

<b>TENDER NO – PSER:SCT:BAR-M2049:20</b>		
VOLUME-IF-TECH:FGD	TECHNICAL SPECIFICATION	Page 1

<b>CLAUSE NO</b>	<b>DESCRIPTION</b>
<b>1.0</b>	<b>GENERAL</b>
<b>2.0</b>	<b>CIVIL WORKS, FOUNDATION, GROUTING</b>
<b>3.0</b>	<b>ERCTION WORK</b>
<b>4.0</b>	<b>WELDING, HEAT-TREATMENT, RADIOGRAPHY AND NDT</b>
<b>5.0</b>	<b>APPLICATION OF INSULATION</b>
<b>6.0</b>	<b>PAINTING INCLUDING FINISH PAINTING</b>
<b>7.0</b>	<b>TESTING, PRE-COMMISSIONING, COMMISSIONING AND POST-COMMISSIONING</b>

<b>1.0 GENERAL</b>	
1.1	The intent of this specification is to provide services for execution of project according to most modern and proven techniques and codes. The omission of specific reference to any method, equipment or material necessary for the proper and efficient services towards installation of the plant shall not relieve the contractor of the responsibility of providing such services / facilities to complete the work or portion of work awarded to him. The quoted price shall deem to be inclusive of all such contingencies.
1.2	The contractor shall carry out the work in accordance with standard practices / codes /instructions / drawings / documents /specification/manuals supplied by BHEL from time to time.
1.3	The work shall conform to dimensions and tolerances given in various drawings and documents that will be provided during execution. 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 affected from contractor's bills towards expenditure incurred including BHEL's usual overhead charges.
1.4	Following shall be the responsibility of contractor and have to be provided within finally accepted price.
1.4.1	Provision as required of all types of labour, supervisors, engineers, watch and ward, tools & tackles, calibrated inspection, measuring and test equipment as specified and otherwise required for the work, consumables for erection, testing and commissioning including material handling.
1.4.2	Proper out-turn as per BHEL's plan and commitment
1.4.3	Completion of work as per BHEL Schedule.
1.4.4	Good quality and accurate workmanship for proper performances of equipment.
1.4.5	Repair and rectification as and when required
1.4.6	Preservation / Re-conservation of all components during storage / erection till handing over.
1.5	Contractor shall execute the work as per sequence and procedure prescribed by BHEL at site. 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.
1.6	All necessary certificates and licenses, permits & clearances required to carry out this work from the respective statutory/ local authorities are to be arranged by the contractor at his cost in time to ensure smooth progress of work.
1.7	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
1.8	The terminal points as decided by BHEL shall be final and binding on the contractor
1.9	The work covered under this specification is of highly sophisticated nature requiring the best quality of workmanship, engineering and construction management. The contractor should ensure timely completion of the work. The contractor must have the adequate quantity of tools, construction aids, equipment, etc. in this possession.

	He must also on his rolls adequate trained, qualified and experienced supervisory staff and skilled personnel.
1.10	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 milestone are achieved as per schedule/ plans. Contractor shall arrange & augment the resources accordingly.
1.11	<b>HOUSE KEEPING</b> -The contractor is supposed to carryout housekeeping of the work area on regular basis to keep the work place neat and tidy and available for the SAFE Working. The scrap, generated daily during the Execution activities, is to be dumped at designated area as decided by BHEL/ NTPC on daily basis. The erection materials issued to the contractor and kept near the work area should also be staged properly at site. Compliance report on above shall be submitted by the contractor to BHEL on Daily basis. In case the contractor fails to do so, BHEL have rights to carryout the same from the other party at the Risk and cost of the contractor. The cost applicable with BHEL overheads shall also be recovered from the monthly running bills of contractor
<b>2.0</b>	<b>CIVIL WORKS, FOUNDATION, GROUTING</b>
2.1	BHEL shall provide all equipment foundations. For the correctness of these foundations as per drawings, the contractor shall check the dimensions & locations of the foundations, pockets, anchor-bolt pitch. Further, top elevation of foundations shall be checked with respect to benchmark. All minor adjustments of foundation level, dressing and chipping of foundation surfaces up to 50 mm, enlarging the pockets in foundations etc., as may be required for the erection of equipment / plants shall be carried out by the contractor.
2.2	While on the job, care is essential to avoid too much chipping and resultant lowering of level. In case of excess chipping, contractor has to arrange additional packing plates as per requirements provided BHEL Engineer allows it. When required by manufacturers, the embedded sub-sole plates shall be scraped and checked with Prussian blue to get the required contact with frames.
2.3	The contractor shall ensure perfect matching of packer plates including machining, scraping and blue matching with foundation by dressing the foundation, as well as perfect matching between the packer plates and the base plate of equipment to the satisfaction of BHEL Engineer. If required the packer plates may have to aligned and fixed on the foundations using special high strength, non-shrinking and quick-setting grouts. The minimum thickness below the packer plate should be 20 mm.
2.4	Entire grouting work of foundation bolt grouting, base plate grouting, equipment grouting etc. including materials shall be carried out by the civil work agency of BHEL. While grouting will be carried out by other agency, the contractor has to ensure that all the matching joints which are not to be grouted shall be kept free from the grouting mixture by applying tape or any other alternative method approved by Engineer. All assistance required has to be provided by the contractor. If required, decoupling of equipment's has to be done for conducting the verification. In case any disturbance is noticed the cause, if any, shall be removed and re-alignment done as part of work.
2.5	The contractor shall check and verify the alignment of equipment, alignment of shafts of rotating machinery, the slopes of all bearing pedestals, centering of rotors with respect to their sealing bores, couplings etc. as applicable and the like items to ensure that no displacement had taken place during grouting. The values recorded prior to grouting shall be used during post grouting check up and verifications. Such

	pre and post grout records of alignment details shall be maintained by the contractor in a manner acceptable to the Engineer.
<b>3.0</b>	<b>ERECTION WORK</b>
3.1	All normal erection and assembly techniques necessary for completion of works under this specification and magnitude have to be carried out. The omission of specific technique /method/process does not absolve the contractor of his responsibility for the particular operation. These would include,
3.1.1	Scaffolding and rigging operations,
3.1.2	Machine / flame / electric cutting, grinding, welding, radiography and stress relieving
3.1.3	Fitting, fettling, filing, straightening, chamfering, chipping, scrapping, reaming, as cleaning, checking, levelling, blue matching, aligning and assembly.
3.1.4	Machining, surface grinding, drilling, doweling, shaping.
3.1.5	Temporary erections for alignment, dismantling of certain equipment for checking, Cleaning , servicing and site fabrication.
3.1.6	Insulation and painting.
3.2	Any fixtures, scaffolding materials, approach ladder, concrete block supports, steel structures required for temporary supporting, pre-assembly or checking, welding, lifting and handling during pre-assembly and erection shall be arranged by contractor at his cost.
3.3	No members of any ladder / structure / platform should be cut without specific approval of BHEL. In case it is necessary to cut, the contractor shall rectify / repair in a manner acceptable to BHEL / customer without any additional cost.
3.4	The contractor shall erect scaffolding / temporary platforms for erection. These should be of adequate capacity and shall never be over loaded. These should be replaced when not found suitable during erection work and dismantled on work completion and removed from work site.
3.5	It shall be the responsibility of the contractor to provide ladders on columns for initial work 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. In case it is absolutely necessary then the contractor shall cut the temporary structure and rectify the column as directed by the engineer.
3.6	The contractor is strictly prohibited in using the FGD/ Auxiliary Components for any temporary supporting or scaffolding works etc. In case of such misuse a sum of determined by Engineer will be recovered from contractor's bills.
3.7	<b>Below mentioned erection sequence is indicative only and give the general idea to the contractor for absorber erection. :</b>
1	Marking and packer liner setting
2	Bottom plate installation
3	1st stage casing panel installation
4	Baffle panel installation
5	Scaffolding and Structure up to 17 Mtr
6	2nd stage casing panel installation
7	Scaffolding and Structure up to 20.0 Mtr
8	3rd stage casing panel installation
9	Inlet duct panel installation
10	Scaffolding and Structure up to 22 Mtr.
11	4th stage casing panel installation

12	Scaffolding and Structure up to 24 Mtr. and spray pipe installation
13	5th stage casing panel installation
14	Scaffolding and Structure up to 26 Mtr.
15	6th stage casing panel installation
16	Scaffolding and Structure up to 28 Mtr.
17	7th stage casing panel installation
18	Scaffolding and Structure up to 31 Mtr. and remaining structure erection
19	Ceiling panel installation
20	Rubber lining
21	Dismantling of scaffolding up to mist eliminator level
22	Absorber internals ( Spray pipe and mist eliminator) installation
23	Dismantling of scaffolding up to spray pipe level
24	Absorber internals ( Spray pipe and spray nozzle) installation
25	All scaffolding dismantling
26	Fiber grating installation
27	Agitator installation
<b>3.8</b>	<b>Casing Panel Installation</b>
3.8.1	Splices of bottom plates at which casing panel are located shall be cleaned.
3.8.2	Location of casing shall be marked on the foundation. Then, according to the casing panel assembly drawings, the location of vertical splices between plates shall be marked
3.8.3	Temporary assembly of lower stage casing panel shall be done by Tack-weld the guide pieces to the bottom plate at prescribed intervals of inside and outside the circular marking.
3.8.4	Temporary assembly of upper stage casing panel shall be done as per Match marks which have been provided on the inside surface of the lower stage casing panel shall be matched to vertical splice line and assembled.
3.8.5	After that welding of the casing panel to be done. The weld between lower stage casing panel and bottom plate shall be performed in a suitable time after the completion of vertical splice for lower stage casing panel.
3.8.6	Vertical splice shall be welded from side by back step method of 1/3 of wall plate width after the completion of assembly of upper wall plate. After the welding from outside, grinding from inside shall be performed with grinder. Welding of horizontal splices shall alternate across the 1st wall. 2nd wall weld's shall be laid simultaneously.
3.8.7	Spacers used for root gap of welds shall be removed.
3.8.8	Appurtenances such as manholes and nozzles shall be installed after marking on correct locations in accordance with the layout dwgs. The time to install then shall be decided in consideration of site construction progress. The location of large diameter nozzles which will be connected to rubber lined pipes shall be determined in accordance with the final piping locations which shall be set at the site.
3.9	Spray Pipe Installation
3.9.1	Check all concerned absorber dimensions, ie. tolerance of absorber casing, support beam location, absorber nozzle location, flange face location, bolt hole location, size and spacing etc., before Spray Pipe installation.
3.9.2	Install the temporary support on absorber nozzles for inserting Spray Pipe into absorber. The temporary support shall be installed at almost the same height of bottom of Spray Pipe

	<ul style="list-style-type: none"> <li>• Lift Spray Pipe up to the same height as absorber nozzle.</li> <li>• Insert the tip of Spray Pipe into the absorber, and unload the tip of Spray Pipe onto the temporary support.</li> <li>• Insert Spray Pipe into the absorber by using of chain block.</li> <li>• Insert bolt to Spray Pipe flange and Spray Pipe saddle, and tighten as temporary. Then check the horizontal level and insert shim plate to adjust the horizontal level. The level tolerance should be referred to specific drawing.</li> <li>• Tighten all the bolts and nuts. In case of dissimilar material between Spray Pipe flange (especially FRP made) and absorber flange, bolt tightening procedure should be strictly complied with the specific drawings in order to prevent the crack on the flanges.</li> <li>• Loosen the saddle setting bolts and nuts by half rotation to allow the Spray Pipe thermal expansion, and then lock the nuts by double nuts fixing.</li> </ul>
3.10	Spray Nozzle
3.10.1	<p>Modify the scaffolding for installation of Spray Nozzle.</p> <p>Set the Spray Nozzle on the Spray Pipe flange, and tighten the bolts and nuts up to about 75% of full torque by using of torque wrench.</p> <p>Check the horizontal level of Spray Nozzle face within the tolerance which is specified in the drawings, and tighten up to full torque. This level is most important for FGD performance.</p> <p>The special care shall be taken to SiC made Spray Nozzle, since these are weak against mechanical shock and impact.</p>
3.11	Mist Eliminator Installation
3.11.1	<p>Check all concerned absorber dimensions, ie. tolerance of absorber casing, support beam location, bolt hole location, size and spacing etc., before installation of Mist Eliminator.</p> <p>Insert the lower washing spray pipe into the absorber. In order to protect the FRP made pipe, do not slide the pipe on the support.</p> <p>Insert the dedicated shim plates between pipe and pipe support, and fixing Ubands or U-bolts and external flanges.</p> <p>Install the lower panel of Mist Eliminator and tightly coupled each other by means of comb brace and tie insulock.</p> <p>Install the lower down washing spray pipe and upper up washing spray pipe as same manner as the above.</p> <p>Install the upper panel of Mist Eliminator, and install upper washing spray pipe as same manner as the above.</p> <p>After installation of Mist Eliminator, to protect the panels by means of load spreaders e.g. wooden planks to allow walking on them during further stage of installation.</p>

3.12	Certain adjustment in length may be necessary while erecting pipelines / ducts / casings etc. The contractor should remove the extra lengths / add extra lengths to suit the final layout after preparing edges afresh by adopting specified heat treatment procedures.
3.13	Suspensions for ducting will be supplied in running lengths, which shall be cut to size and adjusted as required. Ducts / expansion bellows are dispatched to site in loose walls plates / pieces and these are to be assembled and welded at site along with stiffeners etc., before erection within the finally accepted rates. All joints connecting duct expansion piece and dampers shall be seal welded on inside as well as on outside.
3.14	Mechanical erection works associated with the power cylinders, valves, valve actuators etc., coming under various groups shall be provided by contractor within the finally accepted rates. The Erection, testing and commissioning of all electrically operated valves, actuators and dampers is covered within the scope of this specification.
3.15	The contractor shall carry out trial run of all motors including checking the direction of rotation in the uncoupled condition. Checking of alignment and recoupling of the motor to the driven equipment as per instructions of BHEL engineer and to their satisfaction. All electrical motors have to be tested for IR & PI values prior to the trial run. Where required, dry out may have to be carried out by using external heating source. Contractor shall make all arrangements in this regard and complete the work as instructed. Vendor shall all necessary MMDs including the motorized insulation testers for the above test.
3.16	The contractor shall fabricate pipe, special bends etc., threading and welding as required for installing lube oil system and carry out the acid cleaning of the fabricated piping. The contractor shall also service the lube oil system, carrying out the hydraulic test of oil coolers etc.
3.17	Contractor shall carry out kerosene testing of all bearing housings of various rotating equipment like pumps, fans etc., as per BHEL engineer's instructions. Performance of hydro test of oil coolers of rotating machines and hydro test of other equipment as per BHEL engineer's instructions is included in the scope of work. Forced lube oil system of motors or rotating equipment form parts of the work under this specification.
3.18	Certain rotating machinery after initial runs and commissioning of the equipment have to be hot aligned as per the instructions of BHEL engineer. Cleaning fans, ducting etc., free of extraneous steel, scaffolding materials electrodes, all foreign materials etc., before trial run of rotating machinery, and at various stages of pre-commissioning activities as per BHEL engineer's instruction, is within the scope of work.
3.19	Some of the rotating equipment and electrical motors are provided with protective greases only. Contractor shall arrange for cleaning of the same with kerosene or some other reagent. If necessary, dismantling some of the parts of the equipment would be necessary. He shall arrange for re-greasing / lubricating them with recommended lubricants and for assembling back the dismantled parts, at quoted rate. Lubricants will, however, be supplied free of cost by BHEL.
3.20	After initial trial of rotating equipment, control and power cabling for motors and other equipment / instrumentation shall have to be disconnected for checking alignment and re-setting / re-alignment / hot alignment. Contractor shall have to arrange for disconnecting control and power cabling as per BHEL engineer's instructions and clearance and reconnect the control and power cabling after realignment. Quoted tonnage rate shall be inclusive of the above.

3.21	Packer plates supplied may have to be machined to the correct dimensions. It may also be necessary to blue match the same with each other/ with equipment / with foundations as per BHEL instructions
3.22	Contractor shall arrange changing of preservative oil in the gearboxes, journal and other bearing assemblies of rotating equipment when in storage areas or after erection of equipment as the case may be as per the instructions of BHEL engineer. Necessary lubricants / oil will be supplied by BHEL and the same will be drawn by contractor from BHEL / customer's stores and transporting to site. No additional payment will be made for such works even though supply of lube oil might have been made under regular dispatch-able unit (DU) number against product group main assembly (PGMA) and appearing in the shipping list. Prior to the commissioning of the equipment, oil should be drained and collected in drums provided by BHEL and returned to BHEL / customer's stores.
3.23	The fans, mills and other rotating machines shall be checked for clearances and other vital tolerances. Necessary assistance for balancing of equipment during trial run, if required, shall be provided by the contractor free of cost.
3.24	Whenever required the contractor shall arrange for pre-qualification of process task performers.
3.25	Ducts/ expansion bellows (metallic & non-metallic) are normally supplied in loose wall plates/ segments and these are to be assembled and welded at site before erection. Correction of ovalities/ distortion of ducts, expansion bellows etc occurred during transportation/ handling are to be carried before erection as part of work. Erection of mechanical components of non-metallic joints is included in the scope of work. All joints connecting ducts, expansion pieces and dampers shall be seal welded. These welds have to be made leak proof and tested as per technical instruction / requirement.
3.26	Non specified jobs at the interface / terminal points like bolting welding, gasket changing etc. have to be done by the contractor within the quoted price.
3.27	Instrument tapping coming on the FGD and associated equipment's to be welded/fitted by the contractor with in the quoted price
3.28	The terminal points decided by BHEL should be final and binding on the contractor for deciding the scope of work and effecting payment for the work done.
3.29	Actuators / drives of dampers, gates, powered vanes etc. may have to be serviced, lubricated, before erection, during pre-commissioning & commissioning, including carrying out minor adjustments required as incidental to the work.
3.30	All rotating machines and equipment shall be cleaned, lubricated, checked for their smooth rotation, if necessary by dismantling and refitting before erection. If, in the opinion of 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.
3.31	All the shafts of rotating equipment shall be properly aligned to those of the matching equipment within design tolerances All bearings, shafts and other rotating parts shall be thoroughly cleaned and suitably lubricated before starting.
3.32	All the motors and equipment shall be suitably doweled after alignment of shafts with taper / parallel machined dowels as per the direction of the Engineer. Dowel pins required are be machined by the contractor at his own cost. However the materials for dowel pins shall be issued by BHEL free of cost.
3.33	The HT motor bearings shall be blue matched at site and checked for bearing clearances. The contractor if required shall carry out scraping of bearing housing. No extra claim for blue matching up to 1mm initial gap will be entertained.
3.34	The contractor at no extra cost to BHEL shall carry out servicing and

	realignment of skid mounted equipment.
3.35	Certain instruments like pressure gauges, pressure transmitters, temperature gauges, flow switches and indicators, etc., are received in assembled condition as integral part of equipment. Contractor shall be responsible for safe receipt, installation and custody of these instruments supplied mounted on skids / equipment. The calibration of skid / equipment mounted instruments shall be arranged by BHEL through other agency engaged for C&I. Contractor will be informed by BHEL engineer about the details of C&I agency. The contractor shall coordinate with the C&I agency for removal, calibration and re-installation of the instruments. Though C&I agency will remove and reinstall the instruments after calibration, the contractor for this package will maintain the list of all the instruments removed & reinstalled. Instruments prior to removal and after reinstallation shall be considered in custody of the contractor for this package.
3.36	All electrical panels, control gears, motors and such other devices shall be properly dried by heating to improve IR valve, before they are energized. Bearings, slip rings commutators and other exposed parts shall be protected against moisture ingress and corrosion during storage and periodically inspected.
3.37	The contractor shall completely erect and test all the piping systems, covered in the specification including sampling lines up to and including sample coolers, hangers & supports, valves and accessories in accordance with the drawings furnished. This includes all necessary bolting, welding, pre-heating, stress relieving, testing, cleaning and painting. System shall be demonstrated in condition to operate continuously in a manner acceptable to the Engineer. Welding shall be used throughout for joining pipes except where flanged, screwed or other type joints are specified or sown on the drawings. All piping shall be erected true to the lines and elevation as indicated in the drawings.
3.38	Pipes sent in standard length shall 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 upto 65-mm nominal bore will have to be fabricated at site. Only cold cutting methods are to be employed for cutting of pipes and tubes irrespective of the size and material. Gas Cutting , if any ,will be allowed only in CS LP piping
3.39	The contractor shall ensure lowering of pipes in position with adequate precautions as to avoid any damage to either material or men. Only the anchoring points earmarked for the purpose of lowering the pipes are to be used.
3.40	It is possible that a few flanges may not be matching. The contractor shall be required to cut and re-weld the same as and when required without any additional cost.
3.41	Wherever piping erected by the contractor is connected to equipment / piping erected by the other agencies the joint at the connecting point shall be the responsibility of the contractor who is erecting the piping under this specifications.
3.42	Normally the high-pressure valves will have prepared edges for welding. But, if it becomes necessary, the contractor will prepare new edges or recondition the edges by grinding or chamfering to match the corresponding tubes and pipes within the scope of the work.

3.43	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 and during commissioning.
3.44	The contractor shall be responsible for correct orientation of all valves so that seats, stems and hand wheels will be in desired location. It is the responsibility of the contractor to obtain the information regarding orientation of valves not fully located on drawings before the same are installed.
3.45	Suspension for piping, etc., will be supplied in running lengths, which shall be cut to suitable sizes and adjusted as required
3.46	The adjustment of all hangers & supports erected in both cold & hot conditions for maintaining the proper slopes towards the drain pots and application of cold pull in the piping wherever required is also included in the scope of the contractor.
3.47	Spring suspensions / constant load hangers have to be pre-assembled for required load and erection carried out as per instructions of BHEL. Any adjustments, removal of temporary arrests / locks etc., have to be carried out as and when required.
3.48	Contractor shall install piping in such a way that no excessive or destructive expansion forces exists in either the cold condition or under conditions of maximum temperature and pressure. All bends, expansion joints and any other special fittings necessary to take care of proper expansion shall be incorporated as per the advice of Engineer. During installation of expansion joints, anchors, care must be taken to see that full design movement is available at all times from maximum and minimum temperature.
3.49	The hanger assemblies shall not be used for attachment of rigging to hoist the pipes into position. Other means shall be used to securely hold the pipe in position till pipe supports are completely assembled and attached to the pipe and building structure.
3.50	Layout of small-bore piping, oil systems etc. as required shall be done as per 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 even after completion of erection or from aesthetic point of view. Contractor at no extra cost should carry this out. As built drawing is to be submitted by the contractor after erection completion.
3.51	All the valves, including motorized valves, flap valves, dampers, actuators, etc. shall be serviced and lubricated to the satisfaction of Engineer before erecting the same and during pre-commissioning also. Welding or jointing of extension spindle for valves to suit the site conditions and operational facility shall be part of erection work within the quoted rates.
3.52	Erection and welding of necessary instrumentation tapping points, thermocouple pads, thermo-wells, valves, battery of first root valves, condensing vessels, flow nozzles and control valves to be provided on, auxiliaries and pipe lines are covered within the scope of this specification. This will be the responsibility of the contractor and will be done as per the instructions of BHEL Engineer. The welding of all the above items will be contractor's responsibility even if the: <ul style="list-style-type: none"> <li><b>a.</b> Product groups, under which these items are released, are not covered in the scope of this tender.</li> <li><b>b.</b> Items are supplied by any agency other than BHEL.</li> </ul>
3.53	The contractor shall carry out the tightening of the field bolts on the equipment

	and piping covered under this specification by using either the calibrated torque wrench method or the turn of part method. The methods used the tools and the equipment deployed shall be subject to the approval of Engineer. The competent technicians shall carry out the bolting work.
3.54	The contractor shall prepare as built piping drawing & submit to BHEL Engineer for approval & verification of material used.
3.55	Plate Type Heat exchangers will be supplied for cooling of Auxiliary Cooling water lines. Vendor scope covers erection of these PHEs as per the instruction of BHEL engineers.
3.56	Contractor has to make canopies for motors, actuators, lub oil units, control valves etc. Material for this will be supplied in random lengths / sizes. No separate payment for fabrication is envisaged. Only the erection tonnage rate applicable for Misc eqpt. / structure steel item no. 3 of rate schedule will be paid for this work.
3.57	BHEL will provide free of cost only the shims and packer plates (either machined or plain) which go as permanent part of the equipment. Certain packer plates and shims over and above the quantity received as a part of supplies from manufacturing units of BHEL, will have to be cut out from steel plates / steel sheets at site to meet site requirement. Contractor shall cut and prepare packers and shims by gas cutting/chiseling / grinding/machining and de-burr the same. However, machining of the packers wherever necessary shall be arranged by the contractor.
3.58	All lifting tackles including wire-ropes slings, shackles, used by the contractor, shall be got approved by BHEL Engineer. It will be the responsibility of the contractor to ensure safe lifting of the equipment taking due precautions to avoid any accidents and damages to equipment and personnel. Calibration/fitness testing certificates from recognized agency are to be submitted to BHEL site office for equipment/instrument/appliances to be used, as per requirement of BHEL/ISO system. Expenditure on such works forms a part of the scope of work.
3.59	The contractor shall erect scaffoldings/Temporary platforms supports etc required during erection before the permanent supports are erected. These should be of adequate capacity and shall never be overloaded. These should be replaced when not found suitable during erection work. All structure materials required for the above shall be arranged by the contractor at his own cost. No such material shall be supplied by BHEL in any case. Welding of temporary supports, cleats etc on the columns shall be avoided. In case of absolute necessity, contractor shall take prior approval from BHEL Engineer. Further, any cutting or alteration of member of the structure or platform or other equipment shall not be done without specific prior approval of BHEL Engineer.
3.60	Tanks shall be supplied by the units in more than one segment (rolled sections) having height of segment approx. 2500 mm. Contractor have to complete the assembly at site with necessary welding/NDT/testing as per the approved FQP. Rubber lining of the tanks shall be in the scope of the rubber lining vendor.
3.61	Lime stone silos shall be supplied by the units in more than one segment (3 to 4 segment) and height of segment shall be 2500 mm. Contractor shall have to complete the assembly, final welding,/NDT/testing as per the approved drawings/documents/ FQP.

<b>4.0 WELDING, HEAT-TREATMENT, RADIOGRAPHY AND NDT</b>	
4.1	The pressure parts, equipment and piping shall be erected in conformity with the provisions of Indian Boiler Regulation and as may be directed by BHEL as per any standard / specification in practice in BHEL. The method of welding (arc, gas, TIG or other method) may be indicated in the detailed drawings / schedules. BHEL Engineer will have the option of changing the method of welding as per site requirements.
4.2	Welding of pressure parts, equipment, piping, high tensile structural steel shall be done by certified high pressure welders who possess valid certificate of CIB of the State in which the equipment is erected as per provision of IBR.(if applicable) The H.P. welder who possesses necessary certificate shall ensure re-validation as per relevant provisions of IBR and keep the certificate valid till the completion of work. The services of such welders, the validity of whose certificates have expired shall not be utilized for high-pressure works.
4.3	All welders including tack welders, structural and high pressure welder shall be tested as per ASME section IX / IBR and approved by BHEL Engineer before they are actually engaged on work even though they may possess a valid IBR 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 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.
4.4	Engineer may stop any welder from the work if his performance is unsatisfactory for any reason or if there is a high percentage of rejection in the joints welded by him. The welder having passed qualification tests does not absolve the contractor of contractual obligation to continuously check the welder's performance.
4.5	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 engineer.
4.6	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. All arrangements required for the above shall be the responsibility of the contractor at no additional cost.
4.7	All expenses for testing of contractor's welders including destructive and nondestructive tests conducted by BHEL at site or at laboratory shall have to be borne by the contractor only. Limited quantity of raw material required for making test pieces will be supplied by BHEL free of cost.
4.8	The regulators used on welding machines shall be calibrated before putting these into use for work. The Contractor at his cost shall also arrange periodic calibration for the same.
4.9	Only BHEL/ CUSTOMER approved electrodes and filler wire are to be arranged and used by the contractor, within the finally quoted price. BHEL/ NTPC reserve the right to test from the certified lab of approved electrode being used by the contractor. Testing charges for the same shall be borne by the contractor. 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

	<p>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.</p>
4.10	All butt / fillet welds shall be subject to dye penetration test as per the instructions of the engineer at no additional cost.
4.11	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 otherwise of the welds shall be final.
4.12	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.
4.13	All welds shall be painted with anticorrosive red oxide paint once radiography and stress relieving works are over. Necessary consumables and scaffolding etc including paints shall be provided by contractor at his own cost.
4.14	Pre-heating, radiography and other NDT tests, post heating and stress relieving after welding of tubes, pipes, including attachment welding wherever necessary, are part of erection work and shall be carried out by the contractor in accordance with the instructions of the Engineer. Contractor at his cost shall arrange all equipment and consumables essential for carrying out the above process
4.15	Contractor shall arrange all necessary stress relieving equipment with automatic recording devices. The contractor arrange for labour heating elements, thermocouples, thermo-chalks, temperature recorders, thermocouple attachment units, graphs, sheets insulating materials like asbestos cloth, ceramic beads, asbestos ropes etc. required for heat treatment/ stress relieving operations. The contractor should take a note of the following,
4.15.1	<ul style="list-style-type: none"> <li>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.</li> </ul>
4.15.2	<ul style="list-style-type: none"> <li>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.</li> </ul>
4.16	The contractor shall obtain the signature of Engineer or his representative on the strip chart of the recorder prior to the starting of SR operations.
4.17	The contractor shall also be equipped for carrying out other NDT like LPI / MPI/UT / Hardness test etc. as required as per welding schedules / drawings within the finally accepted price / rates. For UT machine shall be used of recordable type.
4.18	The technical particulars, specification and other general details for radiography work shall be in accordance with ASME, IBR or ISO as specified by BHEL.

4.19	Contractor for radiography work shall use iridium-192. 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).
4.20	Low speed high contrasts, fine grain films (D-7 or equivalent) in 10 cm width only be used for weld joint radiography. Film density shall be between 1.5 to 2.0.
4.21	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
4.22	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.
4.23	Lead intensifying screens for front and back of the film should be used as per the above referred ASME specification.
4.24	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.
4.25	For multiple exposures on pipes, an overlap of about 25-mm of film should be provided
4.26	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.
4.27	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.
4.28	The contractor shall have a dark room fully equipped with radiography equipment, film (un-exposed), chemicals and any other dark room accessories.
4.29	Radiography inspection of welds shall be performed in accordance with requirements and recommendation of BHEL Engineer. The quantum of radiographic inspection shall be as per provision of ASME / BHEL/NTPC approved documents. 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
4.30	All the Radiographs shall be properly preserved and shall become the property of BHEL. They are to be reconciled with the work done, joints radiographed and submitted to BHEL / customer.
4.31	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.
4.32	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.
4.33	Wherever radiographs are not accepted, on account of bad shot, joints shall be reradiographed and re- submitted for evaluation.
4.34	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-radiographed at contractor's cost.
4.35	If the contractor does not carry out radiography work due to non-availability of source / film / chemical / operator etc., BHEL will get the work done departmentally or through some other agency at the risk and cost of the contractor.
4.36	Heat treatment and radiography may be required to be carried out at any time (day and night) to ensure the continuity of progress. The contractor shall make all necessary arrangements including labour, supervisors/ Engineer required for the work as per directions of BHEL.
4.37	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.
4.38	The pressure parts, equipment and piping shall be erected in conformity with the provisions of Indian Boiler Regulation and as may be directed by BHEL as per any standard / specification in practice in BHEL. The method of welding (arc, gas, TIG or other method) may be indicated in the detailed drawings / schedules. BHEL Engineer will have the option of changing the method of welding as per site requirements.
4.39	Check shots as per the requirement of BHEL/ NTPC will be taken at your cost.
4.40	Welding of galvanised iron pipes/fittings would be permitted provided the same is carried out by means of special electrodes suitable for the above application and the same shall be approved by contractor. After, welding, welded portions shall be applied with three coats of zinc silicate treatment/rich paint over one coat of suitable primer. Further, the Contractor shall provide proper zinc paint at the point of welding.
<b>5.0</b>	<b>APPLICATION OF INSULATION</b>
5.1	All attachment welding, including welding of hooks / supports as per pitch both on equipment and piping shall be done as directed by Engineer. Attachment welding shall have to be done by certified welders. If necessary contractor may have to cut the hooks to correct length. Application of red oxide paint including supply of paint on welded portions as directed by BHEL is also included in scope of work.
5.2	The mineral wool mattresses (bonded / un-bonded) / LRB mattresses are received at site in standard sizes. These are to be dressed / cut to suit site requirements by the contractor
5.3	The number of layers / thickness of mineral wool / LRB mattresses for auxiliaries, pipe lines, valves and other vessels shall be as per various drawings and as directed by Engineer. For applying the mineral wool mattress, the required holding materials, if necessary by fabrication of rings/ hooks shall be fixed as directed and as per drawings and spec.
5.4	The contractor should ensure, proper finishing of surface of the insulation, sheeting and cementing.
5.5	The contractor should ensure that the finished surface of the insulation works conforms to the dimensions and tolerances given in the drawings. Aesthetic finish and accuracy of work are most important.

5.6	It is the responsibility of the contractor to ensure that the insulation materials and sheet metal covering issued to him for application are well protected against loss or damage from weather conditions. Closed / semi closed sheds or any other arrangements required for this will be by him at his cost. If any damage occurs to the material due to improper storage or due to any causes attributable to the contractor except for normal breakage or damages allowed in such cases, the cost of such damaged material shall be to the account of the contractor.
5.7	Aluminum sheet cladding will be fabricated to the sizes and shapes specified in drawings. Beading, swaging, beveling of sheets, crowning the sheets if necessary will be carried out by him. Two coats of anti-corrosive black bituminous paint are to be applied on inner surfaces of the cladding. Bitumen sealing compound on the joints if necessary is included in the scope of this work. <b>Contractor may note that he will also supply anti-corrosive black bituminous paint &amp; bituminous sealing compound required for above works at his cost. However if supply by the BHEL MUs same will be issue free of charges to contractor.</b>
5.8	Aluminum sheet metal cladding over insulation will consists of plain / ribbed / corrugated sheets. The sheets will be supplied in standard sizes. Cutting them to required size, grooving, fabricating bends, boxes etc., for proper covering is contractors responsibility. Any cutting / bending / welding of fabricated skin casing sheets if required will also covered within the scope of this contract.
5.9	A logbook shall be maintained by the contractor to obtain clearance for application of insulation. If the contractor does the work on his own accord without prior permission the area may have to be redone at his cost.
5.10	Contractor is liable for the exact accounting of the material issued to him and he shall make any unaccountable losses good. Wastage allowance for the material issued are as below:
1	Wool / LRB mattresses and cladding sheets 2%
2	Insulation bricks and mortar 2%
3	Castable refractory 1%
5.11	The entire surplus, unused materials etc., supplied by BHEL shall be returned to BHEL after the work is over. Materials like gunny bags and packing materials, empty containers may be returned at periodical intervals.
5.12	The contractor shall leave certain gaps and opening while doing the work as per instructions of BHEL engineer to facilitate inspection during commissioning and to fix gauges, fittings and instruments. The gaps will have to be finished as per drawings at a later date by the contractor at his cost
5.13	If during erection and commissioning any of the parts are to be insulated temporarily fixed and then replaced by permanent ones at a later date or if any of the parts are to be removed for modification, rectification, adjustment and then refitted or if some parts are to be opened for inspection and checking and for measurement of metal surface temperature the same may necessitate removal and re-application of insulation and sheet metal cladding, which shall be done by the contractor and the erection rate quoted shall be inclusive of such contingencies.
5.14	Removable type of insulation shall be provided for valves, fittings, expansion joints etcas per the drawings or as directed by BHEL Engineer.
5.15	All temporary pipelines required during testing, pre-commissioning and commissioning should be insulated as directed by BHEL at no extra cost to BHEL. However required insulation material shall be issued by BHEL free of cost.
5.16	<b>Wrapping and Coating</b>
5.16.1	The external surfaces of the buried pipes shall be thoroughly cleaned of rust, weld

	scales, burns etc. by sand or grit blasting/power tool cleaning method or any other method specified in the drawings/ documents before start application of anticorrosive coats. Kerosene, solvent or other cleaning material should not be used for external cleaning of the pipes. The above work shall be carried out to the satisfactory of BHEL engineers or as instructed by BHEL engineers.
5.16.2	Coating & Wrapping shall be done after completion of weld and/ or flanged connections and after completion & approval of Hydro testing.
5.16.3	The materials used for coating and wrapping are a. Coating Primer (Coal Tar Primer) b. Coating Enamel (Coal Tar Enamel) c. Wrapping Materials
5.16.4	All primer/coating/wrapping materials and methods of application shall conform to IS:10221 except asphalt/bitumen material. Materials (primer/coating/wrapping) as per AWWA-C-203 are also acceptable. Number of coats and wraps, minimum thickness for each layer of application shall be as per IS-10221. Number of Coats and wraps shall be decided based on soil corrosivity/resistivity as indicated in IS-10221. Total thickness of completed coating and wrapping shall not be less than 4.0 mm.
5.16.5	Alternatively, the anti-corrosive protection for buried pipes can consist of anticorrosive protection Coal-tar tapes. Material and application of tapes shall conform to IS 15337 or equivalent. These-tapes shall be applied hot over the cold coal tar primer in steps of 2mm thickness so as to cover the spiral edges of the first tape by the application of second tape. The total nominal thickness of the finished protective coating shall be 4.0 mm.
5.16.6	Tests to be carried out after application – (a) Bond / Adhesion test (b) Holiday test. The preservative paint, anticorrosive tape, all the required consumables, T&Ps and the instruments required for the above application and testing are to be arranged by the contractor at his cost.
5.16.7	All the provisions for bed preparation / laying the pipe / application of primer/ coating / wrapping with tapes etc., as indicated above are applicable for buried galvanized steel (GI) pipes also.
5.16.8	<b>BHEL shall provide the material for the wrapping and coating on free of cost basis. In event of loss of material due to wastage/wrong application by the contractor, then contractor shall arrange the material at his own cost. Wastage allowance will be 1%.</b>
6.0	<b>PAINTING INCLUDING FINISH PAINTING</b>
6.1	All exposed metal parts of the equipment, structure, auxiliaries, piping, and other items (covered within the scope of this contract) after installations are to be painted. Mostly the equipment / components installed are with one coat each of primer paint and synthetic enamel / heat resistant paint. However, due to aging, the same may have got deteriorated for peeled off. The surfaces are to be thoroughly cleaned of all dirt, rust, scales, grease, oils and other foreign materials by wire brushing, scrapping, any other method as per requirement of BHEL. The same will be inspected and approved by the engineer before painting.
6.2	After applying the primer paints all structure / equipment / items, shall be finish painted with one coat of epoxy finish & one coat of aliphatic polyurethane / as specified by BHEL engineer. In case proper finish is not obtained in two coats, the contractor shall apply additional coat (s) till proper finish is achieved. After completion of painting all bright spots shall be cleaned to the satisfaction of

	Engineer.
6.3	Certain equipment like control panels, valves etc. shall require spray painting. The contractor shall make arrangements of the required equipment for spray painting. Spray painting at the job site shall be permitted only at times and locations approved by Engineer.
6.4	Contractor at no extra cost to BHEL shall supply all paints, primers, tools and other consumables including scaffolding materials required for finish painting. Paint is to be BHEL/NTPC approved make only and painting should be as per colour scheme and quality approved / specified by BHEL/NTPC. Valid Test Certificate for the paint so supplied shall be made available before use of the same on work. No paint whose shelf life has expired should be used for painting.
6.5	The contractor may be required to fill up dents / marks by applying putty before final painting of equipment. All materials and arrangements have to be made within quoted lump sum price/rates.
6.6	The contractor shall provide legends with direction of flow on equipment and piping in size specified by Engineer. Letter writing shall be done in Hindi / English or in both languages.
6.7	The painters have to undergo test on a mock plate of size 1m*1m and only qualified painters will be allowed to work. The contractor shall ensure availability of
6.7.1	• Ford Cup-4 to measure consistency of paint,
6.7.2	• Automatic magnetic gauge to measure the dry film thickness and
6.7.3	• SSPC Visual standards to assess degree of cleanliness of surfaces to be painted.
6.8	All paints should be stored in well-ventilated store. The painters and other personnel deployed should use proper protective equipment to avoid inhalation of fumes.
<b>7.0</b>	<b>TESTING, PRE-COMMISSIONING, COMMISSIONING, AND POST-COMMISSIONING</b>
7.1	The contractor shall carry out all the required tests, pre-commissioning and commissioning activities required for the successful and reliable operation of FGD system as per the approved commissioning procedure / quality plans of BHEL/NTPC. These would include, Air /gas tightness test of ducts, Hydraulic test of piping, Holiday test of underground piping Water fill test/vacuum box test of tanks, Trial run of pumps/blowers/ball mills/feeders/vacuum belt filter/hydro cyclones, Testing of fire protection system etc. as instructed by BHEL using their own consumables, labour and scaffoldings etc. Specific omission of any test which is required for the successfully commissioning of the FGD system does not absolve the contractor of its responsibilities of performing of that test.
7.2	All required tests (Mechanical and electrical) indicated by BHEL and their clients for successful commissioning are included in the scope of these specifications. These tests / activities may not have been listed in these specifications but contractor shall conduct the tests as per the approved commissioning procedure.
7.3	The 'Initial Operation'/trial operation of the complete facility as an integral unit shall be conducted for 720 continuous hours. During the period of initial operation of 720 hours, the FGD System shall operate continuously at full load for a period not less than 72 hours .The Initial Operation shall be considered successful, provided that each item/ part of the facility can operate continuously at the specified operating characteristics, for

	the period of Initial Operation with all operating parameters within the specified limits and at or near the predicted performance of the equipment/ facility.
7.4	Specialized test equipment, if any, shall be provided by BHEL / its client free of hire charges. However contractor has to take proper care of the equipment issued to him.
7.5	After completion of erection of ducts, the contractor shall conduct the air/gas tightness of the inlet duct from ID fan outlet to booster fan to absorber inlet and outlet duct from absorber outlet up to wet stack chimney. Erection etc. of blowers and blanks and putty required for conducting air tightness test shall be carried out as part of work (Putty to be procured by the contractor without any extra cost to BHEL).
7.6	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.
7.7	The scope of pre-commissioning activities cover installation of all necessary equipment including temporary piping, supports, valves, blanking, pumps, tanks, with access platforms valves, along with accessories required for hydro test for any other tests. The scope also covers the offsite disposal of effluents of the tests under the scope of this contract as per instruction of BHEL Engineer.
7.8	It shall be the responsibility of the contractor to provide various category 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&P's, IMTE's 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.
7.9	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.
7.10	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.
7.11	During commissioning, opening / closing of valves, changing of gaskets, realignment 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.
7.12	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.
7.13	The valves will have to be checked, cleaned or overhauled in full or in part before erection, during pre-commissioning and commissioning as may be necessary.
7.14	In case any defect is noticed during tests, trial runs and commissioning such as loose components, undue noise or vibration, strain on connected equipment etc., the contractor shall immediately attend to these defects and take necessary corrective measures. If any readjustment and realignment are necessary, the contractor at his cost shall do the same as per Engineer's instructions including repair, rectification and replacement work. The parts to be replaced shall be provided by BHEL.

7.15	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.
7.16	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 unserviced. Wherever necessary as required by BHEL Engineer, the contractor shall arrange to lap / grind valve seats. Cleaning and servicing of all the filters / strainers, toppings of oils coming in the system shall be done by the contractor within the accepted price.
7.17	Necessary technical support during the commissioning of the equipment's as mentioned in the clause no. 2.14.6 shall be provided by BHEL
7.18	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. The contractor shall carry out any other test as desired by BHEL Engineer/ Manufacturer on erected equipment covered under scope of this contract during testing and commissioning to demonstrate the physical completion of any part or parts of the work performed by the contractor
7.19	The scope of pre-commissioning, commissioning and post commissioning activities cover installation of all necessary temporary piping, supports, valves, blanking, pumps, tanks etc. and other accessories with access platforms valves, pressure gauges, electric cables, switches, cutting of some of existing valve, placing of rubber wedges in the valves etc., required for hydro test, or any other tests as the case may be and will carry out above activities under this scope of work as per instructions of BHEL. The scope also covers the off site disposal of effluents
7.20	It shall be the responsibility of the contractor to preserve the cleaned surface as per BHEL's requirement.
7.21	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 additional cost. The contractor shall carryout the required test on the pipelines such as Hydraulic Test of various piping systems, Ultrasonic Test for weld defects and finding thickness, Dye penetrant test, Magnetic particles test for Weld defects and materials defects etc. All facilities (manpower, materials, equipment, consumables etc.) including proper approaches wherever required shall be provided by the contractor for satisfactory conduction of above tests. Special equipment such as magnetic particle tester, ultrasonic test kit and engineers required for these tests shall be arranged by the contractor along with Qualified technician within finally accepted rates.
7.22	In certain places blanking has to be resorted prior to Hydraulic test and spool pieces have to be erected in place of control valves, orifices and other fittings and these spool pieces have to be subsequently replaced with the regular valves/ fittings by the contractor at no extra cost.
7.23	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 for the complete requirement of supervision, consumables, labour, T&P and IMTEs required till such time the commissioned units are taken over by the BHEL's customer.
7.24	It is possible that due to any reason the final supporting may not be completed before conducting Hydraulic Test. The contractor may have to strengthen or install

	any additional supports as per instruction of BHEL. This work is a part of the work and no additional payment shall be made on this account
7.25	All the shafts of the equipment shall have to be properly aligned to that of matching equipment to perfection, accuracy as required and the equipment shall be free from excessive vibration so as to avoid over-heating 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 recommendations of BHEL engineer.
7.26	During commissioning changing of gaskets, tightening of bolts, realigning of rotating and other equipment, attending to leakage and minor adjustments of erected equipment may arise. The quoted rate of contractor shall be inclusive of all such works
7.27	Lubricating oil units of the rotating machines are to be cleaned thoroughly before pouring of final lubricating oil. Topping up of lubricants during running of the set till handing over to be done by the vendor. Required lubricants both for first filling and topping up are to be supplied by BHEL free of cost. The empty containers of the lubricating oils should be returned to BHEL stores/place indicated by BHEL from time to time.
7.28	The instruction of the motor manufacturer regarding storage of the motors and re conservation must be strictly followed without any deviation.
7.29	Attending the punch points post commissioning and resolve the deficiency for handing over the unit to customer M/s NTPC