEAT TREATMENT & ND EXAMINATION)</u> <u>FOR T23 WELDS</u>											
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:											
<u>Contractor</u>				<u>BHEL</u>				<u>Customer</u>			

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.	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.
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.	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.
1	P 1 / 1	SA 192	0.06-0.18	0.27-0.63	0.035 Max.	0.035 Max.	0.25 Max.	-	-	-	-	-	325	180	35
2	P 1 / 1	SA 210 Gr A1 (Remarks: Carbon restricted to 0.25% Max.)	0.27 Max.	0.93 Max.	0.035 Max.	0.035 Max.	0.10 Max.	-	-	-	-	-	415	255	30
3	P 1 / 1	SA 179	0.06-0.18	0.27-0.63	0.035 Max.	0.035 Max.	-	-	-	-	-	-	325	180	35
4	P 1 / 2	SA 210 Gr C (Remarks: Carbon restricted to 0.30% Max.)	0.35 Max.	0.29-1.06	0.035 Max.	0.035 Max.	0.10 Max.	-	-	-	-	-	485	275	30
5	P 3 / 1	SA 209 T1	0.10-0.20	0.30-0.80	0.025 Max.	0.025 Max.	0.10-0.50	-	-	0.44-0.65	-	-	380	205	30
6	P 4 / 1	SA 213 T11	0.05-0.15	0.30-0.60	0.025 Max.	0.025 Max.	0.50-1.00	-	1.00-1.50	0.44-0.65	-	-	415	205	30
7	P 4 / 1	SA 213 T12	0.05-0.15	0.30-0.61	0.025 Max.	0.025 Max.	0.50 Max.	-	0.80-1.25	0.44-0.65	-	-	415	220	30
8	P 5 A / 1	SA 213 T22	0.05-0.15	0.30-0.60	0.025 Max.	0.025 Max.	0.50 Max.	-	1.90-2.60	0.87-1.13	-	-	415	205	30

TABLE-A2.2: TUBES(ASME) (Contd...)

Sl. No.	P. No. / Group No.	Material Specification	Chemical Composition (%)										Mechanical Properties (Min.)		
			C	Mn	P	S	Si	Ni	Cr	Mo	V	W	T.S MPa	Y.S MPa	% E Min.
9	P 5 B / 1	SA 213 T5	0.15 Max.	0.30-0.60	0.025 Max.	0.025 Max.	0.50 Max.	-	4.00-6.00	0.45-0.65	-	-	415	205	30
10	P 5 B / 1	SA 213 T9	0.15 Max.	0.30-0.60	0.025 Max.	0.025 Max.	0.25-1.00	-	8.00-10.00	0.90-1.10	-	-	415	205	30
11	P 1 5 E / 1	SA 213 T91	0.07-0.14	0.30-0.60	0.02 Max.	0.01 Max.	0.20-0.50	0.40 Max.	8.00-9.50	0.85-1.05	0.18-0.25	-	585	415	20
12	P 8 / 1	SA 213 TP 304 H	0.04-0.10	2.00 Max.	0.045 Max.	0.03 Max.	1.00 Max.	8.00-11.00	18.00-20.00	-	-	-	515	205	35
13	P8/1	SA 213 TP 321H	0.04-0.10	2.00 Max.	0.045 Max.	0.03 Max.	1.00 Max.	9.00-12.00	17.00-19.00	-	-	-	515	205	35
15	P 8 / 2	SA 213 TP 347 H	0.04-0.10	2.00 Max.	0.045 Max.	0.03 Max.	1.00 Max.	9.00-13.00	17.00-19.00	-	-	-	515	205	35
15	Code case 2199	SA213 T23	0.04-0.10	0.10-0.60	0.030	0.010	0.050	--	1.90-2.60	0.05-0.30	0.20-0.30	1.45-1.75	510	400	20
16	15E/1 (Code case 2169)	SA213 T92	0.07-0.13	0.30-0.60	0.020	0.010	0.50	0.40	8.5-9.5	0.30-0.60	0.15-0.25	1.5-2.0	620	440	20
17	P8/1 (Code case 2328 - S30432)	SA 213 UNS S30432 (Super 304H)	0.07-0.13	1.00	0.040	0.010	0.30	7.5-10.5	17.0-19.0	-	-	-	590	235	35

TABLE A2.3: FORGINGS (ASME)

Sl. No.	P. No. / Group No.	Material Specification	Chemical Composition (%)										Mechanical Properties (Min.)		
			C	Mn	P	S	Si	Ni	Cr	Mo	V	W, Cb	T.S MPa	Y.S MPa	% E Min.
1	P 1 / 2	SA 105 (Remarks: Carbon restricted to 0.25% Max.)	0.35 Max.	0.60-1.05	0.035 Max.	0.04 Max.	0.1 - 0.35	0.40 Max.	0.30 Max.	0.12 Max.	0.08 Max	-	485	250	30
2	P 4 / 1	SA 182 F11 Class 3	0.10-0.20	0.30-0.80	0.04 Max.	0.04 Max.	0.50 - 1.00	-	1.00-1.50	0.44-0.65	-	-	515	310	20
3	P 4 / 1	SA 182 F 12 Class 2	0.10-0.20	0.30-0.80	0.04 Max.	0.04 Max.	0.10 - 0.60	-	0.80-1.25	0.44-0.65	-	-	485	275	20
4	P 5 A / 1	SA 182 F 22 Class 3	0.15 Max.	0.30-0.60	0.04 Max.	0.04 Max.	0.50 Max.	-	2.00-2.50	0.87-1.13	-	-	515	310	20
5	P 1 5 E / 1	SA 182 F91	0.08-0.12	0.30-0.60	0.02 Max.	0.01 Max.	0.20 - 0.50	0.40 Max.	8.00-9.50	0.85-1.05	0.18-0.25	-	620	415	20
6	P 1 5 E / 1	SA 182 F92	0.7-0.13	0.30-0.60	0.02 Max.	0.01 Max.	0.50 Max.	0.40 Max.	8.50-9.50	0.30-0.60	0.15-0.25	W:1.50-2.00; Cb: 0.04-0.09	620	440	20

TABLE A2.4: CASTINGS (ASME)

Sl. No.	P. No. /Group No.	Material Specification	Chemical Composition (%)								Mechanical Properties (Min.)		
			C	Mn	P	S	Si	Ni	Cr	Mo	MPa	MPa	% 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	Y.S	%E
	(MPa)	(MPa)	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 ind	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 ind	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 ind	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	P15E11	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./	Material	Thickness	C	Mn	P	S	Si	Ni	Cr	Mo	V	T.S	Y.S	%E
	Group No.	Specification	mm										(MPa)	(MPa)	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	0.40	-	-	-	-	450	345	17
			>40					0.15-0.40	-	-	-	-0.01-0.1			
13	P 1 / 1	IS 2062 E250 Gr.A	all thickness	0.23	1.5	0.045	0.045	0.4	-	-	-	-	410	230	23
14	P 1 / 1	IS 2062 E250 Gr.BR BO	all thickness	0.22	1.5	0.045	0.045	0.4	-	-	-	-	410	230	23
15	P 1 / 1	IS 2062 E250 GrC	all thickness	0.2	1.5	0.04	0.04	0.4	-	-	-	-	410	230	23
16	P 1 / 1	IS 2062 E350 Gr A.BR,BO	all thickness	0.2	1.55	0.045	0.045	0.45	-	-	-	-	490	320	22
17	P 1 / 1	IS 2062 E350 GrC	all thickness	0.2	1.55	0.04	0.04	0.45	-	-	-	-	490	320	22
18	P 1 / 1	IS 2062 E450BR	all thickness	0.22	1.65	0.045	0.045	0.45	-	-	-	-	570	450	20
19	P 1 / 1	BSEN10025 Gr 420N	all thickness	0.2	1.0-1.7	0.03	0.025	0.6	0.8	0.3	0.1	0.2	500	320	18

TABLE A2.6: PIPES (OTHER SPECIFICATION)

Sl. No.	Equivalent P. No. /Group No.	Material Specification	Chemical Composition (%)									Mechanical Properties (Min.)		
			C	Mn	P	S	Si	Ni	Cr	Mo	V	T.S Kg / mm ²	Y.S Kg / mm ²	% EMin.
1	P1/1	DIN St. 35.8	0.17 Max.	0.40-0.80	0.04 Max.	0.04 Max.	0.10-0.35	-	-	-	-	36.70-48.96	24	25
2	P1/1	DIN St. 45.8	0.21 Max.	0.45-1.20	0.04 Max.	0.04 Max.	0.10-0.35	-	-	-	-	41.80-54.10	26	21
3	P1/1	BS 3602 / 410	0.21 Max.	0.40-1.20	0.045 Max.	0.045 Max.	0.35 Max.	-	-	-	-	41.82-56.10	25	22
4	P1/1	BS 3602 / 460	0.22 Max.	0.80-1.40	0.045 Max.	0.045 Max.	0.35 Max.	-	-	-	-	46.90-61.20	28.60	21
5	P4/1	BS 3604 620-460 HFS or CDS 620-440	0.10-0.15	0.40 Max.	0.04 Max.	0.04 Max.	0.10-0.35	-	0.70-1.10	0.45-0.65	-	46.90- 62.22	18.36	22
			0.10-0.18	0.40-0.70	0.04 Max.	0.04 Max.	0.10-0.35	-	0.70-1.10	0.45-0.65	-	44.90- 60.20	29.58	22
6	P5/1	BS 3604 622 HFS or CDS	0.08-0.15	0.40-0.70	0.04 Max.	0.04 Max.	0.50 Max.	-	2.00-2.50	0.90-1.20	-	48.80	26.80	17
7	-	BS 3604 HFS 660 Or CDS 660	0.15 Max.	0.40-0.70	0.04 Max.	0.04 Max.	0.10-0.35	-	0.25-0.50	0.50-0.70	0.22-0.30	47.30	30	17
8	P5B/2	X20CrMoV121D IN17175	0.17-0.23	≤ 1.00	0.030 Max.	0.030 Max.	≥ 0.50	0.30-0.80	10.00-12.50	0.80-1.20	0.25-0.35	70-86	50	17

TABLE A2.7: TUBES (OTHER SPECIFICATIONS)

Sl. No.	Equivalent P. No. /Group No.	Material Specification	Chemical Composition (%)									Mechanical Properties (Min.)		
			C	Mn	P	S	Si	Ni	Cr	Mo	V	T.S Kg / mm ² (MPa)	Y.S Kg / mm ² (MPa)	% E Min.
1	P1/1	DIN St. 35.8	0.17 Max.	0.40- 0.80	0.04 Max.	0.04 Max.	0.10- 0.35	-	-	-	-	36.70- 48.96	24	25
2	P1/1	DIN St. 45.8	0.21 Max.	0.40- 1.20	0.04 Max.	0.04 Max.	0.10- 0.35	-	-	-	-	41.80- 54.06	26	21
3	P1/1	BS 3059 / 360	0.17 Max.	0.40- 0.80	0.045 Max.	0.045 Max.	0.35 Max.	-	-	-	-	36.70- 51.00	22	24
4	P1/1	BS 3059 / 440	0.12- 0.18	0.90- 1.20	0.040 Max.	0.035 Max.	0.10- 0.35	-	-	-	-	44.88- 59.20	25	21
5	P3/1	15 Mo3 DIN17175	0.12- 0.20	0.40- 0.80	0.035 Max.	0.035 Max.	0.10- 0.35	-	-	0.25- 0.35	-	45.90- 61.20	27.50	22
6	P4/1	13 Cr Mo 4- 5DIN17175	0.10- 0.18	0.40- 0.70	0.035 Max.	0.035 Max.	0.10- 0.35	-	0.70- 1.10	0.45- 0.65	-	44.88- 60.18	29.60	22
7	P4 /1	BS 3059 / 620	0.10- 0.15	0.40- 0.70	0.040 Max.	0.040 Max.	0.10- 0.35	-	0.70- 1.10	0.45- 0.65	-	46.90- 62.20	18.40	22
8	P5/1	10 Cr Mo 9- 10DIN17175	0.08- 0.15	0.40- 0.70	0.035 Max.	0.035 Max.	0.50 Max.	-	2.00- 2.50	0.90- 1.20	-	45.90- 61.20	28.60	20
9	P5/1	BS 3059 (622) - 440	0.08- 0.15	0.40- 0.70	0.04 Max.	0.04 Max.	0.50 Max.	-	2.00- 2.50	0.90- 1.20	-	44.90- 60.18	17.85	20
10	P5/1	BS 3059 (622) - 490	0.08- 0.15	0.40- 0.70	0.040 Max.	0.040 Max.	0.50 Max.	-	2.00- 2.50	0.90- 1.20	-	49.98- 65.00	28.05	20
11	-	14 Mo V 63 DIN17175	0.10- 0.18	0.40- 0.70	0.035 Max.	0.035 Max.	0.10- 0.35		0.30- 0.60	0.50- 0.70	0.22- 0.32	46.90- 62.22	32.60	20
12	P5B/2	X20CrMoV121 DIN17175	0.17- 0.23	≤ 1.00	0.030 Max.	0.030 Max.	≥ 0.50	0.30- 0.80	10.00- 12.50	0.80- 1.20	0.25- 0.35	70-86	50	17

**CHAPTER A3: WELDING
MATERIAL SPECIFICATION AND
CONTROL**

SECTION A3.1-WELDING MATERIAL SPECIFICATION AND CONTROL

1.0 SCOPE:

1.1. This chapter details out the welding material specification and controls at sites.

2.0 CONTENTS:

1. Table- A3.1 - Weld Metal Chemical Composition.
2. Table - A3.2 - Mechanical property requirement for all-weld metal.
3. Receipt inspection of welding electrodes/filler wires.
4. Storage and identification of welding electrodes/filler wires.
5. Drying and holding of welding electrodes.
6. Selection and issue of welding electrodes/filler wires.
7. Table-A3.3 - Selection of GTAW filler wire, SMAW electrodes for butt welds in tubes, pipes, headers.
8. Table-A3.4 - Selection of electrodes for welding attachments to tubes.
9. Table-A3.5 - Selection of electrodes, preheat, PWHT for attachment to attachment welds.
10. Table-A3.6 -Selection of electrodes for welding nozzle attachments, hand hole plate, RG plug etc. to headers, pipes.
11. Table-A3.7 –Selection of filler wire and electrodes for non-pressure parts(including structures)
12. Table-A3.8 -A numbers
13. Table-A3.9 -F numbers
14. SFA Classification

3.0 For welding consumables not covered in this chapter, relevant details may be obtained from the concerned Manufacturing Units.

Table-A3.1
WELD METAL CHEMICAL COMPOSITION

Electrode/ Consumable	SFA No.	Weight, %										Other Elements % ^a
		C	Mn	Si	P	S	Ni	Cr	Mo	V	Cu	
E 6010	5.1	0.20	1.20	1.00	NS	NS	0.30	0.20	0.30	0.08	NS	Combined Limit for Mn+Ni+Cu+Mo+V=1.75
E 6013	5.1	0.20	1.20	1.00	NS	NS	0.30	0.20	0.30	0.08	NS	
E 7018	5.1	0.15	1.60	0.75	0.035	0.035	0.30	0.20	0.30	0.08	NS	
E 7018-1	5.1	0.15	1.60	0.75	0.035	0.035	0.30	0.20	0.30	0.08	NS	
E 7018-A1	5.5	0.12	0.90	0.80	0.03	0.03	NS	NS	0.40- 0.65	NS	NS	
E 8018-B2	5.5	0.05- 0.12	0.90	0.80	0.03	0.03	NS	1.00- 1.50	0.40- 0.65	NS	NS	
E 9018-B3	5.5	0.05- 0.12	0.90	0.80	0.03	0.03	NS	2.00- 2.50	0.90- 1.20	NS	NS	
E 9015-B91	5.5	0.08- 0.13	1.20	0.30	0.01	0.01	0.80	8.00- 10.50	0.85- 1.20	0.15- 0.30	0.04 - 0.25	
E9015-B92	5.5	0.08- 0.15	1.20	0.60	0.020	0.015	1.0	8.0-10.0	0.30- 0.70	0.15- 0.30	0.25	W: 1.50-2.00; Nb: 0.02-0.08 B:0.006; Al: 0.04; N: 0.03- 0.08
E9018-B23/ E9015-B23	5.5	0.04- 0.12	1.00	0.60	0.015	0.015	0.5	1.9-2.9	0.30	0.15- 0.30	0.25	W: 1.50-2.00; Nb: 0.02-0.10 B:0.006; Al: 0.04; N: 0.05
E 308	5.4	0.08	0.50- 2.50	1.00	0.04	0.03	9.00- 11.00	18.00- 21.00	0.75	NS	0.75	
E 308-L	5.4	0.04	0.50- 2.50	1.00	0.04	0.03	9.00- 11.00	18.00- 21.00	0.75	NS	0.75	

Table-A3.1 (Contd...)
WELD METAL CHEMICAL COMPOSITION

Electrode/ Consumable	SFA No.	Weight, %										Other Elements % ^a
		C	Mn	Si	P	S	Ni	Cr	Mo	V	Cu	
E 309	5.4	0.15	0.50- 2.50	1.00	0.04	0.03	12.00- 14.00	22.00- 25.00	0.75	NS	0.75	
E 309-L	5.4	0.04	0.50- 2.50	1.00	0.04	0.03	12.00- 14.00	22.00- 25.00	0.75	NS	0.75	
E 347	5.4	0.08	0.50- 2.50	1.00	0.04	0.03	9.00- 11.00	18.00- 21.00	0.75	NS	0.75	Cb+Ta 8XC Min. to 1.00 Max.
E316	5.4	0.08	0.5-2.5	1.00	0.04	0.03	11.0- 14.0	17.0- 20.0	2.0-3.0	NS	0.75	
E2209-16	5.4	0.04	0.5-2.0	1.00	0.04	0.03	7.5-9.5	21.5- 23.5	2.5-3.5	NS	0.75	N:0.08-0.20
ENiCrFe-3	5.11	0.10	5.0-9.5	1.00	0.03	0.015	59.0 min	13.0- 17.0	NS	NS	0.50	Fe: 12.0; Ta+ Cb: 1.0- 2.5; Ti: 1.0; others: 0.5
ENiCrFe-7	5.11	0.05	5.0	0.75	0.03	0.015	Rem	28.0- 31.5	0.5	NS	0.50	Fe: 7.0-12.0; Ta+ Cb: 1.0-2.5; others: 0.5
ENi-CI	5.15	2.00	2.50	4.00	NS	0.03	85 ^d min	NS	NS	NS	2.5 ^e	Fe Al others 8.0 1.0 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 Al others Rem ^f 1.0 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 Zr Al 0.05- 0.02- 0.05- 0.15 0.12 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 unspecified elements 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 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) %
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 Welding Electrodes/Filler Wires

1.0 SCOPE:

1.1 This procedure is applicable for storage of welding electrodes/filler wires used at sites.

2.0 PROCEDURE:

2.1 Only materials accepted (based on receipt inspection) shall be taken into account for storage.

2.2 STORAGE FACILITY:

2.2.1 The storage facility shall be identified.

2.2.2 Access shall be 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 Maintain a 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 concerned manufacturing 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 concerned manufacturing units.

2.2 Issue:

- 2.2.1 Issue of welding electrodes / filler wires shall be based on authorised welding electrodes issue voucher.
- 2.2.2 It is recommended to restrict quantity issued to not more than 4 hours' requirements.
- 2.2.3 Re-dried low hydrogen electrodes shall be carried to the work spot in a portable oven.
- 2.2.4 Maintain the temperature in the portable oven at the work spot above 65°C.
- 2.2.5 Unused electrodes shall be segregated and reused only after repeating drying and holding cycles.

Table- A3.3
SELECTION OF GTAW FILLER WIRE, SMAW ELECTRODE FOR
BUTT WELDS IN TUBES, PIPES AND HEADERS

Material	Welding Process	P1 Gr 1/ P1 Gr 2	P3 Gr 1	P4 Gr 1	P5A Gr 1	P15 E Gr 1	T23	T92/P92	P8	P8 SA 213 UNS S 30432	DIN14MoV6 3 or equivalent
P1 Gr 1	GTAW	ER 70S-A1									
P1 Gr 2	SMAW	E7018-1 Note 1									
P3 Gr 1	GTAW	ER 70S-A1	ER 70S-A1								
	SMAW	E7018-1	E7018-A1								
P4 Gr 1	GTAW	ER 70S-A1	ER 70S-A1	ER 80S-B2							
	SMAW	E7018-1	E7018-A1	E8018-B2							
P5A Gr 1	GTAW	ER 70S-A1	ER 70S-A1	ER 80S-B2	ER 90S-B3	ER 90S-B3	ER90S-B3				
	SMAW	E7018-1	E7018-A1	E8018-B2	E9018-B3	E9018-B3	E9018-B3				
P15 E Gr.1 Gr.91	GTAW					ER90S-B9	TGS2CW/ 2CrWVTIG/ YT-SCM2S	ER90S-B9			
	SMAW					E9015-91	E9018-B23	E9015-B91			
T23	GTAW						TGS2CW/ 2CrWVTIG/YT- SCM2S	TGS2CW/ 2CrWVTIG/ YT-SCM2S			
	SMAW						E9018-B23	E9018-B23			

Table- A3.3 (Contd...)

Material	Welding Process	P1 Gr 1 P1 Gr 2	P3 Gr 1	P4 Gr 1	P5A Gr 1	P15 E Gr 1	T23	T92/P92	P8	P8 SA 213 UNS S 30432	DIN14MoV63 or equivalent
P15 E Gr.1 Gr.92	GTAW							9CrWV-TIG/ Themanit- MTS616			
	SMAW							E9015-B92			
P8	GTAW			ERNi Cr3	ERNiCr3	ERNiCr3	ERNiCr3	ERNiCrFe7A	ER347		
	SMAW			ENiC rFe3	ENiCrFe3	ENiCrFe3	ENiCrFe3	ENiCrFe7	E347		
P8 SA 213 UNS S30432	GTAW									YT304H/ THERMANIT 304H Cu	
DIN14MoV63 or equivalent	GTAW				ER 90S- B3						ER90S-B3
	SMAW				E9018-B3						E9018-B3

Note-1: E7018-A1 for P1 Gr2 + P1 Gr2 when PWHT is involved.

Table- A3.4
SELECTION OF ELECTRODES FOR WELDING ATTACHMENTS TO TUBES

Tube Material	Attachment Material			
	P1 Group 1	P4 Group 1	P5A Group 1	P8
P1 Group 1 P1 Group 2	E 7018	E 7018	E 7018	E 309
P3	E 7018-A1	E 7018-A1	E 7018-A1	E 309
P4 Group 1	E 8018-B2	E 8018-B2	E 8018-B2	E 309
P5A Group 1	E 9018-B3	E 9018-B3	E 9018-B3	E 309
P8 including SA 213 UNS S30432		E 309	E 309	E 347
P15E Gr.1 (Gr. 91/92)			E9018-B3	ENiCrFe-3
SA213T23			E9018-B3	ENiCrFe-3

Table- A3.5
SELECTION OF ELECTRODES, PREHEAT, PWHT
FOR ATTACHMENT TO ATTACHMENT WELDS
(Seal Bands, High Crown Bars, End Bars, End Bar Lifting Lugs and Collector Plates etc.)

Material (Note 2)	Welding Requirements	P1	P3	P4	P5 A	P8 Group 1	P8 Group 2	P 15E / 1
P1	Electrode Preheat PWHT	E7018 Nil Nil	-	E 7018 150°C 650 – 670°C	-	-	-	-
P3	Electrode Preheat PWHT	E7018 150°C (Note 1) For Thickness>16mm: 620-650°C	E7018-A1 150°C For Thickness>16mm: 620- 650°C	-	-	-	-	-
P4	Electrode Preheat PWHT	E7018 150°C (Note 1) For Thickness>13mm: 650-670°C	E7018-A1 150°C For Thickness>13mm: 650- 670°	E8018-B2 150°C (Note 1) For Thickness>13mm: 650-670°C	-	-	-	-
P5 A	Electrode Preheat PWHT	-	-	E8018-B2 150°C (Note 1) For Thickness>13: 680- 710°C	E9018-B3 150°C (Note 1) For Thickness>13:680- 710°C	-	-	-
P8	Electrode Preheat PWHT	E309 Nil Nil	-	E309 Nil Nil	E309 Nil Nil	E347 Nil Nil	E309 Nil Nil	-
P 15E/ 1	Electrode Preheat PWHT	-	-	-	E9018-B3 220°C 730-760 °C	ENi Cr Fe3 220°C (only on P15E side) 730-760 °C	ENi Cr Fe3 220°C (only on P15E side) 730-760 °C	E9015-B91 220°C 740-770 °C

Note – 1 : Preheat is not required for P3/P4 up 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	CO₂ 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

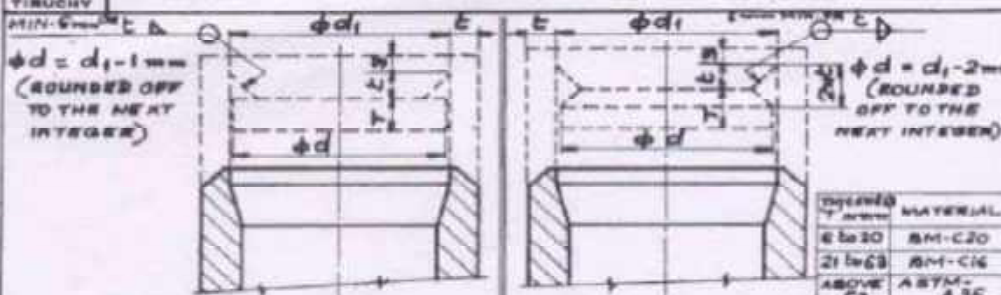
TABLE- A3.9 (Contd...)
F NUMBERSGROUPING OF ELECTRODES AND WELDING RODS FOR
QUALIFICATION

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



SELECTION CHART FOR DUMMY END COVERS FOR HYDRAULIC TEST

THICKNESS $T = 0.5 d_1 \sqrt{\frac{f}{\sigma}}$ (ISO REC. R 831/1968) $f = 1900 \text{ kg/cm}^2$ TEST
 ROUNDED OFF TO THE NEXT NEAREST RATIONALISED PLATE SIZE.



CASE WHEN $T \leq 20$

CASE WHEN $T > 20$

THICKNESS OF DUMMY END COVERS FOR HYDRAULIC TEST (T)

TEST PRESSURE (kg/cm²)	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	5	5	5	5
30	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5
35	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5
40	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5
45	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5
50	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5
55	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5
60	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5
65	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5
70	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5
75	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5
80	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5
85	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5
90	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5
95	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5
100	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5
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	40	40
250	20	20	25	32	32	32	36	36	36	40	40	40	40	40	40	40
300	20	25	32	32	36	36	40	40	40	40	40	40	40	40	40	40
350	25	32	32	36	40	40	40	40	40	40	40	40	40	40	40	40
400	32	32	40	36	36	36	36	36	36	36	36	36	36	36	36	36
450	32	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36
500	36	40	36	36	36	36	36	36	36	36	36	36	36	36	36	36

MICROFILMED ON

ROLL 100371 P. 1528

PREPARED BY

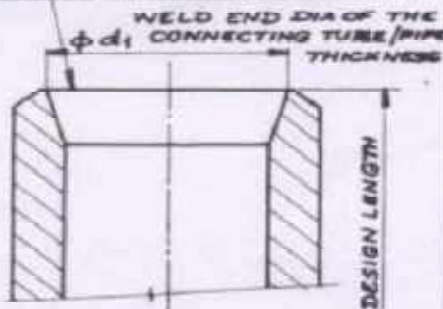
CHECKED BY

40-B-006-2897



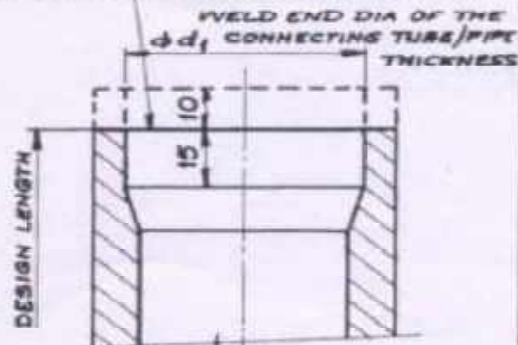
NIPPLES - FREE END DETAILS. (FOR HEADERS ONLY.)

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



STRAIGHT NIPPLES WHICH DO NOT REQUIRE ANY ALLOWANCE. (NO SHOP HYD. TEST.)

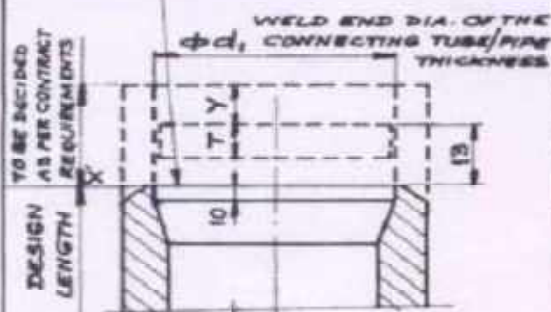
INDICATE STYLE NO 'C' - d_1
TO SPS NO 710004-74 (LAT. REV.)



STRAIGHT & BENT NIPPLES WHICH REQUIRE 10 mm ALLOWANCE. (NO SHOP HYD. TEST.)

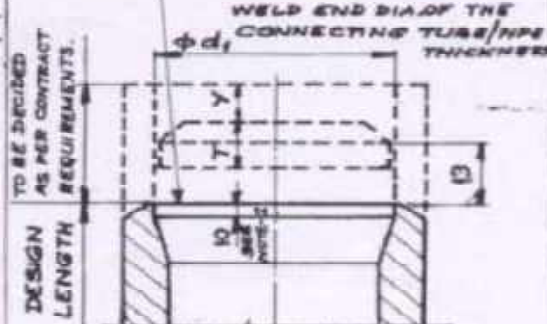
CASE WHEN $T \leq 20$

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



CASE WHEN $T > 20$

INDICATE STYLE NO 'C' - d_1
TO SPS 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 DRS NO 40-B-006-2897.

2. IN CASE THE THICKNESS REQUIRED FOR THE SUMMIT END COVER IS MORE THAN 25mm THE INSIDE HEIGHT OF MACHINING (WHICH IS NOW 10mm) WILL BE INCREASED APPROPRIATELY.

PREPARED BY

G. S. N. C.

CHECKED BY.

R. S. N. C.

MICROFILMED ON
ROLL 500324 FRAME 153

40-B-006-2897

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 IIR										
Site :			Test Record No. :			 Affix welder photo				
Contractor Name :			DATE :							
NAME Srl.										
ID NO :										
WPS No. :			Rev :							
Variables			Recorded Actual values (within 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										
Si/A 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										
Appearance						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 :				
BH-EL :			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.

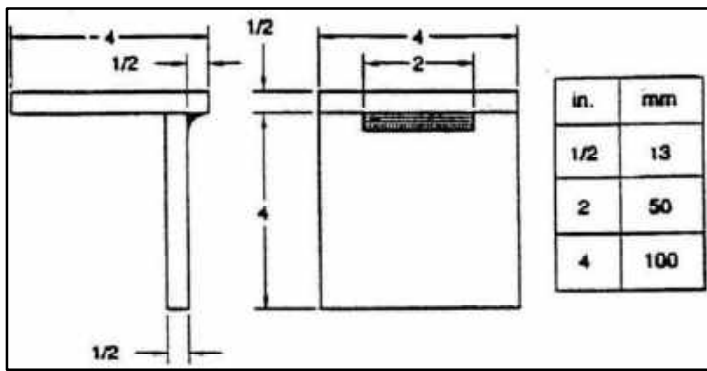


Figure A6.1 – Structural Tack Weld Specimen

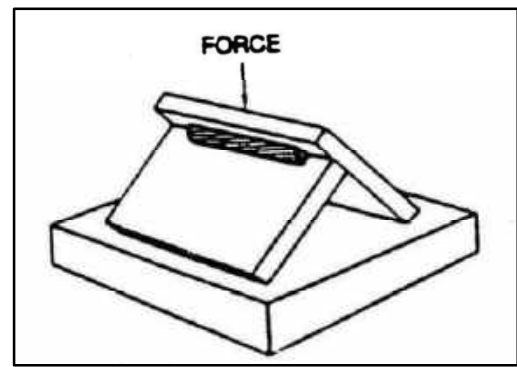


Figure A6.2 – Break Test

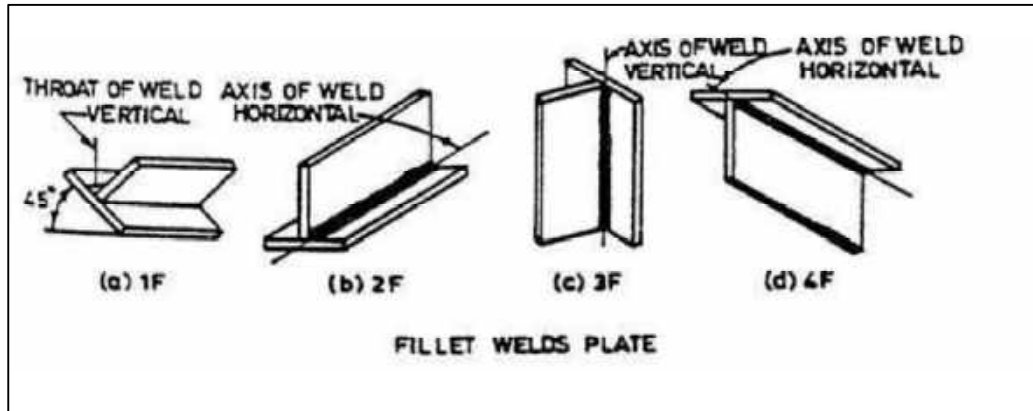


Figure A6.3 - Weld Positions

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 site fabrication, 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 by IBR, 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 have basic 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' or double '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.

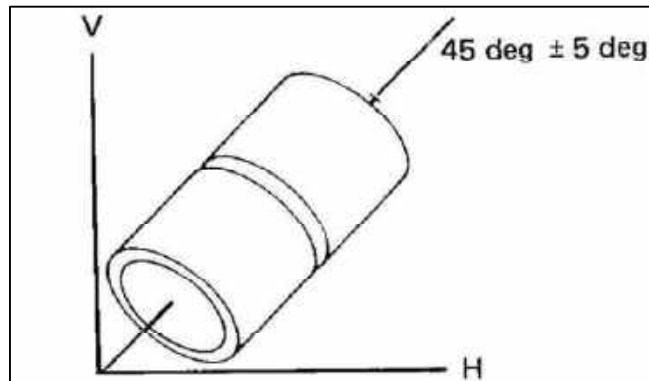


Figure A6.46G-Position

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.

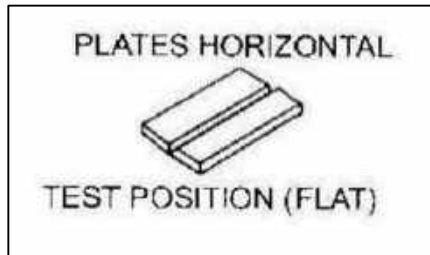


Figure A6.5 Flat position

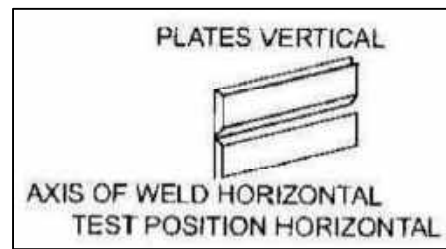


Figure A6.6 Horizontal Position

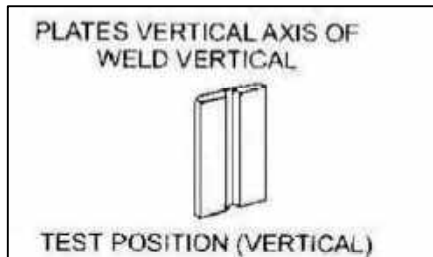


Figure A6.7 Vertical Position



Figure A6.8 Overhead Position

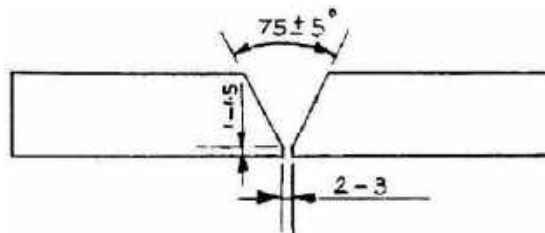
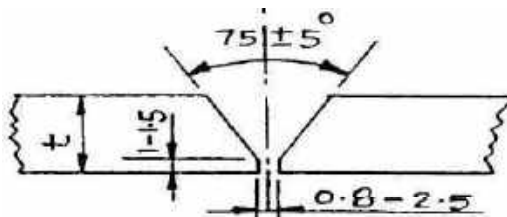
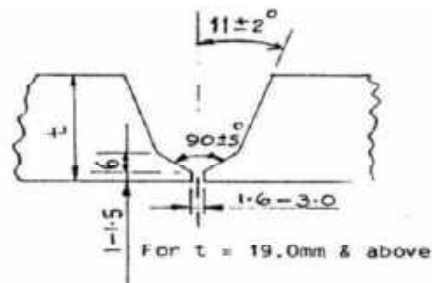


Figure A6.9- Plate butt weld specimen



(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 Record 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 E-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 2.7.1 reviewing 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

[illegible]

Note : 1. Upto and including 5% defects., performance is satisfactory else unsatisfactory.

2. Upto and including 2.5% defects, performance 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 be aware of 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 weld of 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 mismatch shall 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 & 3.2.6 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 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

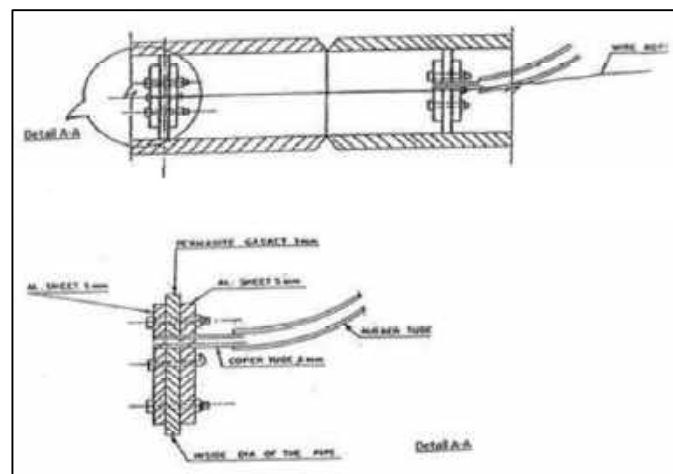


Figure B2.1

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 the dams. 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).

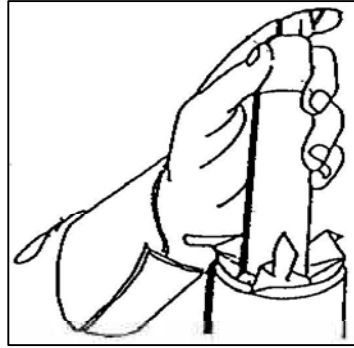


Figure B2.2

- 3.3.5.2. For larger pipes, cut out a circular aluminium foil disc slightly larger than the diameter and shape it to the inside pipe circumference. (A small hole may be punched in the paper to ensure complete evacuation of air when purging) (Refer Figure B2.3).

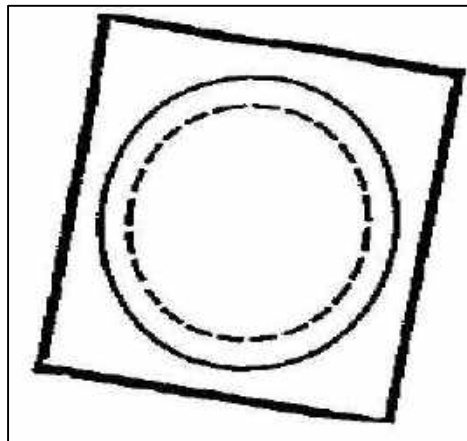


Figure B2.3

- 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).

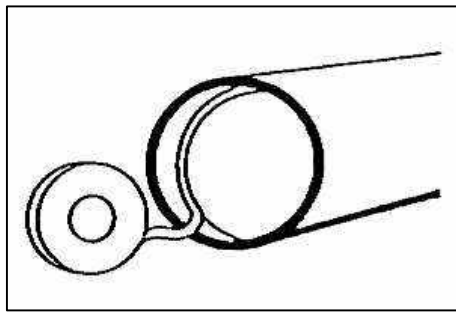


Figure B2.4

- 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.

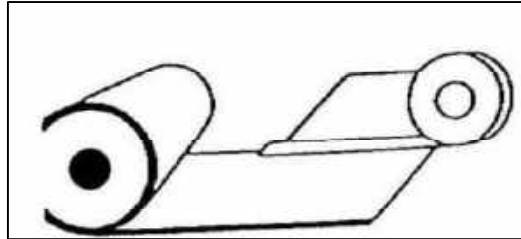


Figure B2.5

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-3.4 of 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 be preheated 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 temperature of 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 temperature measurement on the weld joint shall be recorded using calibrated gauges/instruments at regular intervals of 15 minutes in the log book by Site Engineer.

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 (Refer NDE Manual AA/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 requirements as 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 number BHE: 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 located from the weld outside surface. The defect area shall be marked and repaired as below:

- a) The weld shall be removed by grinding (gouging not permitted) such that the area for repair welding shall be free from sharp corners and provided with sufficient slope towards the weld face 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.

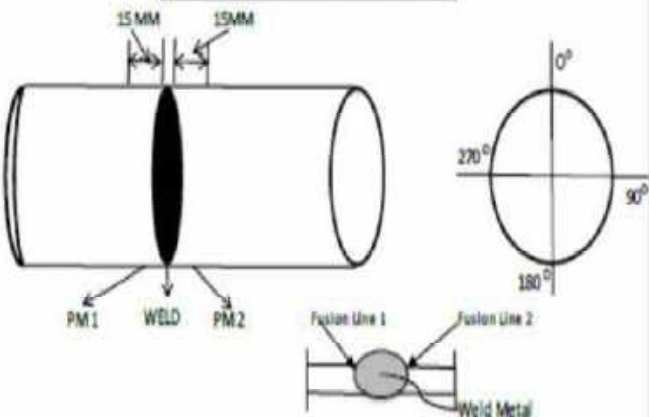
The hardness of the weld metal and the base metal in the soak band (heating band), excluding welding heat-affected zone shall be between 160HB & 300HB for Gr.91 and Gr.92 joints. The hardness measurements shall be recorded in the format as given in Annexure IX. Joints having hardness above 300HB shall 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°			
3 O' Clock/ 90°			
6 O'Clock/ 180°			
9 O'Clock/ 270°			
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 applicable WPS for the same shall be obtained from concerned 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:
- The equipment used and its working principle and operation.
 - The procedures to be followed in using heating equipment.
 - Procedure to be followed in case of power failure or equipment non-functioning so that heating cycle is not disrupted.
 - Calibration of equipment.
 - Method of fixing thermocouples and compensating cables leading to HT recorder.
 - 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 to final 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:

- Cutting by Band saw/Hack saw/Machining.
- Pipes Edge Preparation by machining. Machining shall be done without excessive pressure to prevent heating up of pipe
- 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 made available, 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 on root 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 for a period of Minimum 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 **DON'T's:**

- a. Avoid Oxy-Acetylene flame cutting.
- b. Avoid Weld-build up to correct the weld end-d1 or to set right the lip of the weld bevel.
- c. Avoid Arc strike on materials at the time of weld fit up or during welding.
- d. Do not Tack weld the Thermocouple wires with Manual Arc/TIG welding.
- e. NO GTAW root welding without thorough purging of root area.
- f. Do not use Oxy-acetylene flame heating for any heating requirements.
- g. Do not use Thermal chocks on the weld groove.

- h. Do not stop argon purging till completion of GTAW root welding and two layers of SMAW.
- i. No Tack welding or Bridge piece welding is permitted.
- j. Do not use unidentified TIG wires or electrodes.
- k. Do not exceed the maximum interpass temperature indicated in WPS
- l. Do not allow moisture, rain, water, cold wind, cold draft etc. to come in contact with the weld zone or heating zone during the entire cycle from preheat to PWHT.
- m. Do not exceed the limits of PWHT soaking temperature.
- n. Do not Interrupt the Welding/heating cycle except for unavoidable power failures
- o. Do not use 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.

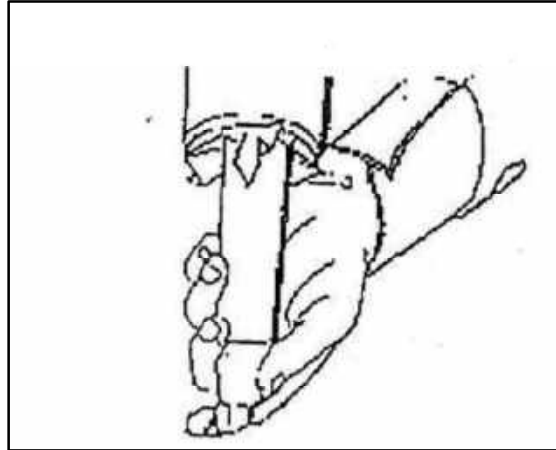


Figure B3.1: Insertion of Water Soluble Tissue paper

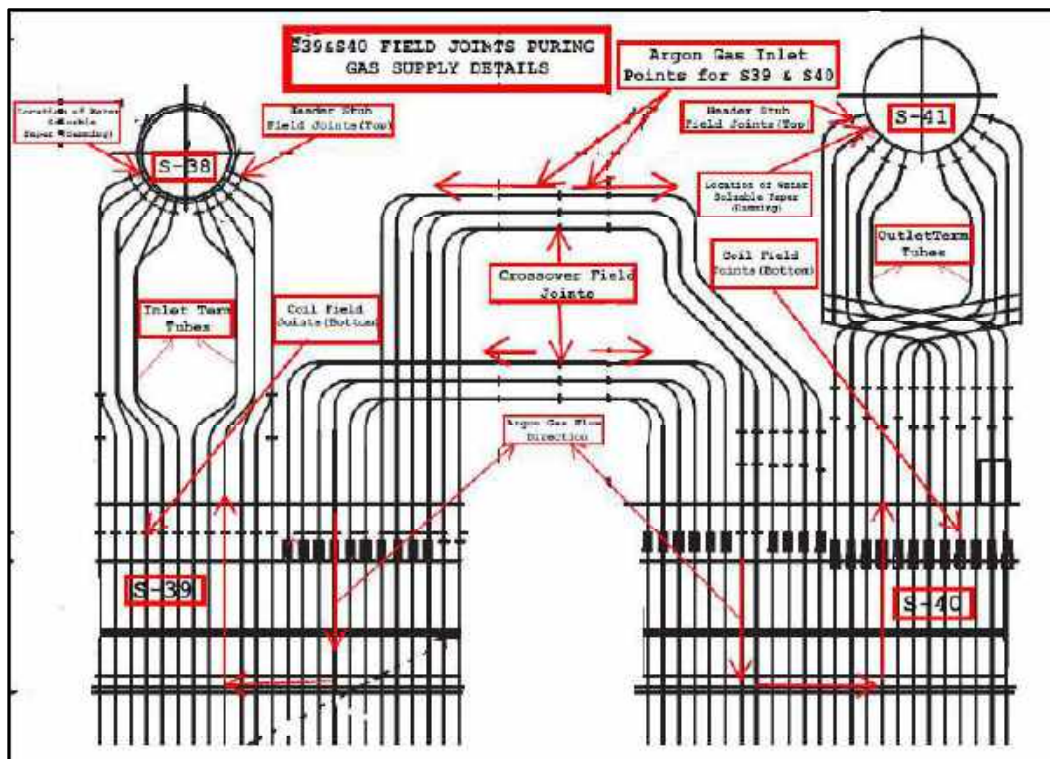


Figure B2.2: Purging Arrangement for SH Header Field Joints

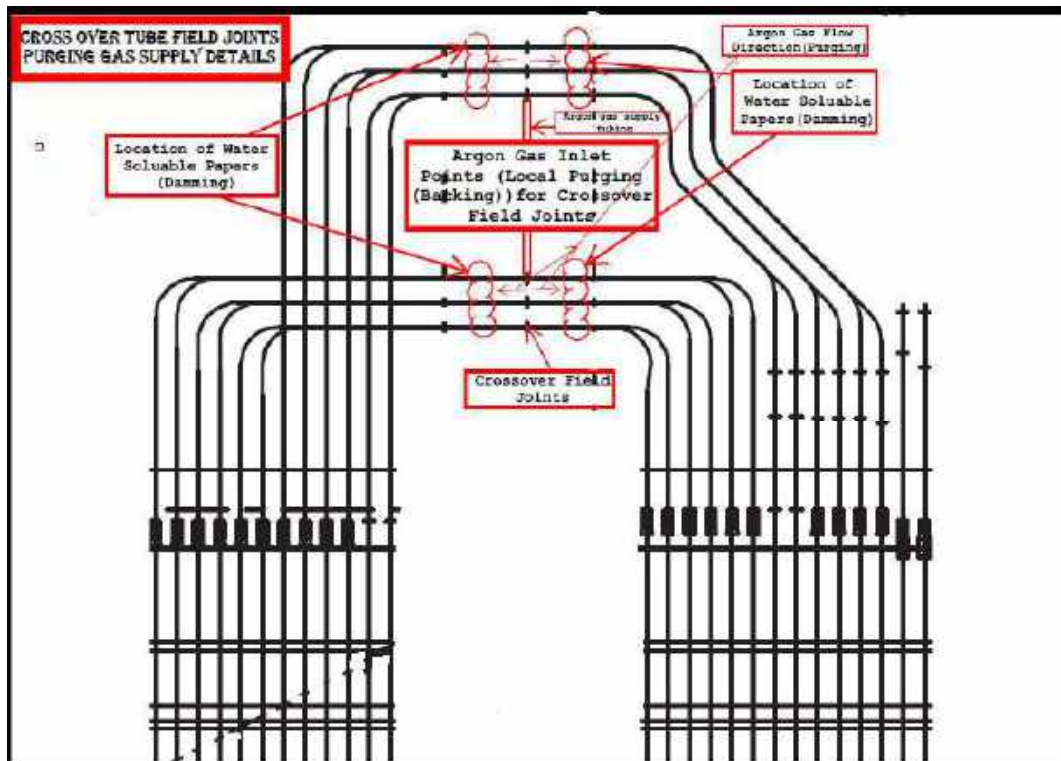


Figure B2.3: Purging Arrangement for Cross Over Tube Field Joints

**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 before fit-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 Figure B4.1, 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

Social Accountability 8000 Compliance Format

A. Basic information

Name of the organization		
Address		
Telephone No		
Name of the Proprietor		
Nature of Business		
License Number and date of expiry		
Employees	Staff (Total Number)	Workmen (Total Number)
• Permanent		
• Casual		
• Badli		
• Temporary		
• Contracted		

B. Information regarding Social Accountability

- What is the minimum age required to join your organization? _____ Years
- What types of certificates (Like mark sheet, birth certificate) you keep with you? Original Copy / Xerox
- Do you require to keep any kind of deposit inform of cash at the time of employment? Yes/No
- Do you provide safe & healthy work environment as per statutory requirement? Yes/No
- If directly not provided by you, do you get health & safety benefits from NALCO? Yes/No
- Are you certified for SA 8000? Yes/No
If Yes, please submit a copy of SA8000 Certificate along with this filled up questionnaire

Have you undergone Code of Conduct Audit (COC Audit) in last 2 years ? Yes/No

If yes, please submit a copy of Code of Conduct Audit Report along with this filled up questionnaire

Have your sub-suppliers been certified for SA 8000? Yes/No

Have your sub-suppliers undergone Code of Conduct Audit (COC Audit) in last 2 years? Yes/No

▪ Do you provide personal protective equipment(s) to your employees free of cost? Yes/No

▪ Do you provide safety training to your employees? Yes/No

▪ Do you ensure canteen facility for your employees? Yes/No

▪ If not, do you get the facilities from NALCO Yes/No

▪ What types of medical benefits you provide to your employees?

▪ Do you allow trade union and collective bargaining in your organization? Yes/No

If no, how do you ensure freedom of expression?

▪ Incase of non-performance of any employee, how do you deal with such situations?

▪ What are the procedures of hiring/promotion/ remuneration in your organization?

- Do you provide appointment letter to your employees? Yes/No
- Do you maintain a documented terms and conditions of employment? Yes/No
- Do you maintain a disciplinary procedure? Yes/No
- If no, how do you terminate your employee?

- How do you ensure that your employees are not discrimination on the basis of cast creed, gender, religion, age and dieses?

- How many shift you have? _____ shifts
- What is the official working time? _____ hours
- Which day is off day in your organization? _____
- In case, a person works in off day or holiday, how is he/she compensated?

- Do you pay overtime to your employees as per law? Yes/No
- What is the lowest amount (salary/wage) you pay to your employees? Rs. _____/-
- Is there any case of deduction in wage? Yes/No

- In case, it is yes, what are the general reasons for such deduction?

- Is there any apprentice period in your organization? Yes/No

- If yes, what is the apprentice period in your organization? _____

- Do you have any international certification Yes/No

- If yes, please specify

- Do you receive, handle or promote goods and/or services from supplier/subcontractors or sub-suppliers Yes/No

- Do you receive, handle or promote goods and/or services from supplier/subcontractors or sub-suppliers who are classified as home worker? Yes/No

- If yes, what steps you have taken to ensure that they get similar level of protection as afforded to directly employed employees?

- Have you taken care to look into issues related to child labor Forced labor, health & safety, working hours and remuneration of your suppliers Yes/No

We do hereby declare that our organization is committed to social accountability. We will promptly implement remedial/corrective actions identified against the requirement and promptly inform your organization. We also declare that the sub-contractors/sub supplier's performances are monitored by us. Moreover, we declare that if invited, we shall participate in awareness program as well as monitoring program organized by you.

We declare that the above-mentioned information is correct.

Signature:

Designation:

Date

Seal of the organization

Project		Vendor			Package/Unit	
SL	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	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	Shortfall attributable to contractor w.r.t. Plan as per Form-14 for the subject month	PERFORMANCE	35		Percentage of shortfall to be calculated w.r.t. Total planned target for the month as per part-A of F-14. If more than one work has been planned in a month then Weightages of works shall be assigned at the time of plan to arrive at plan vs achievement calculation.	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	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	Number of days of non-availability of required Manpower including supporting staff as per plan submitted in F-14 for the month.	RESOURCES	7		Cumulative number of days Sufficient Manpower was not available as per Plan in F-14	Daily Log Book entry/Incident Registers/letter references
#3.02	Number of days of non-availability of required T&P as per plan submitted in F-14 for the month.	RESOURCES	7		Cumulative number of days Sufficient T&P was not available as per Plan in F-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	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	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

MONTHLY PERFORMANCE EVALUATION OF CONTRACTOR

Form No.: F-15 (Rev 02)

Page 6 of 6

Project		Vendor			Package/Unit	
SL	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.) @ 3 points/ accident					
	Less Deduction in Score Due to Minor Accidents(All Others) @ 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	

Name and Signature of BHEL Package In-charge

Name and Signature of Contractor

 PSSR	MONTHLY PLAN & REVIEW WITH CONTRACTOR		Page 2 of 6
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 = $[(\Sigma E - \Sigma B) / (\Sigma A - \Sigma D)] \times 100$
 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)

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 CONTRACTOR'S SCOPE:-

Date of Plan/ Review.....

[illegible]

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 = $\Sigma F \times 100$

BHIEL 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)

 PSSR	MONTHLY PLAN & REVIEW WITH CONTRACTOR	Page 4 of 6
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 = $100 \times \Sigma(C \times D) / \Sigma(A \times B)$

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 – C: PLAN(PHYSICAL) FOR THE NEXT MONTH i.e.

[illegible]

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)

 PSSR	MONTHLY PLAN & REVIEW WITH CONTRACTOR		Page 6 of 6

Name of Project		Contract No.	
Name of Work		Name of Contractor	

PART – D: REASONS FOR SHORTEALL 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)

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 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.

**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 Claim(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 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 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 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.

**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 01/06/2019 to 31/5/2021 (WITHIN USEFUL LIFE)	Revised rates (Rs./Hour) valid from 01/06/2019 to 31/5/2021 (BEYOND USEFUL LIFE)
I.	CRANES :-			
1	Portal Gantry Crane 500T	15	20100.00	19980.00
2	100MT Crawler Crane ZOOMLION CRANE-QUY-100	10	11370.00	11320.00
3	Heavy Lift Crawler Crane 600MT Class DEMAG Model CC2800	15	56290.00	55940.00
4	PORTAL CRANE, 360T	15	14070.00	13980.00
5	600MT Class Crawler Crane- Manitowoc Model 18000-UPGRADED	15	55460.00	55110.00
6	600MT Class Crawler Crane- Liebherr Model LR1600-2 (Upgraded version)	15	68610.00	68180.00
7	CRAWLER CRANE FMC/LINKBELT 718, 250T (WITH RINGER)	15	33510.00	33300.00
8	CRAWLER CRANE FMC/LINKBELT 718, 250T (WITH-OUT RINGER)	15	20940.00	20810.00
9	MANITOWOC M-250T TRUCK CRANE	15	30160.00	29970.00
10	270 MT Class Crawler Crane- Manitowoc Model 2250	15	31660.00	31470.00
11	300MT Crane Crawler Crane LIEBHERR Model LR-1350/1	15	26390.00	26220.00
11.A	300MT Crane Crawler Crane LIEBHERR Model LR-1350/1 (UPGRADED)	15	36110.00	36110.00
12	250MT Class Mid range Crawler Crane- Kobelco Model CKE2500-2	15	15130.00	15030.00
12.A	250MT Class Mid range Crawler Crane- Kobelco Model CKE2500-2 (UPGRADED)	15	18850.00	18850.00
13	LINKBELT LS- 248H CRAWLER CRANE (180T)	15	16750.00	16650.00
14	MANITOWAC MODEL 888 CRAWLER CRANE (200 MT)	15	21780.00	21640.00
15	CRAWLER CRANE SUMITOMO, 150T	15	10890.00	10820.00
16	All Terrain Crane, 150MT- Liebherr Model LTM1150	15	13400.00	13320.00
17	CRAWLER CRANE, 120 T Fushun Model QUY120	10	10830.00	10780.00
18.A	CRAWLER CRANE 135MT Kobelco Model CK1350- 1F	15	10720.00	10650.00
18.B	CRAWLER CRANE 135MT Kobelco Model CK1350	15	8880.00	8820.00
19	CRAWLER CRANE 120MT - Tata-Sumitomo Model SCX1200-2	15	10050.00	9990.00
20	CRAWLER CRANE 100 T (KH 500)	15	10050.00	9990.00
21	Hydraulic Crawler Crane 80MT, Fushun Model QUY 80B	10	5410.00	5390.00
22	ROUGH TERRAIN CRANE 75T (RT880)	12	6140.00	6110.00
23	CRAWLER CRANE, 75T -Tata Model 955ALC/TFC280	12	5370.00	5340.00
24	Mobile Crane, 55MT (TIL)	12	4410.00	4390.00
25	CRAWLER CRANE, 25T -Tata Model TFC75	10	3030.00	3010.00
26	MOBILE CRANE, 20MT (TIL)	10	2270.00	2260.00
27	MOBILE CRANE, 20MT (ESCORTS)	10	2270.00	2260.00
28	MOBILE CRANE ESCORTS- 14MT	10	710.00	710.00
29	HYDAULIC PICK & CARRY CRANE, 8/9/10/11/12 MT	10	390.00	380.00
30	ELECTRIC GANTRY CRANE 3T	5	430.00	430.00
31	ELECTRIC GANTRY CRANE 5T	5	540.00	540.00
32	ELECTRIC GANTRY CRANE 30T	5	3640.00	3620.00
33	FORK LIFT 5T	5	650.00	650.00
34	FORK LIFT 3T	5	540.00	540.00

**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 01/06/2019 to 31/5/2021 (WITHIN USEFUL LIFE)	Revised rates (Rs./Hour) valid from 01/06/2019 to 31/5/2021 (BEYOND USEFUL LIFE)
I.	CRANES :-			
1	Portal Gantry Crane 500T	15	22340.00	22200.00
2	100MT Crawler Crane ZOOMLION CRANE-QUY-100	10	12630.00	12570.00
3	Heavy Lift Crawler Crane 600MT Class DEMAG Model CC2800	15	62550.00	62160.00
4	PORTAL CRANE, 360T	15	15630.00	15540.00
5	600MT Class Crawler Crane- Manitowoc Model 18000-UPGRADED	15	61620.00	61240.00
6	600MT Class Crawler Crane- Liebherr Model LR1600-2 (Upgraded version)	15	76230.00	75760.00
7	CRAWLER CRANE FMC/LINKBELT 718, 250T (WITH RINGER)	15	37230.00	37000.00
8	CRAWLER CRANE FMC/LINKBELT 718, 250T (WITH-OUT RINGER)	15	23270.00	23120.00
9	MANITOWOC M-250T TRUCK CRANE	15	33510.00	33300.00
10	270 MT Class Crawler Crane- Manitowoc Model 2250	15	35180.00	34960.00
11	300MT Crane Crawler Crane LIEBHERR Model LR-1350/1	15	29320.00	29130.00
11.A	300MT Crane Crawler Crane LIEBHERR Model LR-1350/1 (UPGRADED)	15	40120.00	40120.00
12	250MT Class Mid range Crawler Crane- Kobelco Model CKE2500-2	15	16810.00	16700.00
12.A	250MT Class Mid range Crawler Crane- Kobelco Model CKE2500-2 (UPGRADED)	15	20950.00	20950.00
13	LINKBELT LS- 248H CRAWLER CRANE (180T)	15	18610.00	18500.00
14	MANITOWAC MODEL 888 CRAWLER CRANE (200 MT)	15	24200.00	24050.00
15	CRAWLER CRANE SUMITOMO, 150T	15	12100.00	12020.00
16	All Terrain Crane, 150MT- Liebherr Model LTM1150	15	14890.00	14800.00
17	CRAWLER CRANE, 120 T Fushun Model QUY120	10	12030.00	11970.00
18.A	CRAWLER CRANE 135MT Kobelco Model CK1350- 1F	15	11910.00	11840.00
18.B	CRAWLER CRANE 135MT Kobelco Model CK1350	15	9860.00	9800.00
19	CRAWLER CRANE 120MT - Tata-Sumitomo Model SCX1200-2	15	11170.00	11100.00
20	CRAWLER CRANE 100 T (KH 500)	15	11170.00	11100.00
21	Hydraulic Crawler Crane 80MT, Fushun Model QUY 80B	10	6010.00	5980.00
22	ROUGH TERRAIN CRANE 75T (RT880)	12	6830.00	6790.00
23	CRAWLER CRANE, 75T -Tata Model 955ALC/TFC280	12	5970.00	5940.00
24	Mobile Crane, 55MT (TIL)	12	4900.00	4880.00
25	CRAWLER CRANE, 25T -Tata Model TFC75	10	3370.00	3350.00
26	MOBILE CRANE, 20MT (TIL)	10	2520.00	2510.00
27	MOBILE CRANE, 20MT (ESCORTS)	10	2520.00	2510.00
28	MOBILE CRANE ESCORTS- 14MT	10	790.00	790.00
29	HYDAULIC PICK & CARRY CRANE, 8/9/10/11/12 MT	10	430.00	430.00
30	ELECTRIC GANTRY CRANE 3T	5	480.00	480.00
31	ELECTRIC GANTRY CRANE 5T	5	600.00	600.00
32	ELECTRIC GANTRY CRANE 30T	5	4040.00	4030.00
33	FORK LIFT 5T	5	720.00	720.00
34	FORK LIFT 3T	5	600.00	600.00

**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 01/06/2019 to 31/5/2021
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 FILTRATION EQUIPMENT 6000LPH CAPACITY WITHOUT STORAGE TANK	6370
3	-DO-, WITH STORAGE TANK	7280
4	OIL FILTRATION M/C, 250/500 LPH (OTHER THAN SILICON OIL)	910
5	OIL FILTRATION M/C, 250GPH/1000LPH (OTHER THAN SILICON	1360
6	OIL FILTRATION M/C, 500GPH/2500LPH (OTHER THAN SILICON	1820
7	OIL FILTRATION M/C, 1000GPH/5000LPH (OTHER THAN SILICON	3640
8	Portable Lube Oil Purification Unit (Centrifuge M/c) Capacity: 750	1270
9	Low Vacuum de-hydration unit	630
10	DIESEL GENERATING SET,250 KVA	1770
11	DIESEL GENERATING SET,25 KVA	500
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

**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 01/06/2019 to 31/5/2021
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
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

**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 01/06/2019 to 31/5/2021
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 DIAGNOSTIC REPAIR KIT	2000
56	SECONDARY INJECTION RELAY TEST KIT	5270
57	MICRO OHM METER	1450
58	DIGITAL MICRO OHM METER MEASURING RANGE: 200 $\mu\Omega$ TO 20K Ω	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
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

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 01/06/2019 to 31/5/2021
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

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 01/06/2019 to 31/5/2021
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	ELECTRIC WINCH 5T	1410
6	ELECTRIC 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	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	1510
6	OIL FILTERATION M/C, 500GPH/2500LPH (OTHER THAN SILICON	2020
7	OIL FILTERATION M/C, 1000GPH/5000LPH (OTHER THAN SILICON	4040
8	Portable Lube Oil Purification Unit (Centrifuge M/c) Capacity: 750	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

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 01/06/2019 to 31/5/2021
17	AIR COMPRESSORS 250/300/330/360/350 CFM	3030
18	AIR COMPRESSORS 140/150/190/210 CFM	1010
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

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 01/06/2019 to 31/5/2021
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
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 DIAGNOSTIC REPAIR KIT	2220
56	SECONDARY INJECTION RELAY TEST KIT	5860
57	MICRO OHM METER	1610
58	DIGITAL MICRO OHM METER	3590
59	PMI Machine OLYMPUS make	3730
60	Mobile Lighting Mast -	960
61	10KVA RESISTANCE BRAZING MACHINE	160
62	RECURRENT SURGE OSCILLOGRAPH (RSO) TEST KIT WITH	510

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 01/06/2019 to 31/5/2021
63	HYDROGEN GAS LEAK DETECTOR	60
64	STATOR WEDGE ANALYZER KIT WITH COMPLETE	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	520
72	CENTRIFUGAL PUMP SET FOR ACID CLEANING (WITH MOTOR	480
73	HI SPEED MEMORY RECORDER, MAKE -YOKOGAWA, MODEL	2010
74	TROLLEY MOUNTED HYDRAULIC JACK (100 MT)	1400
75	5KV Insulation Tester	500
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

Vol I, Part II

Chapter 19: Painting Schedule For FOHS Tanks

SURFACE PREPARATION & PAINTING SCHEDULE

			1 st Coat			Intermediate			Final					
Paint Specification	Surface Cleaning	Method of Application of Paint	Type	No. of coats	Thk. Per Coat (micron)	Type	No. of coats	Thk. Per Coat (micron)	Type	No. of coats	Thk. Per Coat (micron)	Total Thk. (micron)	Colour	
HFO & LDO Tank - Inside	Sand Blasting	Manual/ pray Painting	Linseed Oil	2 Coats										
LDO Tank & related piping - External	Sand Blasting	Manual/ Spray Painting	Zinc phosphat e Primer	2	35	Nil	0	0	Synthetic Enamel Paint	2	35	140	IS Shade	
Tanks underneath surface area	Manual Cleaning	Manual Brush	Coal Tar	2	30	Nil	0	0	Nil	0	0	60	-	
HFO tanks & related Pipes- External	Sand Blasting	Manual/ Spray Painting	Zinc phosphat e Primer	2	35	Nil	0	0	Nil	0	0	70	IS Shade	
Other equipment	Standard practices of the respective vendor													

Note: The LDO tank shell and roof to be painted with silver colour.