NTPC Limited

(A Government of India Enterprise)

SINGRAULI SUPER THERMAL POWER PROJECT
STAGE - III (2x800MW)

PART - D

ERECTION CONDITIONS OF CONTRACT

SECTION – VI

TECHNICAL SPECIFICATION

FOR

EPC PACKAGE

BIDDING DOCUMENT NO.: CS-1150-001R-2

1.00.00 GENERAL

1.01.00 The following provisions shall supplement the conditions already contained in the other parts of these specifications and documents and shall govern that portion of the work of this contract which is to be performed at site. The erection requirements and procedures not specified in these documents shall be in accordance with the recommendations of the equipment manufacturer, or as mutually agreed to between the Employer and the Contractor prior to commencement of erection work.

1.02.00 The Contractor upon signing of the Contract shall, in addition to a Project Co-ordinator, nominate another responsible officer as his representative at Site suitably designated for the purpose of overall responsibility and co-ordination of the Works to be performed at Site. Such a person shall function from the Site office of the Contractor during the pendency of Contract.

2.00.00 REGULATION OF LOCAL AUTHORITIES AND STATUTES

2.01.00 In addition to the local laws and regulations, the Contractor shall also comply with the Minimum Wages Act and the Payment of Wages Act (both of the Government of India) and the rules made there under in respect of its labour and the labour of its sub-contractors currently employed on or connected with the contract.

2.02.00 All registration and statutory inspection fees, if any, in respect of his work pursuant to this Contract shall be to the account of the Contractor. However, any registration, statutory inspection fees lawfully pay-able under the provisions of the Indian Boiler Regula-tions and any other statutory laws and its amendments from time to time during erection in respect of the plant equipment ultimately to be owned by the Employer, shall be to the account of the Employer. Should any such inspection or registration need to be re-arranged due to the fault of the Contractor or his Sub-Contractor, the additional fees for such inspection and/or registration shall be borne by the Contractor.

3.00.00 WELDING OF PRESSURE PARTS AND HIGH PRESSURE PIPING

The welding of all pressure parts and high pressure piping shall be in accordance with the following requirements:

3.01.00 Qualification of Weld Procedures

Only qualified welding procedures as per ASME Section IX shall be used by contractor at site. Procedure qualification records along with WPS shall be submitted to NTPC for review. Welding procedure shall indicate all essential and non-essential parameters as per ASME Section IX. Makes of welding consumables shall be subject to employer's approval.

3.02.00 Welder's Qualification

Only welders who are qualified in accordance with the latest applicable requirements of the Indian Boiler Regulations, shall be permitted to perform any welding work on the pressure parts and its attachment welding. In addition to such statutory qualification requirements, the welders shall also undergo a satisfactory pre-production qualification test to be conducted by the Contractor at site as per ASME Sec IX in presence of employer's representative(s), prior to performing work under these specifications. The services of an independent testing laboratory shall be retained by the Contractor to perform welder qualification tests for welders.

All the welders carrying out welding at site shall carry an identification badge, which shall indicate the category and the grade of welding for which they have been tested

and authorised to carry out welding.

3.03.00 **Records**

Welders performance shall be monitored regularly and record of their performance shall be maintained by contractor in a manner acceptable to the employer. Contractor shall maintain such records including record of procedure qualification & welder qualification and hand-over to the employer at the end of work.

3.04.00 **MARKING**

On completion of each welded joint, the welder shall mark his regularly assigned identification mark near the joint. The welder's identification numbers, inspection stamps or code symbol stamps and any other information shall not be directly stamped on any alloy steel piping. In alloy steel piping, all such information shall be stamped on separate marking plate which shall be tack welded on pipe near the weld.

3.05.00 Welding Equipment for high pressure (Boiler, PCP) -

For GTAW process: HF Welding machines to be used.

For SMAW process: Inverter based welding machine are to be used.

Main contractor to ensure the availability of sufficient numbers of welding equipment during the each phase of project construction so as not to impede the progress of the project

4.00.00 HEAT TREATMENT

4.01.00 Heat Treatment -Pre-heating, post-heating and post-weld heat treatment operations of all welds, shall be performed in accordance with the requirements of applicable code and WPS. Local post weld heat treatments shall be adopted only in cases where it is normally impracticable to subject the entire assembly as such for stress relieving operations. Heating may be by means of electric induction coils or electric resistance coils as acceptable to employer. Oxyacetylene flame heating or exothermic chemical heating methods will not be permitted. Complete recording of the temperatures through out the stress relieving cycle of the material and the weld subjected to heat treatment shall be made by means of chartless recorder / IIOT sensors duly password protected with a connectivity to remote server /Cloud. All hardware and software required to meet above intent shall be in the scope of bidder.

4.02.00 After setting up the weld joint for heat treatment operation, the Employer's signature shall be obtained on the strips chart of the recorder prior to starting of heat treatment cycle. The right hand corner of the strip chart at the starting point of the heat treatment cycle shall contain details like the weld number, material, diameter and thickness, method of heating adopted, prescribed ranges of heat treatment temperatures, date of heat treatment, reference to item number of the Field welding Schedule (as specified at clause no 7.00.00- of this chapter) etc.

4.03.00 Heat Treatment - weld number, material, diameter and thickness, method of heating adopted, prescribed ranges of heat treatment temperatures, date of heat treatment, reference to item number of the Field welding. Schedule shall be mentioned on data for identification.

5.00.00 WELD EDGE PREPARATION

Preparation at site of weld joint shall be in accordance with details acceptable to the Employer. Wherever possible, machining or automatic flame cutting shall be used for edge preparation. Hand flame cutting will be permitted only where edge preparation otherwise is impractical. All slag shall be removed from cuts and all the hand cuts shall be ground smooth to the satisfaction of the Employer. Flame cutting of alloy steel pipe shall be avoided. Wherever such cutting is done, a 200mm length at the cut face shall be removed by machining. Pneumatic hand tools such as edge preparation, tube cutting machine can be used.

6.00.00 CLEANING AND SERVICING

6.01.00 The inside of all tubes, pipes, valves and fittings shall be free from dirt, and loose scales before being erected. All the pipelines shall be thoroughly blown and/or flushed. Each steam and water tubes shall be blown with compressed air and shall be subjected to 'ball test' before erection to ensure that no obstructions exist. A system for recording of all such operations shall be developed and maintained in a manner to ensure that no obstructions are left inside the tubes and no tubes are left uncleaned and untested.

6.02.00 All valves and valve actuators, and dampers and damper actuators, if any, shall be thoroughly cleaned and serviced prior to pre-commissioning tests and/or Initial Operations of the plant. A system for recording of such servicing operation shall be developed and maintained in a manner acceptable to the Employer and to ensure that no valves or dampers including their actuators are left unserviced.

6.03.00 All interior surfaces of the turbine shall be thoroughly cleaned prior to boxing - up to remove all traces of oil preservations.

7.00.00 FIELD WELDING SCHEDULE

The Contractor shall submit to the Employer, a certified and complete field welding schedule for all the field welding activities to be carried out in respect of the pressure parts involved in the equipment furnished and erected by him, at least 90 days prior to the scheduled start of erection work at site. Such schedule will be strictly followed by the Contractor during the process of erection. The above field-welding schedule to be issued by the Contractor shall contain the following:

(a.) Drawing No (s)

(b.) Location of the weld

(c.) Size of the weld (outside diameter and thickness)

(d.) Type of joints

(e.) Material specifications

(f.) Size of fillet on backing ring, when the type of joint is with backing ring

(g.) Electrode/ filler metal specifications

(h.) Number of welds per unit

(i.) Quantity of filler metal per weld

(j.) Indication of required Non-destructive Examination (NDE) for each weld

(k.) Pre-heat temperatures for welding

(l.) Process of welding

(m.) Post-welding heat treatment temperature ranges, duration, under as specified at clause no 4.00.00 of this chapter entitled "Heat Treatment".

(n.) Qualification details of weld procedures to be adopted as specified at clause no 3.01.00 of this chapter entitled 'Qualification of Weld Procedures'.

8.00.00 SITE RUN MISCELLANEOUS PIPING

Sketches or diagrams of the proposed routings of all piping, not already indicated and routed on the shop drawings which were reviewed by the Employer, shall be submitted to the Employer for review, Employer's acceptance of such site routings shall be obtained before the piping is erected. All these site run piping shall be installed in such a manner as to present an orderly and neat installation. They shall be located as to avoid obstruction of access and passages. Valves, instruments or any other special items shall be located convenient for operation by the operating personnel. Pipe runs shall be plumb or level except where pitch for drainage is required. Pipe runs that are not parallel to the building structure, walls or column rows shall be avoided so that deflection of pipes between hangers does not exceed 6 mm. No miscellaneous pipe shall be routed and installed above or adjacent to electrical equipment.

9.00.00 THERMAL EXPANSIONS

All piping installation shall be such that no excessive or destructive expansion forces exist either in the cold condition or under condition of maximum temperature. All bends, expansion joints and any other special fittings, necessary to provide proper expansion, shall be incorporated. During installation of expansion joints and anchors, care must be taken to make sure that full design movement is available at all times for maximum to minimum temperature and vice-versa.

10.00.00 PIPING SUPPORTS

10.01.00 Hangers, supports and anchors shall be installed as required to obtain a safe, reliable and complete pipe installation. All supports shall be properly levelled and anchored when installed. The anchors shall be so placed that thermal expansion will be absorbed by bends without subjecting the valves or equipment to excessive strains.

10.02.00 The hanger assemblies shall not be used for the attachment of rigging to hoist the pipe into place. Other means shall be used to securely hold the pipe in place till the pipe support is completely assembled and attached to the pipe and building structures and spring support is set to accommodate the pipe way. All temporary rigging shall be removed in such a way that the pipe support is not subjected to any sudden load. All piping, having variable spring type supports, shall be held securely in place by temporary means during the hydraulic test of pipe system. Constant support type spring hangers used during hydraulic test shall be pinned or blocked solid during the test. After complete installation and insulation of the piping and filling of the piping with its normal operating medium, the pipe support springs shall be adjusted to the cold positions. If necessary, the spring support shall be re-adjusted to the hot positions after the line has been placed for service at its normal maximum operating temperature conditions. Electric arc welding only shall be used to weld all pipe supports to structural steel members that form part of the building supporting structure. The structural beams shall not be heated more than necessary during welding of supports and such welds shall run parallel to the axis of the span. All lugs or any other attachments welded to the piping shall be of the same material as the pipe.

11.00.00 PRESSURE TESTING

11.01.00 On completion of erection of pressure parts, a hydraulic test in accordance with the requirements of the Indian Boiler Regulations shall be performed by the Contractor.

11.02.00 All the valves, high pressure pipes and inter-connected pipes connecting the pressure parts shall be tested along with pressure parts. All blank flanges or any removable plugs required for openings not closed by the valves, and piping provided, shall be furnished by the Contractor. The pressurization equipment including water piping from the supply, needed for the above test shall also be furnished by the Contractor. Any defects noticed during the testing are to be rectified and the unit re-tested. If any welding is done on the pressure parts after the Hydraulic test, the Hydraulic test for that portion of pressure parts shall be repeated.

11.03.00 Thy hydraulic test shall be considered successful only on certification to that effect

by the concerned inspecting Authority as per the provisions of the Indian Boiler Regulations and the Employer.

12.00.00 THERMOWELLS AND FLOW NOZZLES

12.01.00 All the thermowells and flow nozzles in the equipment furnished under the technical specifications shall be installed as a part of this work.

12.02.00 All thermowell connections incorporated in the steam service shall be plugged during the pressure testing and the blow out of steam piping systems. Upon completion of the blow out operation, all thermowells shall be installed and seam welded. Similarly, all flow nozzles in the steam lines shall also be installed only on completion of steam blowing operations unless otherwise agreed to by the Employer, depending upon the sequence of cleaning and purging operations to be adopted by the Contractor at the field.

13.00.00 INSULATION, LAGGING AND CLADDING

The provision of insulation, lagging and cladding of the various equipments and portion of the equipment covered under the Contract, shall be furnished by the Contractor as specified elsewhere or agree to separately in writing. Welds required for holding insulation on pressure parts shall be carried out by IBR qualified welder.

13.01.00 **Piping, Pipe Fittings & Valves**

All piping insulation and metal cladding furnished with the equipment to be erected shall be applied as specified herein.

13.01.01 **Piping**

The insulation on piping shall be applied using wire loops on 150mm centres. These wire loops shall be thoroughly embedded into the outer insulation surface and all cracks, voids and depressions shall be filled with insulating cement suitable for the piping temperature so as to form a smooth base for application of cladding. The wires used for piping insulation shall be of 16 SWG. The surface shall be smooth and uniform before applying the outer covering. All piping insulation ends shall be terminated at a sufficient distance from flanges to facilitate removal of bolts.

13.01.02 **Flanges**

Insulation on flanges shall be by means of blocks of insulating material securely bound to the flange by wire loops. Such blocks of insulation shall be long enough to

overlap the adjacent pipe insulation by an amount equal to the thickness of adjacent pipe insulation. Smooth finish shall be obtained by the application of insulating cement. Alternatively, sectional pipe insulation of proper diameter may be used. Insulation on flanges shall not be done until the pipe and equipment have been in service during the initial operation and till all the flange bolts have been retightened.

13.01.03 **Bends and Elbows**

Insulation on bends and elbows shall be cut into sections sufficiently short to form a reasonable smooth external surface. After the application of insulation material in place, it shall be smoothly coated with insulating cement. Elbows may be insulated as above or alternatively by means of specially moulded insulation enclosures.

13.01.04 **Cladding**

Cladding shall be of aluminium sheet of thickness as per details given in detail Technical Specification or will be provided during detail engineering shall be machine rolled and formed to accurately fit insulation curvatures. Cladding shall be secured using self-tapping screws. Screws shall be adequate number and so located as to produce tight joints. The spacing of screws shall be as far as possible uniform and on centres not exceeding 150 mm. For outside diameters less than 230 mm, spacing of screws shall be on centres not exceeding 100 mm. adequate number of screws shall be provided for fixing the cladding and be so placed in such locations, as to produce a smooth cladding finish without bellying'. Insulated elbows having insulated diameters less than 330 mm shall be provided with preformed smooth aluminium elbow jackets. Wherever possible, all joints should be lapped a minimum of 50 mm with joints facing downwards and so placed that they are obscured from normal points of vision. All the joints in the cladding shall be made with suitable provisions for expansions. All butt joints such as those at piping tees shall be made using rolled seams. In addition, to prevent galvanic corrosion, suitable action, as specified at clause no 13.02.00 of this chapter, shall be taken.

13.01.05 **Valves and Fittings**

All valves and fittings (above valve size of 2 inches) installed in the pipelines shall also be applied with insulation and furnished with suitably shaped boxes so as to facilitate easy dismantling of the fittings. The insulation thickness for valves, valve fittings etc., shall be same as that used on the line on which they are installed. All voids shall be properly filled up with insulating material and as per the directions of the Employer.

13.02.00 **Protection of Equipment during Insulation Applications**

All equipment and structures shall be suitably protected from damage while applying insulation after completion of insulation. All equipment and structures shall be thoroughly cleaned and remove insulating materials which might have fallen on them.

14.00.00 CODE REQUIREMENTS

The erection requirements and procedures to be followed during the installation of the equipment shall be in accordance with the relevant Indian Electricity Rules & Codes, Indian Boiler Regulations, ASME codes and accepted good practices, the Employer's Drawings and other applicable Indian recognised codes and laws and regulations of the Government of India.

15.00.00 ELECTRICAL SAFETY REGULATIONS

15.01.00 In no circumstances will the Contractor interfere with fuses and electrical equipment belonging to the other Contractor or Employer.

15.02.00 Before the Contractor connects any electrical appliances to any plug or socket belonging to the other Contractor or Employer, he shall:

(a) Satisfy the Employer that the appliance is in good working condition.

(b) Inform the Employer of the maximum current rating,voltage and phase of the appliances.

(c) Obtain permission of the Employer detailing the socket to which the appliances may be connected.

The Employer will not grant permission to connect unitl he is satisfied that

(d) The appliance is in good condition and is fitted with suitable plug

(e) The appliance is fitted with a suitable cable having two earth conductors,one of which shall be an earthened metal sheath surrounding the cores.

15.03.00 No electric cable in use by the other Contractor/Employer will be disturbed without permission.No weight of any description willl be imposed on any such cable and ladder or similar equipment will rest against or to be attached with it.

15.04.00 No reapir work shall be carried out on any live equipment.The equipment must be declared safe by the Employer and a permit to work issued before any work is carried out.

15.05.00 The Contractor shall employ the necessary number of qualified,full time electricians to maintain his temporary electrical installation..

16.00.00 REMOVAL OF MATERIAL

No material brought to the Site shall be removed from the Site by the Contractor and/or his Sub-Contractors without the prior written approval of the Employer.

17.00.00 INSPECTION, TESTING AND INSPECTION CERTIFICATES

The provisions of the clause entitled Inspection, Testing and Inspection Certificates given in Part - C of the Technical Specification, shall also be applicable to the erection portion of the Works. The Employer shall have the right to re-inspect any equipment though previously inspected and approved by him at the Contractor's works, before and after the same are erected at Site. If by the above inspection, the Employer rejects any equipment, the Contractor shall make good for such rejections either by replacement or modification/ repairs as may be necessary to the satisfaction of the Employer. Such replacements will also include the replacements or re-execution of such of those works of other Contractors and/or agencies, which might have got damaged or affected by the replacements or re-work done to the Contractor's work.

18.00.00 ACCESS TO SITE AND WORKS ON SITE

18.01.00 Suitable access to site and permission to work at the Site shall be accorded to the Contractor by the Employer in reasonable time.

18.02.00 In the execution of the Works, no person other than the Contractor or his duly appointed representative, Sub-Contractor and workmen, shall be allowed to do work

on the Site, except by the special permission, in writing by the Employer or his representative.

19.00.00 CONTRACTOR'S SITE OFFICE ESTABLISHMENT

The Contractor shall establish a Office at the Site and keep posted an authorised representative for the purpose of the Contract. Any written order or instruction of the Employer or his duly authorised representative, shall be communicated to the said authorised resident representative of the Contractor and the same shall be deemed to have been communicated to the Contractor at his legal address.

20.00.00 CO-OPERATION WITH OTHER CONTRACTORS

20.01.00 Contractor, who may be performing other works on behalf of the Employer and the workmen who may be employed by the Employer and doing work in the vicinity of the works under the Contract. The Contractor shall also arrange to perform his work as to minimise, to the maximum extent possible, interference with the work of other Contracts and their workmen. Any injury or damage that may be sustained by the employees of the other Contractors and the Employer, due to the Contractor's work shall promptly be made good at his own expense. The Employer shall determine the resolution of any difference or conflict that may arise between the Contractor and other Contractors or between the Contractor and the workmen of the Employer in regard to their work. If the work of the Contractor is delayed because of the any acts of omission of another Contractor, the same shall be dealt in accordance with GCC.

Employer shall have full access to visit the contractor's site at any time for inspection and surveillance checks.

20.02.00 The Employer shall be notified promptly by the Contractor of any defects in the other Contractor's works that could affect the Contractor's Works. The Employer shall determine the corrective measures if any, required to rectify this situation after inspection of the works and such decisions by the Employer shall be binding on the Contractor.

21.00.00 DISCIPLINE OF WORKMEN

The Contractor shall adhere to the disciplinary procedure set by the Employer in respect of his employees and workmen at Site. The Employer shall be at liberty to object to the presence of any representative or employee of the Contractor at the Site, if in the opinion of the Employer such employee has mis-conducted himself or is incompetent, negligent or otherwise unde-sirable then the Contractor shall remove such a person objected to and provide in his place a competent replacement.

22.00.00 **CONTRACTOR'S FIELD OPERATION**

22.01.00 The Contractor shall keep the Employer informed in advance regarding his field activity plans and schedules for carrying out each part of the works. Any review of such plan or schedule or method of work by the Employer shall not relieve the Contractor of any of his responsibilities towards the field activities. Such reviews shall also not be considered as an assumption of any risk or liability by the Employer or any of his representatives and no claim of the Contractor will be entertained because of the failure or inefficiency of any such plan or schedule or method of work reviewed. The Contractor shall be solely responsible for the safety, adequacy and efficiency of plant and equipment and his erection methods.

22.02.00	The Contractor shall have the complete responsibility for the conditions of the Work-Site including the safety of all persons employed by him or his Sub-Contractor and all the properties under his custody during the performance of the work. This requirement shall apply continuously till the completion of the Contract and shall not be limited to normal working hours. The construction review by the Employer is not intended to include review of Contractor's safety measures in, on or near the Work-Site, and their adequacy or otherwise.
23.00.00	**PHOTOGRAPHS AND PROGRESS REPORT**
23.01.00	The Contractor shall furnish three (3) prints each to the Employer of progress photographs of the work done at Site. Photographs shall be taken as and when indicated by the Employer or his representative. Photographs shall be adequate in size and number to indicate various stages of erection. Each photograph shall contain the date, the name of the Contractor and the title of the photograph.
23.02.00	The above photographs shall accompany the monthly progress report detailing out the progress achieved on all erection activities as compared to the schedules. The report shall also indicate the reasons for the variance between the scheduled and actual progress and the action proposed for corrective measures, wherever necessary.
23.03.00	Project Management System to be implemented as defined in Annexure-A to sub section IIC (Project Management) of technical specifications Section VI, Part A.
24.00.00	**MAN-POWER REPORT**
24.01.00	The Contractor shall submit to the Employer, on the first day of every month, a man hour schedule for the month, detailing the man hours scheduled for the month, skill-wise and area-wise.
24.02.00	The Contractor shall also submit to the Employer on the first day of every month, a man power report of the previous month detailing the number of persons scheduled to have been employed and actually employed, skill- wise and the areas of employment of such labour.
25.00.00	**PROTECTION OF WORK**
	The Contractor shall have total responsibility for protecting his works till it is finally taken over by the Employer. No claim will be entertained by the Employer or the representative of the Employer for any damage or loss to the Contractor's works and the Contractor shall be responsible for complete restoration of the damaged works to original conditions to comply with the specification and drawings. Should any such damage to the Contractor's Works occur because of other party not being under his supervision or control, the Contractor shall make his claim directly with the party concerned. If disagreement or conflict or dispute develops between the Contractor and the other party or parties concerned regarding the responsibility for damage to the Contractor's Works the same shall be resolved as per the provisions of the as specified at clause no 20.00.00- of this chapter entitled "Co-operation with other Contractors." The Contractor shall not cause any delay in the repair of such damaged Works because of any delay in the resolution of such disputes. The Contractor shall proceed to repair the Work immediately and no cause thereof will be assigned pending resolution of such disputes.
26.00.00	**EMPLOYMENT OF LABOUR**

26.01.00	In addition to all local laws and regulations pertaining to the employment of labour to be complied with by the Contractor pursuant to GCC, the Contractor will be expected to employ on the work its employees with relevant skills and experience of the particular work. No female labour shall be employed after darkness. No person below the age of eighteen years shall be deployed. The deployment shall be in compliance of all the applicable labour laws.
26.02.00	All travelling expenses including provisions of all necessary transport to and from Site, lodging allow-ances and other payments to the Contractor's employees shall be the sole responsibility of the Contractor.
26.03.00	The hours of work on the Site shall be decided by the Principal Employer and the Contractor shall adhere to it. Working hours will normally be eight (8) hours per day - Monday through Saturday.
26.04.00	Contractor's employees shall wear identification badges while on work at Site.
26.05.00	In case the Principal Employer becomes liable to pay any wages or dues to the labour or any Government agency under any of the provisions of the Minimum Wages Act, Workmen Compensation Act, Contact Labour Regulation Abolition Act or any other law due to act of omission of the Contractor, the Principal Employer may make such payments and shall recover the same from the Contractor's Bills.
27.00.00	**FACILITIES TO BE PROVIDED BY THE EMPLOYER**
27.01.00	**Communication**
	The Employer will extend the telephone facilities, if available at Site, for purposes of Contract. The Contractor shall be charged at actuals for such facili-ties.
27.02.00	**Railway Siding**
	Railway siding shall be provided by owner (up to plant entry point) for coal transportation to site. However the same may not be available to the bidder for material/supplies transport etc. Bidder has to plan its own arrangement for movement of ODC consignment to plant site. Further, irrespective of readiness of railway siding, owner reserves the option of coal supply in stackyard before the synchronization of first unit for which bidder has to ensure readiness of coal supply system up to mill bunker.
28.00.00	**FACILITIES TO BE PROVIDED BY THE CONTRACTOR**
28.01.00	**Contractor's site office Establishment**
	The Contractor shall establish a site office at the site and keep posted an authorized representative for the purpose of the contract, pursuant to GCC. The site office will include one conference meeting room (250-300 Sq Ft) for site meetings between the Contractor and the Employer. The contractor shall also provide four (4) furnished office rooms (150-250 SqFt) for use by the Employer to facilitate effective co-ordination during the tenancy of the contract.
28.02.00	**Tools, tackles and scaffoldings**
	The Contractor shall provide all the construction equipments, tools, tackles and scaffoldings required for pre-assembly, installation, testing, commissioning and conducting Guarantee tests of the equipments covered under the Contract. He shall submit a list of all such materials to the Employer before the commencement of pre-assembly at Site. These tools and tackles shall not be removed from the Site without

	the written permission of the Employer. The Contractor shall arrange Dozer, Hydra, Cranes, Trailer, etc. for the purpose of fabrication, erection and commissioning.
28.03.00	**Testing Equipment and Facilities:**
	The contractor shall provide the necessary testing, equipment and facilities.
28.04.00	**Site laboratory for civil works:**
	Contractor shall provide and maintain a site laboratory for the testing of construction material under the direction and general supervision of employer.
28.05.00	**First-aid**
28.05.01	The Contractor shall provide necessary first-aid facilities for all his employees, representatives and workmen working at the Site. Enough number of Contractor's personnel shall be trained in administering first-aid.
28.05.02	As per NTPC Safety rules, ambulance is to be provided by the contractor, however, in case of any emergency, employer may provide the services of an ambulance for transportation to the nearest hospital.
28.06.00	**Cleanliness**
28.06.01	The Contractor shall be responsible for keeping the entire area allotted to him clean and free from rubbish, debris etc. during the period of Contract. The Contractor shall employ enough number of special personnel to thoroughly clean his work-area at least once in a day. All such rubbish and scrap material shall be stacked or disposed in a place to be identified by the Employer. Materials and stores shall be so arranged to permit easy cleaning of the area. In areas where equipment might drip oil and cause damage to the floor surface, a suitable protective cover of a flame resistant, oil proof sheet shall be provided to protect the floor from such damage.
28.06.02	Similarly the labour colony, the offices and the residential areas of the Contractor's employees and workmen shall be kept clean and neat to the entire satisfaction of the Employer. Proper sanitary arrangements shall be provided by the Contractor, in the work-areas, office and residential areas of the Contractor.
28.07.00	**Not used**
28.08.00	**Electricity**
	Refer to construction power, as envisaged in Sub Section-II-B, Part A, Sec VI of Technical specification.
28.09.00	**Water**
	Contractor shall make all arrangements himself for the supply of construction water as well as potable water for labour and other personnel at the worksite/colony. However, drawal of construction/potable water from bore-well shall be permitted if found suitable. Any statutory clearance required shall be obtained by the contractor. Assistance, if required shall be provided by the owner.
29.00.00	**LINES AND GRADES**
	All the Works shall be performed to the lines, grades and elevations indicated on the drawings. The Contractor shall be responsible to locate and layout the Works. Basic horizontal and vertical control points will be established and marked by the Employer at Site at suitable points. These points shall be used as datum for the works under the Contract. The Contractor shall inform the Employer well in advance

	of the times and places at which he wishes to do work in the area allotted to him so that suitable datum points may be established and checked by the Employer to enable the Contractor to proceed with his works. Any work done without being properly located may be removed and/or dismantled by the Employer at Contractor's expense.
30.00.00	**FIRE PROTECTION**
30.01.00	The work procedures that are to be used during the erection shall be those which minimise fire hazards to the extent practicable. Combustible materials, combustible waste and rubbish shall be collected and removed from the Site at least once each day. Fuels, oils and volatile or flammable materials shall be stored away from the construction and equipment and materials storage areas in safe containers. Untreated canvas, paper, plastic or other flammable flexible materials shall not at all be used at Site for any other purpose unless otherwise specified. If any such materials are received with the equipment at the Site, the same shall be removed and replaced with acceptable material before moving into the construction or storage area.
30.02.00	Similarly corrugated paper fabricated cartons etc. will not be permitted in the construction area either for storage or for handling of materials. All such materials used shall be of water proof and flame resistant type. All the other materials such as working drawings, plans etc. which are combustible but are essential for the works to be executed shall be protected against combustion resulting from welding sparks, cutting flames and other similar fire sources.
30.03.00	All the Contractor's supervisory personnel and sufficient number of workers shall be trained for fire-fighting and shall be assigned specific fire protection duties. Enough of such trained personnel must be available at the Site during the entire period of the Contract.
30.04.00	The Contractor shall provide enough fire protection equipment of the types and number for the warehouses, office, temporary structures, labour colony area etc. Access to such fire protection equipment, shall be easy and kept open at all time.
31.00.00	**SECURITY**
	The Contractor shall have total responsibility for all equipment and materials in his custody stores, loose, semi-assembled and/or erected by him at Site. The Contractor shall make suitable security arrangements including employment of security personnel to ensure the protection of all materials, equipment and works from theft, fire, pilferage and any other damages and loss. All materials of the Contractor shall enter and leave the Employer Site only with the written permission of the Employer in the prescribed manner.
32.00.00	**CONTRACTOR'S AREA LIMITS**
	The Employer will mark-out the boundary limits of access roads, parking spaces, storage and construction areas for the Contractor and the Contractor shall not trespass the areas not so marked out for him. The Contractor shall be responsible to ensure that none of his personnel move out of the areas marked out for his operations. In case of such a need for the Contactor's personnel to work out of the areas marked out for him the same shall be done only with the written permission of the Employer.

33.00.00 CONTRACTOR'S CO-OPERATION WITH THE EMPLOYER

In case where the performance of the erection work by the Contractor affects the operation of the system facilities of the Employer, such erection work of the Contractor shall be scheduled to be performed only in the manner stipulated by the Employer and the same shall be acceptable at all times to the Contractor. The Employer may impose such restrictions on the facilities provided to the Contractor such as electricity, etc. as he may think fit in the interest of the Employer and the Contractor shall strictly adhere to such restrictions and co-operate with the Employer. It will be the responsibility of the Contractor to provide all necessary temporary instrumentation and other measuring devices required during start-up and operation of the equipment systems which are erected by him. The Contractor shall also be responsible for flushing and initial filling of all the oil and lubricants required for the equipment furnished and installed by him, so as to make such equipment ready for operation. The Contractor shall be responsible for supplying such flushing oil and other lubricants unless otherwise specified elsewhere in documents and specifications.

34.00.00 PRE-COMMISSIONING AND COMMISSIONING ACTIVITIES

34.01.00 **GENERAL**

34.01.01 The Contractor upon completion of installation of equipments and systems, shall conduct pre-commissioning and commissioning activities, to make the equipment/systems ready for safe, reliable and efficient operation on sustained basis. All pre-commissioning/commissioning activities considered essential for such readiness of the equipment/systems including those mutually agreed and included in the Contractor's quality assurance programme as well as those indicated in clauses elsewhere in the technical specifications shall be performed by the contractor.

34.01.02 The pre-commissioning and commissioning activities including Guarantee/ demonstration/acceptability tests, checks and trial operations of the equipment/ systems furnished and installed by the contractor shall be the responsibility of the Contractor as detailed in relevant clauses in Technical Specification. The Contractor shall provide, in addition, test instruments, calibrating devices etc. and labour required for successful performance of these operations. If it is anticipated that the above test may prolong for a long time, the Contractor’s workmen required for the above test shall always be present at site during such operations.

34.01.03 The following activities shall be carried out by the contractor, 18 month prior to schedule date of commissioning of the equipment/systems installed by him.

(a.) The contractor shall furnish the organization chart of his operation and commissioning engineers for the acceptance of employer. Adequate number of operation and commissioning engineers shall be deployed by the contractor to effectively meet the requirement of round the clock operation in shifts also, till the plant is taken over by the employer.

(b.) The contractor shall submit the bio-data containing the details of experience of his operation and commissioning engineers for the acceptance of employer.

(c.) The contractor shall furnish the deployment schedule of his operation and commissioning engineers for the acceptance of the employer.

(d.) Apart from above, contractor shall ensure deployment of sufficient skilled/semi-skilled/unskilled manpower during pre-commissioning and commissioning activities.

34.01.04 It shall be the responsibility of the Contractor to provide all necessary temporary instrumentation and other measuring devices required during start-up and initial operation of the equipment/systems which are installed by him.

34.01.05 The Contractor shall also be responsible for flushing and initial filling of all oils and lubricants required for the equipment furnished and installed by him so as to make such equipment ready for operation. The Contractor shall be responsible for supplying such flushing oil and other lubricants unless otherwise specified elsewhere in these specifications and documents.

34.02.00 **COMMISSIONING DOCUMENTATION**

34.02.01 The contractor shall submit the commissioning documentation, comprising of Standard checklists, pre-commissioning procedures, testing schedules, commissioning schedules and commissioning networks for various equipment/ systems covered under the contract, for the approval of employer.

34.02.02 Standard checklist, as the name suggests, shall be a fairly general documents, containing the list of all checks required to be carried out for similar and repetitive type of equipment to ensure consistent and thorough checking. An indicative list of such equipment is enclosed as Annexure I.

34.02.03 The testing schedule is a document, designed for safe and systematic commissioning of individual equipment/sub-system (for example Boiler Feed Pump, condensate pump, compressor etc) Commissioning schedule is a document envisaged for commissioning of a system (for example feed system, Condensate system, Compressed Air system, Fire water system, Unit commissioning etc). The testing/Commissioning schedule shall have a standard format in order to maintain consistency of presentation, content and reporting. A brief write up on the contents of the Testing Schedule/Commissioning Schedule is enclosed as Annexure-II.

34.02.04 The contractor shall submit the list of commissioning documentation to be submitted by him, alongwith their submission schedule for various equipment/systems covered under the contract, with in 6(six) month from the date of award of contract, for the acceptance of employer.

34.02.05 The Contractor shall submit the commissioning documentation, for various equipment/covered under the contract, for the approval of employer, at least 18 months before the scheduled date of commissioning of the equipment/systems.

34.03.00 **COMMISSIONING ACTIVITIES**

34.03.01 Upon completion of pre-commissioning activities/tests, the contractor shall initiate commissioning of facilities. During commissioning the Contractor shall carry out system checking and reliability trials on various parts of the facilities.

34.03.02 Contractor shall carry out the checks/tests at site to prove to the Employer that each equipment of the supply complies with requirements stipulated and is installed in accordance with requirements specified.

34.03.03 Before the plant is put into initial operation the Contractor shall be required to conduct test to demonstrate to the Employer that each item of the plant is capable of correctly performing the functions for which it was specified and its performance,

	parameters etc. are as per the specified/approved values. These tests may be conducted concurrently with those required under commissioning sequence.
34.03.04	The Contractor shall also demonstrate the performance of all C&I equipment, the tests on main equipment of prior to that as the case may be.
34.03.05	Other tests shall be conducted, if required by the Employer, to establish that the plant equipment are in accordance with requirements of the specifications.
34.03.06	The Contractor shall conduct all the commissioning tests and undertake commissioning activities pertaining to all other auxiliaries and equipments including all electrical and C&I equipment/systems not specifically brought out above but are within the scope of work and facilities being supplied and installed by the Contractor and follow the guidelines indicated above or elsewhere in these technical specifications.
34.05.00	**Initial Operation**
	Upon completion of system checking/Tests as above and as a part of commissioning of facilities, complete plant/facilities shall be put on initial operation as stipulated in General Technical Requirements.
35.00.00	**MATERIALS HANDLING AND STORAGE**
35.01.00	All the equipments furnished under the Contract and arriving at Site shall be promptly received, unloaded and transported and stored in the storage spaces by the Contractor.
35.02.00	Contractor shall be responsible for examining all the shipment and notify the Employer immediately of any damage, shortage, discrepancy etc. for the purpose of Employer's information only. The Contractor shall submit to the Employer every week a report detailing all the receipts during the week. However, the Contractor shall be solely responsible for any shortages or damage in transit, handling and / or in storage and erection of the equipment at Site. Any demurrage, wharfage and other such charges claimed by the transporters, railways etc. shall be to the account of the Contractor.
35.03.00	The Contractor shall maintain an accurate and exhaus-tive record detailing out the list of all equipment received by him for the purpose of erection and keep such record open for the inspection of the Employer.
35.04.00	All equipment shall be handled very carefully to prevent any damage or loss. No bare wire ropes, slings, etc. shall be used for unloading and/or handling of the equipment without the specific written permission of the Employer. The equipment stored shall be properly protected to prevent damage either to the equipment or to the floor where they are stored. The equipment from the store shall be moved to the actual location at the appropriate time so as to avoid damage of such equip-ment at Site.
35.05.00	All electrical panels, controls gear, motors and such other devices shall be properly dried by heating before they are installed and energised. Motor bearings, slip rings, commutators and other exposed parts shall be protected against moisture ingress and corrosion during storage and periodically inspected. Heavy rotating parts in assembled conditions shall be periodically rotated to prevent corrosion due to prolonged storage.
35.06.00	All the electrical equipment such as motors, genera-tors, etc. shall be tested for insulation resistance as per OEM Practice. Storage of EHV/Generator transformers

	under Nitrogen /Dry air shall not exceed the time duration as defined by OEM practice.
35.07.00	The Contractor shall ensure that all the packing materials and protection devices used for the various equipments during transit and storage are removed before the equipment are installed.
35.08.00	The consumables and other supplies likely to deteriorate due to storage must be thoroughly protected and stored in a suitable manner to prevent damage or deterioration in quality by storage.
35.09.00	All the materials stored in the open or dusty location must be covered with suitable weatherproof and flame-proof covering material wherever applicable.
35.10.00	If the materials belonging to the Contractor are stored in areas other than those earmarked for him, the Employer will have the right to get it moved to the area earmarked for the Contractor at the Contractor's cost.
35.11.00	The Contractor shall be responsible for making suitable indoor storage facilities to store all equipment which require indoor storage. Normally, all the electrical equipments such as motors, control gear, generators, exciters and consumables like electrodes, lubricants etc. shall be stored in the closed storage space. The Employer, in addition, may direct the Contractor to move certain other materials, which in his opinion will require indoor storage, to indoor storage areas which the Contractor shall strictly comply with.
35.12.00	Sound Storage Management system need to be followed for storage of material. First in First Out method (FIFO) to be adopted to avoid longtime storage. Storage duration of any material at site shall not be more than 3 months. Accordingly supply of material in sequence of erection at site to be ensured. To achieve the same, following is to be adopted: a. Dispatch clearance is to be given in order of sequence of erection. To achieve the goal, proper tags shall be maintained in ascending order. The tag shall be self-explanatory. b. MDCC shall be issued by RIO based on clearance from Site FQA head, Main contractor, Erection head for dispatch and supply of material. Strict adherence to sequential supply of material as per supply schedule.
35.13.00	An automated storage and retrieval system consists of a variety of computer-controlled systems for automatically placing and retrieving of material may be adopted. Accordingly, each material shall be marked with unique identification code.
36.00.00	**CONSTRUCTION MANAGEMENT**
36.01.00	The field activities of the Contractors working at Site, will be coordinated by the Employer and the Employer decision shall be final in resolving any disputes or conflicts between the Contractor and other Contractors and tradesmen of the Employer regarding scheduling and co- ordination of work. Such decision by the Employer shall not be a cause for extra compensation or extension of time for the Contractor.
36.02.00	The Employer shall hold weekly meetings of all the Contractors working at Site, at a time and place to be designated by the Employer. The Contractor shall attend such meetings and take notes of discussions during the meeting and the decisions of the Employer and shall strictly adhere to those decisions in performing his Works. In

addition to the above weekly meeting, the Employer may call for other meeting either with individual Contractors or with selected number of Contractors and in such a case the Contractor if called, will also attend such meetings.

36.03.00 Time is the essence of the Contract and the Contractor shall be responsible for performance of his works in accordance with the specified construction schedule. If at any time, the Contractor is falling behind the schedule, he shall take necessary action to make good for such delays by increasing his work force or by working overtime or otherwise accelerate the progress of the work to comply with the schedule and shall communicate such actions in writing to the Employer, satisfying that his action will compensate for the delay. The Contractor shall not be allowed any extra compensation for such action.

36.04.00 The Employer shall however not be responsible for provision of additional labour and/or materials or supply or any other services to the Contractor except for the co-ordination work between various Contractors as set out earlier.

36.05.00 **Site management during construction phase till handing over of plant**

Bidder shall ensure that the plant site within the plant boundary is managed in a coordinated and professional way all through the construction phase till handing over of plant, ensuring safe, easy & unhindered working conditions and a healthy & hygienic working environment at site. He shall ensure the following measures at site while executing the project.

a) Unhindered motorable road access to all work areas and facilities both during the construction/erection and as they get completed progressively. Required temporary access roads other than the permanent roads shall also be provided. Bidder shall prioritize the construction of approach roads, roads around the main plant block, roads to office & storage areas and the offsite areas from the start of project itself. He shall finalize and submit the complete road layout plan along with priority and completion schedule immediately after the award for review by the Employer. He shall ensure that the roads are promptly repaired and maintained against any damages due to movement of traffic/heavy trailers & cranes etc providing motorable access at all times. Adequate onsite stock of road materials shall be kept and maintained disturbed over the site for repairs especially before the monsoon period.

b) Proper drainage of rainwater, ground water from excavations, water flows from batching plant / construction sites etc. He shall prioritize the construction of permanent drains from the start of the project itself. Till such time the permanent drainage network is done, he shall construct adequate temporary drains to ensure that there is no accumulation /stagnation of water in the plant site. Bidder may consider providing pre-cast RCC drains for temporary/ permanent drain construction for faster construction of drains. The drain construction shall be matched with progress of road construction for preventing damage to roads. Bidder shall provide and maintain adequate number of drainage pumps (both electrical and diesel operated) of suitable capacity for pumping out accumulated water especially during the monsoon periods. All drain diversions required shall be undertaken at the start of the project itself.

c) The plant site is fully secured against unauthorized access.

d) Proper housekeeping by systematic and proper disposal of earth from excavations(separately for usable & surplus earth), muck (from pile bores or otherwise), wastes (from dismantling of pile tops, concrete works etc), packing & insulation wastes, steel scrap, cable wastes etc generated during construction / erection works. Suitable disposal sites for each of above shall be identified in the layout and at site in the beginning of the project itself. It shall be ensured that all agencies engaged by the bidder follow the discipline to dispose off of earth spoils and wastes at the designated places. Preferably once in a week suitable time slot will be identified for housekeeping by all agencies and suitable instructions shall be issued in this regard. Bidder may engage a separate agency or identify a gang for collection of wastes and disposal to designated places. Suitable arrangement / tie-up will also be made for periodic disposal of wastes/ scrap from the designated places.

e) All fabrication areas shall be suitably hard crusted to provide a water free and proper working platform. Suitable sheds preferably pre-engineered structures to be provided for paint shops, fabrication workshops etc for ensuring all weather work conditions for onsite structural works. For the main plant and auxiliary buildings, bidder should preferably plan the works in such a way that structural fabrication is done in suppliers' offsite works / workshops and onsite fabrication works are avoided / kept minimum.

f) Suitable onsite maintenance workshop for day to day breakdown maintenance heavy plant and equipment like batching plants, cranes, earth moving equipment, welding equipment etc. The workshop shall have stock of frequently needed spares and suitable repair facilities with experienced technicians/mechanics. A central test laboratory equipped with test equipment for routine tests like tests on soil, concrete, bricks, aggregates, welds etc with experienced staff shall be established at the start of the project itself.

g) All office and covered store buildings of the bidder and its agencies shall be of prefab/ pre-engineered / porta cabin construction. Shabby semi-finished constructions in brickwork/ GI / asbestos roof etc shall not be permitted.

h) First aid facilities and amenities like rest rooms, suitable pre-engineered toilets (separate for men and women), drinking water fountains/tanks, canteen, crèche for women workers shall be planned and established at the beginning of the project itself. These facilities shall be distributed over the plant area to enable easy access by the construction workers and staff and shall be marked on the plant layout. Suitable treatment for toilet discharge, like bio digesters etc shall be planned and conventional septic tanks / soak pits etc shall be avoided.

i) Proper lighting of all construction / erection areas. Bidder shall erect adequate number of high lighting masts in main plant, offsite, office and store areas for lighting during night. DG sets of adequate capacity shall be provided for emergency backup. The street lighting along the roads shall also be prioritized along with road construction. The construction power ring main shall be planned and erected immediately after the award.

j) Well planned and coordinated storage and movement of plant, equipment and construction materials. System wise / agency wise storage / laydown areas shall be planned and marked on the plant layout at the beginning itself. Bidder shall ensure that all its agencies comply to the areas allocated to

them and follow the designated storage and movement plans. Adequate covered storage shall be constructed for storage of critical equipments like switchgears, MCCs, insulation etc.

k) Proper access control for construction workers, staff and visitors. Bidder shall ensure that suitable electronic based gate pass system is in place from start of project itself to keep record and track of all workers, staff and visitors entering/exiting the plant premises shift wise on daily basis.

l) Compliance to all safety requirements as specified in this document. Bidders shall establish a safety centre at the start of the project itself. It shall have a 24X7 manned safety control room in addition to a permanent safety equipment display room, separate training / lecture hall with AV facilities for safety training, store room with adequate stock of specified safety equipment, a first aid room and other amenities. Bidder shall install 25 Nos. CCTV cameras at all strategic locations in the plant area which shall be linked to the safety control room."

m) Compliance to all environment and other conditions stipulated by the concerned statutory authorities while according clearance / NOC (No objection certificate) to the project. Bidder shall ensure adequate sprinkling of water by deploying water tankers to prevent the fugitive dust nuisance during construction.

n) Development of suitable landscape & green belt areas and rainwater harvesting within the plant premises. Bidder shall plan to develop the landscape & green belt areas and rainwater harvesting from the start of the project itself. The landscape and rain water harvesting plan shall be finalized immediately after award of work and suitable work plan with priority and schedule shall also be finalized thereafter. Top soil before excavation shall be suitably preserved and stacked for landscape and green belt development.

o) Provision of adequate shelters, water supply, sanitation and lighting in construction workers and staff camps. No camps for workers and staff shall be permitted within the plant premises and Bidder shall make separate arrangement outside the plant premises for locating and development of camps for construction workers and staff. The designated areas shall be suitably developed with infrastructure like roads, drains, water supply and sewerage and shall be free from water logging. Suitable low cost shelters will be provided for the workers. Complete area shall be secured by fencing and shall be provided adequate area lighting. Suitable waste disposal, shopping and recreation facilities will be developed in these camps.

Bidder shall ensure that due importance is given to site management as discussed above and a detailed work plan considering the above aspects is finalized immediately after the award. A senior level executive shall be identified who shall be responsible for implementation of the work plan. Suitable format for progress reporting on site management plan shall be developed and made part of the project progress report. The progress on implementation of above work plan shall be reviewed along with project progress in the monthly project review meetings with Employer. In case the progress on site management plan is unsatisfactory, and in the opinion of Employer, bidder's actions on site management aspects is not adequate, Employer may get the relevant work executed through a separate agency

and deduct the expenses incurred from Bidder's bill along with overheads in line with GCC.

p) If Employer decides to retain or withhold any amount from the Contractor, the Employer shall clearly articulate and share with contractor, the reasons and justifications for the retention or withholding of funds. Additionally, specific conditions for releasing the withheld amount shall also be established and communicated at the time of withholding. Upon rectification of the identified issues or deficiencies by the Contractor to the satisfaction of the Employer, the Employer shall promptly release the withheld amount. The release shall be made in accordance with the terms and conditions specified in the contract agreement.

36.06.00 **QUALITY CONTROL ROOM**

Bidder to refer clause no 1.01.00 -G of section IV -Part-A.

36.07.00 Welder Training Center -Contractor shall setup a small welding training center 3 -4 welding booths equiped with GTAW & SMAW setup in a pota cabin/suitable enclosed space to train & hone skill of high pressure welders who are giving high rate of welding defect.

36.08.00 **SMART STORAGE AREA/YARD MONITORING**

Bidder to refer clause no 1.01.00 -F of section IV -Part-A.

37.00.00 FIELD OFFICE RECORDS

The Contractor shall maintain at his Site Office up-to- date copies of all drawings, specifications and other Contract Documents and any other supplementary data complete with all the latest revisions thereto. The Contractor shall also maintain in addition the continuous record of all changes to the above Contract Documents, drawings, specifications, supplementary data, etc. effected at the field and on completion of his total assignment under the Contract shall incorporate all such changes on the drawings and other Engineering data to indicate as installed conditions of the equipment furnished and erected under the Contract. Such drawings and Engineering data shall be submitted to the Employer in required number of copies.

38.00.00 CONTRACTOR'S MATERIALS BROUGHT ON TO SITE

38.01.00 The Contractor shall bring to Site all equipment, components, parts, materials, including construction equipment, tools and tackles for the purpose of the Works under intimation to the Employer. All such goods shall, from the time of their being brought vest in the Employer, but may be used for the purpose of the Works only and shall not on any account be removed or taken away by the Contractor without the written permission of the Employer. The Contractor shall nevertheless be solely liable and responsible for any loss or destruction thereof and damage thereto.

38.02.00 The Employer shall have a lien on such goods for any sum or sums which may at any time be due or owing to him by the Contractor, under, in respect of or by reasons of the Contract. After giving a fifteen (15) days' notice in writing of his intention to do so, the Employer shall be at liberty to sell and dispose of any such goods, in such manner as he shall think fit including public auction or private treaty

and to apply the proceeds in or towards the satisfaction of such sum or sums due as aforesaid.

38.03.00 After the completion of the Works, the Contractor shall remove from the Site under the direction of the Employer the materials such as construction equipment, erection tools and tackles, scaffolding etc. with the written permission of the Employer. If the Contractor fails to remove such materials, within fifteen (15) days of issue of a notice by the Employer to do so then the Employer shall have the liberty to dispose off such materials as detailed under as specified at clause no 38.02.00- of this chapter and credit the proceeds thereto to the account of the Contractor.

39.00.00 PROTECTION OF PROPERTY AND CONTRACTOR'S LIABILITY

39.01.00 The Contractor shall be responsible for any damage resulting from his operations. He shall also be re-sponsible for protection of all persons including members of public and employees of the Employer and the employees of other Contractors and Sub- Contractors and all public and private property including structures, building, other plants and equipments and utilities either above or below the ground.

39.02.00 The Contractor will ensure provision of necessary safety equipment such as barriers, sign - boards, warning lights and alarms, etc. to provide adequate protection to persons and property. The Contractor shall be responsible to give reasonable notice to the Employer and the Employers of public or private property and utili-ties when such property and utilities are likely to get damaged or injured during the performance of his Works and shall make all necessary arrangements with such Employers, related to removal and/or replacement or protection of such property and utilities.

40.00.00 PAINTING

For painting refer Part-A, sub section-III, Section VI of Technical specification.

Painting for structures shall conform to the painting specification specified in Part-B under Civil.

Painting for piping shall conform to the painting specification given in Part-B of the respective chapter.

Painting for Electrical equipments/systems shall conform to the painting specification given in Electrical portion of Part-A and Part-B of technical specifications.

41.00.00 INSURANCE

41.01.00 In addition to the conditions covered under the Clause entitled "Insurance" in Section General Conditions of Contract (GCC), the following provisions will also apply to the portion of works to be done beyond the Contractor's own or his Sub-Contractor's manufacturing Works.

41.02.00 **Workmen's Compensation Insurance**

This insurance shall protect the Contractor against all claims applicable under the Workmen's Compensation Act, 1948 (Government of India). This policy shall also cover the Contractor against claims for injury, disability disease or death of his or his Sub-Contractor's employees, which for any reason are not covered under the Workmen's Compensation Act, 1948. The liabilities shall not be less than the following:

Workmen's Compensation - As per Statutory Provisions

	Employee's Liability	-	As per Statutory Provisions

41.03.00 **Comprehensive Automobile Insurance**

This insurance shall be in such a form to protect the Contractor against all claims for injuries, disability, disease and death to members of public including the Employer's men and damage to the property of other arising from the use of motor vehicles during on or off the Site operations, irrespective of the Ownership of such vehicles. The liability covered shall be as herein indicated:

Fatal Injury	:	Rs.100, 000 each person
	:	Rs.200, 000 each occurrence
Property Damage	:	Rs.100, 000 each occurrence

41.04.00 **Comprehensive General Liability Insurance**

41.04.01 The insurance shall protect the Contractor 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 Contractor, his agents, his employees, his representatives and Sub-Contractors or from riots, strikes and civil commotion. This insurance shall also cover all the liabilities of the Contractor arising out of the Clause entitled "Loss of or Damage to Property; Accident or Injury to workers; Indemnification" in Section General Conditions of Contract (GCC).

41.04.02 The hazards to be covered will pertain to all the Works and areas where the Contractor, his Sub-Contractors, his agents and his employees have to perform work pursuant to the Contract.

41.05.00 The above are only illustrative list of insurance covers normally required and it will be the responsibility of the Contractor 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.

42.00.00 UNFAVOURABLE WORKING CONDITIONS

The Contractor shall confine all his field operations to those works which can be performed without subjecting the equipment and materials to adverse effects during inclement weather conditions, like monsoon, storms, etc. and during other unfavorable construction conditions. No field activities shall be performed by the Contractor under conditions which might adversely affect the quality and efficiency thereof, unless special precautions or measures are taken by the Contractor in a proper and satisfactory manner in the performance of such Works and with the concurrence of the Employer. Such unfavorable construction conditions will in no way relieve the Contractor of his responsibility to perform the Works as per the schedule.

43.00.00 PROTECTION OF MONUMENTS AND REFERENCE POINTS

The Contractor shall ensure that any finds such as relic, antiquity, coins, fossils, etc. which he may come across during the course of performance of his Works either during excavation or elsewhere, are properly protected and handed over to the Employer. Similarly the Contractor shall ensure that the bench marks, reference points, etc., which are marked either with the help of Employer or by the Employer shall not be disturbed in any way during the performance of his Works. If, any work is to be performed which disturb such reference, the same shall be done only after these are transferred to other suitable locations under the direction of the Employer.

The Contractor shall provide all necessary materials and assistance for such relocation of reference points etc.

44.00.00 WORK & SAFETY REGULATIONS

44.01.00 General

i) The contractor shall comply with all the requirements of "The Building and Other Construction Workers (Regulation of Employment & Conditions of Service) Act," 1996 and its Central Rule 1998 / State Rules and any other statutory requirements as applicable.

ii) The Contractor shall follow NTPC Safety Rules as specified in GCC with respect to safety in construction & erection.

iii) The contractor shall have the approved Safety, Health and Environment (SHE) Policy in respect of Safety and health of Building Workers and it shall be circulated widely and displayed at conspicuous place in Hindi and local language understood by the majority of the workers. A copy of the safety policy should be submitted to Engineer in charge.

iv) Thecontractor shall submit the safety plan comprising of methods to implement the Safety Policy/ Rules, Risk assessment and ensuring Safety at work areas, Safety audits, inspections and its compliance, Supervision and responsibility to ensure Safety at various levels, Safety training to employees and workers, review of Safety and accident analysis, ensure Health and Safety Procedures to prevent accidents for approval as per the format of Safety plan as annexed at Annexure - III.

Bidder shall furnish the Safety Plan, duly filled in as per EMPLOYER's Format.

The above proposed "Safety Plan" shall be further discussed/ finalized at Site, in line with the NTPC safety rules, and shall be approved by Project Manager/ Head of Project before start of work at Site.

v) The Contractors shall ensure proper safety of all the workmen, materials, plant and equipment belonging to him or to the Employer or to others, working at the Site.

vi) All equipments used in construction and erection by the contractor shall meet BIS / International Standards and where such standards do not exist, the Contractor shall ensure these to be absolutely safe. All equipments shall be strictly operated and maintained by the contractor in accordance with manufacturer's operation manual. The contractor should also follow Guidelines / Rules of the Employer in this regard.

vii) The Contractors shall provide suitable latest Personal Protective Equipments of prescribed standard to all their employees and workmen according to the need. The Engineer I/c shall have the right to examine these safety equipments to determine their suitability, reliability, acceptability and adaptability. The contractor should also ensure these before their use at worksite.

viii) The Contractor shall provide safe working conditions to all workmen and employees at his workplace including safe means of access, railings, stairs, and ladders, scaffolding, work platforms, toe boards etc. The scaffoldings

shall be erected under the control and supervision of an experienced and competent person. For erection of scaffolds, access, work platforms etc. shall be good and the contractor shall use standard quality of material.

ix) The Contractor shall follow and comply with all the Safety Rules, standards, code of practices of NTPC and relevant provisions of applicable laws pertaining to the safety of workmen, employees, plant and equipment as may be prescribed from time to time without any protest or contest or reservation. In case of any unconformity between statutory requirement and the Safety Rules of the Employer referred above, the latter shall be binding on the Contractor unless the statutory provisions are more stringent. As and when required he can refer / obtain copy of NTPC safety documents as stated above.

x) The contractor shall have his own arrangements with nearby hospitals for shifting and treatment of sick and injured.

The medical examination of the workers employed in hazardous areas shall be conducted as per Rule 223 0f The Building and Other Construction Worker (Regulation of Employment and Condition of Service) Central Rule 1998 Their health records shall be maintained accordingly and to be submitted to Engineer I/c when asked for. If any worker found suffering from occupational health hazard, the worker should be shifted to suitable place of working and properly treated under intimation to Engineer I/c. The medical fitness certificate to be submitted to Engineer (I/c).

xi) First Aid boxes equipped with requisite articles as specified in the Rule 231 of The Building and Other Construction Worker (Regulation of Employment and Condition of Service) Central Rule 1998 shall be provided at construction sites for the use of workers. Training has to be provided on first aid to workmen & office bearers working at site.

44.01.01 **Emergency Action Plan**

The contractor shall prepare an emergency action plan approved by his competent authority to handle any emergency occurred during construction work. Regular mock drills shall be organized to practice this emergency plan. The Emergency Action Plan should be widely circulated to all the employees and suitable infrastructure shall be provided to handle the emergencies.

44.01.02 **Scaffolding**

The contractor shall take all precautions to prevent any accidental collapse of scaffolding or fall of persons from scaffolding. The contractor should ensure that scaffolding are designed by a competent person and it erection and repairs should be done under the expert supervision. The scaffolding shall meet the required strength and other requirements for the purpose for which the scaffold is erected. The material used for scaffold should conform to the BIS / International standards.

44.01.03 **Opening**

The contractor shall ensure that there is no opening in any working platform/any floor of the building, which may cause fall of workers or material. Whenever an opening on a platform/any floor of the building is unavoidable, the opening should be suitably fenced and necessary measures for protection against falling objects or building workers from such platform are taken by providing suitable safety nets, safety belts or other similar means.

44.01.04 **Explosives**

The contractor shall take all precautions while handling, using, storing or transporting of all explosives. Before usage of any explosive necessary warning / danger signals be erected at conspicuous places to warn the workers and general public. The contractor should strictly ensure that all measures and precautions required to be complied for use, handling, storing or transportation of explosives under the rules framed under the Explosives Act, 1884.

44.02.00 **Fencing of Machinery**

The contractor shall provide suitable fencing or guard to all dangerous and moving parts of machinery.

The contractor shall not allow any of the employees to clean, lubricate, repair, adjust or examine during machinery in motion, which may cause injury to the person.

44.03.00 **Carrying of Excessive Weight by a Worker**

The worker shall not be allowed to lift by hand or carry over his head, back or shoulder more than the maximum limit set by the prescribed rules for the construction Workers.

44.04.00 **Dangerous and Harmful Gases / Equipment**

The contractor shall ensure that the workers are not exposed to any harmful gases during any construction activity including excavation, tunneling, confined spaces etc.

The contractor should not allow any worker to go into the confined space unless it is certified by Engineer (I/c) to be safe and fit for the entry to such work place. Proper record and work permits should be followed to carry out such works.

44.05.00 **Overhead Protection**

The contractor shall ensure that any area exposed to risk of falling materials, articles or objects is roped off or cordoned off or otherwise suitably guarded from inadvertent entry of any person.

Wherever there is a possibility of falling of any material, equipment or construction workers while working at heights, a suitable and adequate safety net should be provided. The safety net should be in accordance with BIS Standards.

44.06.00 **Working at Heights**

All working platforms, ways and other places of construction work shall be free from accumulations of debris or any other material causing obstructions and tripping.

Wherever workers are exposed to the hazard of falling into water, the contractor shall provide adequate equipment for saving the employees from drowning and rescuing from such hazards. The contractor shall provide boat or launch equipped with sufficient number of life buoys, life jackets etc. manned with trained personnel at the site of such work.

Every opening at elevation from ground level through which a building worker, vehicle, material equipment etc. may fall at a construction work shall be covered and/or guarded suitably by the contractor to prevent such falls.

Wherever the workers are exposed to the hazards of falling from height, the contractor shall provide full harness safety belts fitted with fall arresting systems to all the employees working at higher elevations and life line of 8 mm diameter wire

rope with turn buckles for anchoring the safety belts while working or moving at higher elevations. Safety nets shall also be provided for saving them from fall from heights and such equipment should be in accordance with BIS standards. Wherever there is a possibility of falling of any material, equipment or construction workers while working at heights, a suitable and adequate safety net should be provided. The safety net should be in accordance with BIS Standards.

The contractor shall provide standard prefabricated ladders on the columns where the workers are required to use them as an access for higher elevations till permanent staircase is provided. The workers shall be provided with safety belts fitted with suitable fall arresting system (fall arrestors) for climbing/getting down through ladders to prevent fall from height.

44.07.00 **Handling of Hazardous Chemicals**

The Contractor will notify well in advance to the Engineer I/c of his intention to bring to the Site any container filled with liquid or gaseous fuel or explosive or petroleum substance or such chemicals which may involve hazards. NTPC shall have the right to prescribe the conditions, under which such container is to be stored, handled and used during the performance of the works and the Contract shall strictly adhere to and comply with such instructions. The Engineer I/c shall have the right at his sole discretion to inspect any such container or such construction plant / equipment for which material in the container is required to be used and if in his opinion, its use is not safe, he may forbid its use. No claim due to such prohibition shall be entertained by NTPC and NTPC shall not entertain any claim of the Contractor towards additional safety provisions / conditions to be provided for / constructed.

Further, any such decision of the Engineer I/c shall not, in any way, absolve the Contractor of his responsibilities and in case, use of such a container or entry thereof into the Site area is forbidden by NTPC, the Contractor shall use alternative methods with the approval of the NTPC without any cost implication to the NTPC or extension of work schedule.

Where it is necessary to provide and / or store petroleum products or petroleum mixtures and explosives, the Contractor shall be responsible for carrying-out such provision and / or storage in accordance with the rules and regulations laid down in Petroleum Act 1934, Explosives Act 1948, and Petroleum and Carbide of Calcium Manual published by the Chief Inspector of Explosives of India. All such storage shall have prior approval of the Engineer I/c. In case any approvals are necessary from the Chief Inspector (Explosives) or any statutory authorities, the Contractor shall be responsible for obtaining the same.

The Contractor shall be fully responsible for the safe storage of his and his Sub-contractor's radio-active sources in accordance with BARC/DAE (Bhabha Atomic Research Centre/ Department of Atomic Energy, Govt. of India) Rules and other applicable provisions. All precautionary measures stipulated by BARC/DAE in connection with use, the contractor would take storage and handling of such material.

The contractor shall provide suitable personal protective equipments to the workers who are handling the hazardous and corrosive substances including alkalis and acids.

As a precautionary measure the contractor should keep the bottles filled with distilled water in cupboard / Boxes near work place for emergency eye wash by worker exposed to such hazardous chemicals.

44.08.00 **Eye Protection**

The contractor shall provide suitable personal protective equipment to his workmen depending upon the nature of hazards and ensure their usage by the workers engaged in operations like welding, cutting, chipping, grinding or similar operations which may cause injuries to his eyes.

44.09.00 **Excavation**

The contractor shall take all necessary measures during excavation to prevent the hazards of falling or sliding material or article from any bank or side of such excavation which is more than one and a half meter above his footing by providing adequate piling, shoring, bracing etc. against such bank or sides.

Adequate and suitable warning signs shall be put up at conspicuous places at the excavation work to prevent any persons or vehicles falling into the excavation trench. No worker should be allowed to work where he may be stuck or endangered by excavation machinery or collapse of excavations or trenches.

44.10.00 **Electrical Hazards**

The contractor should ensure that all electrical installations at the construction work comply with the requirements of latest electricity acts / rules.

The contractor shall take all adequate measures to prevent any worker from coming into physical contact with any electrical equipment or apparatus, machines or live electrical circuits which may cause electrical hazards during the construction work. The contractor shall provide the sufficient ELCBs / RCCBs for all the portable equipments, electrical switchboards, distribution panels etc. to prevent electrical shocks.

The contractor should ensure use of single / double insulated hand tools or low voltage i.e., 110 volts hand tools.

The contractor should also ensure that all temporary electrical installations at the

construction works are provided with earth leakage circuit breakers.

44.11.00 **Vehicular Traffic**

The contractor should employ vehicle drivers who hold a valid driving license under the Motor Vehicles Act, 1988.

44.12.00 **Lifting Appliances, Tools & Tackles, Lifting Gear And Pressure Plant & Equipment etc.**

The contractor shall ensure all the lifting appliances, tools & tackles including cranes etc., lifting gear including fixed or movable and any plant or gear, hoists, Pressure Plant and equipment etc. are in good condition and shall be examined by competent person and only certified shall be used at sites. Periodical Examination and the tests for all lifting / hoisting equipment & tackles shall be carried out. A register of such examinations and tests shall be properly maintained by the Contractor and will be promptly produced as and when desired by the Engineer I/c or by the person authorized by him.

44.13.00 **Excessive Noise, Vibration**

The contractor shall take adequate measures to protect the workers against the harmful effect of excessive noise or vibration. The ambient noise should not exceed the limits prescribed under the concerned rules, Noise Pollution (Regulation and

Control) Rules, 2000. Generally for brownfield projects background noise is in the range of 58-60 DB, however it shall be responsibility of contractor to collect and measure the latest noise data at site.

44.14.00 **Electrical Installations**

44.14.01 The Contractor shall not interfere or disturb electric fuses, wiring and other electrical equipment belonging to the Employer or other contractors under any circumstances, whatsoever, unless expressly permitted in writing by the Engineer I/c to handle such fuses, wiring or electrical equipment.

Before the Contractor connects any electrical appliances to any plug or socket belonging to the other contractor or the NTPC, he shall

i) Satisfy the Engineer I/C that the appliance is in good working condition;

ii) Inform the Engineer I/C of the maximum current rating, voltage and phases of the appliances;

iii) Obtain permission of the Engineer I/C detailing the sockets to which the appliances may be connected.

The Engineer I/C will not grant permission to connect until he is satisfied that:

The appliance is in good condition and is fitted with suitable plug; having earth connection with the body.

Wherever armored / metallic sheathed multi core cable is used, the same armored / sheathed should be connected to earth.

iv) No repair work shall be carried out on any live equipment. The Engineer I/c must declare the equipment safe and a permit to work shall be issued by the NTPC / contractor as the case may be to carry out any repair / maintenance work. While working on electric lines / equipments whether live or dead, suitable type and sufficient quantity of tools will have to be provided by the contractor to electricians / workmen / Officers.

v) The contractor shall employ necessary number of qualified, full time Electricians / Electrical Supervisors to maintain his temporary electrical installation. The installations are provided with suitable ELCBs and RCCBs wherever required.

44.15.00 **Safety Organisation**

44.15.01 The contractor shall employ full time safety officer(s) as per requirement stipulated in NTPC Safety Rules, exclusively to supervise safety aspects of the equipments and workmen, who will coordinate with the NTPC Safety Officer. Further requirement of safety officers, if any, shall be guided by Rule 209 of The Building and Other Construction Worker (Regulation of Employment and Conditions of Service) Central Rule 1998. In case the work is being carried out through subcontractor, the employees / workmen of the sub-contractor shall also be considered as the contractor's employees/workmen for the above purpose.

44.15.02 The name and address of such Safety Officer of the Contractor will be promptly informed in writing to the EIC with a copy to the Project Safety Officer before he starts work or immediately after any change of the incumbent is made during currency of the Contract.

44.16.00 **Reporting of Accident and Investigation**

In case any accident occurs during the construction / erection or other associated activities undertaken by the Contractor thereby causing any near miss, minor or major or fatal injury to his employees due to any reason, whatsoever, it shall be the responsibility of the Contractor to promptly inform the same to the Engineer I/C, NTPC Safety Officer with a copy to NTPC Head of Project in the prescribed form and also to all the authorities envisaged under the applicable laws.

44.17.00 **Right to stop Work**

44.17.01 The Engineer I/C shall have the right at his sole discretion to stop the work, if in his opinion the work is being carried out in such a way that it may cause accidents and endanger the safety of the persons and / or property, and / or equipments. In such cases, the contractor shall be informed in writing about the nature of hazards and possible injury / accident and he shall comply to remove shortcomings promptly. The Contractor after stopping the specific work can, if felt necessary appeal against the order of stoppage of work to the Project Manager within 3 days of such stoppage of work and decision of the Project Manager in this respect shall be conclusive and binding on the Contractor.

44.17.02 The Contractor shall not be entitled for any damages / compensation for stoppage of work, {Sub-Clause XVIII (I)} due to safety reasons and the period of such stoppage of work shall not be taken as an extension of time for Completion of the Facilities and will not be the ground for waiver of levy of liquidated damages.

44.18.00 **Fire Protection**

The contractor shall provide sufficient fire extinguishers at place /s of work. The fire

extinguishers shall be properly maintained as per relevant BIS Standards. The employees shall be trained to operate the fire extinguishers / equipment.

44.19.00 **Penalties**

I If any contractor worker found working without using the safety equipment like safety helmet, safety shoes, safety belts, etc. or without anchoring the safety belts while working at height the Engineer I/c shall have the right to regulate the payment in accordance with provisions of GCC. Further such defaulting worker shall be sent out of the workplace immediately and shall not be allowed to work on that day. Engineer I/c / Safety Officer of NTPC will also issue a notice in this regard to the contractor.

II If two or more fatal accidents occur at same NTPC site under the control of contractor during the period of contract and he has

(1) not complied with keeping adequate PPEs in stock or

(2) defaulted in providing PPEs to his workmen

(3) not followed statutory requirements / NTPC safety rules

(4) been issued warning notice/s by NTPC head of the project on nonobservance of safety norms

(5) not provided safety training to all his workmen, the contractor can be debarred from getting tender documents in NTPC for two years from the date of last accident.

The contractor shall submit the accident data including fatal / non-fatal accidents for the last 3 years where he has undertaken the construction activities Projects-wise

	along with the tender documents. If the information given by the contractor found incorrect, his contract will be liable to be terminated.
44.20.00	The Contractor will make available minimum quantity of all safety equipments and safety PPEs of required specifications as per suggestive list included bidding documents as a part of "List of minimum T & P". Further Contractor will ensure availabilitty of additional requirement for individual worker and safety equipment as per site requirement during execution of the contract till its completion.
44.21.00	The Contractor shall abide by the following during Construction and Erection activities: I. Chain pulley block shall not be used for loads more than 2 (Two) tonne. II. Hydra shall not be used for material transport. III. Cage shall necessarily be provided to Monkey ladders of height more than 4 m. IV. Fencing shall be provided to all Electrical Distribution boards and transformers etc.
44.22.00	Contractor shall ensure following regarding implementation of Safety:
a)	Two Tier Safety Monitoring System: **Separate Safety Consultancy contract** shall be awarded by NTPC for assisting and guiding overall Plant Safety during Construction. The safety consultant shall induct and engage manpower required as per specific requirements of project. **For Construction safety**, Contractor shall engage certified safety team in consultation with NTPC Safety team /safety Consultant for each package/area.
b)	Risk level of different area of plant shall be evaluated by NTPC Safety & Safety consultant. Based on the severity of risk level, total project area shall be categorized into different safety zones and each zone will be identified with different color coding.
c)	Dedicated Project Safety Manager of Safety Consultant will be deployed. Contractor to deploy area/ system wise safety representative for each system/ area of project e.g. SG area, TG Main Power House area and similarly in other BOP Systems.
d)	The Safety Officer can stop work of any contractor if safety rules are violated.
e)	There should also be safety clearance in Quarterly RA bills in addition to the clearances being presently taken from HR and Quality dept.
f)	PPEs, scaffoldings, safety nets, testing tools etc. should be monitored by NTPC Safety Manager to control and maintain the uniformity of Quality for Safety equipment/ PPEs.
g)	There should be 24/7 Safety Control room equipped with IP Camera, AI Input alarms and proper communication system for monitoring safety. All CCTV

	footage shall be available to control room. Drone based safety monitoring shall be done during day. The safety control room shall be operated & managed by NTPC through safety consultant.
h)	Safety management plan for the Project must be submitted for approval before start of work.
i)	In line with the Project Planning, Safety planning will be done jointly by Project Team and Consultants.
j)	Availability of Fire Tender shall be ensured by contractor before start of construction work.
k)	**Number of Safety Stewards**: Each area (e.g. SG, TG, etc.) should have minimum 5 safety Stewards from Main Agency and 5 from the sub agency.
l)	Contractor should provide scaffolding material, pipes, clamps, boards and scaffolding of standard quality.
m)	Uses of Safety net, Fire blankets and fall arrester shall be adequate.
n)	Construction Elevators shall be used during erection phase.
o)	Material transport through Hydra shall be avoided.
p)	Good Quality and new PPEs and tools and machinery shall be used.
q)	All Agency /Sub Agency will deploy Safety manpower after getting approval from Head of safety Consultant.
r)	Contractor Safety officer shall take approval of JSA /HIRA of each area from Safety consultant. Before Start of work in a particular area, concerned Safety consultant clearance is must.
s)	Inspect the site to ensure it is a hazard-free environment & promotes safe practices at the job site.
t)	Verifies that injury logs and reports are completed and submitted to NTPC.
u)	Receives reports from and responds to orders issued by NTPC and Labor inspectors.
v)	Serve as primary contact for project site incident and injury notification, investigation, and follow-up.
w)	Organize and maintain necessary project safety documentation.
x)	Training Setup to be created for giving basic education of Safety to workers.
y)	Safety Park and work simulation facility to be created at site.
z)	Health Check Up facility of workers.
aa)	Vendor Safety circle (with max 25 nos person) and monthly safety award to be created.
bb)	24/7 first aid center (common for all agency) and expenditure on contribution basis which is decided by NTPC safety department.
45.00.00	**FOREIGN PERSONNEL**
45.01.00	The Contractor shall submit to the Employer data on all personnel he proposes to bring into India from abroad for the performance of the Works under the Contract, at least sixty (60) days prior to their departure to India. Such data will include for each

	person the name, his present address, his assignment and responsibility in connection with the works, and a short resume of his qualification, experience etc. in relation to the work to be performed by him.
45.02.00	Any person unsuitable and unacceptable to the Employer shall not be brought to India. Any person brought to India, if found unsuitable or unacceptable by the Employer, the Contractor shall within a reasonable time make alternate arrangements for providing a suitable replacement and repatriation of such unsuitable personnel.
45.03.00	No person brought to India for the purposes of the works shall be repatriated without the consent of the Employer in writing, based on a written request from the Contractor for such repatriation giving reasons for such an action to the Employer. The Employer may give permission for such repatriation provided he is satisfied that the progress of work will not suffer due to such repatriation.
45.04.00	The cost of passports, visas and all other travel expenses to and from India, incurred by the Contractor shall be to his account. The Employer will not provide any residential accommodation and/or furniture for any of the Contractor's personnel including foreign personnel and Contractor shall make his own arrangements for such facilities in the area allotted at Site, to him by the Employer for that purpose.
45.05.00	The Contractor and his expatriate personnel shall respect all Indian Acts, Laws, rules and regulations and shall not in any way interfere with Indian political and religious affairs and shall conform to any other rules and regulations which the Government of India and the Employer may establish from time to time, on them. The Contractor's expatriate personnel shall work and live in close co-operation and coordination with their co-workers and the community and shall not engage themselves in any other employment neither part-time nor full-time nor shall they take part in any local politics.
45.06.00	The Employer shall assist the Contractor, to the extent possible, in obtaining necessary permits to travel to India and back, by issue of necessary certificates and other information needed by the Government agencies.
46.00.00	**FOUNDATION DRESSING & GROUTING FOR EQUIPMENT/ EQUIPMENT BASES**
46.01.00	The surfaces of foundations shall be dressed to bring the top surface of the foundations to the required level, prior to placement of equipment/equipment bases on the foundations.
46.02.00	All the equipment/ equipment bases, shall be grouted and finished by bidder as per these specifications unless otherwise recommended by the equipment manufacturer.
46.03.00	The concrete foundation surfaces shall be properly prepared by bidder by chipping, grinding as required to bring the top of such foundation to the required level, to provide the necessary roughness for bondage and to assure enough bearing strength.
46.04.00	**Grout** The grout for equipment foundation shall be high strength grout having a minimum characteristic compressive strength of 60 N/mm2 at 28 days. The grout shall be ready mix non-shrink, chloride - free, cement based, free flowing, non-metallic grout

as recommended by equipment manufacturer. The ready mix grout shall be of reputed make as approved by the Employer.

The Grout shall have good flowability even at very low water/ grout powder ratio.

The Grout shall have characteristics of controlled expansion to be able to occupy its original volume to fill the voids and to compensate for shrinkage. Grout shall be of pre-mix variety so that only water needs to be added before use.

The mixing of the Grout shall conform to the recommendations of the manufacturer of the Grout.

46.05.00 **Placing of Grout**

46.05.01 After the base has been prepared, its alignment and level has been checked and approved and before actually placing the grout, a low dam shall be set around the base at a distance that will permit pouring and manipulation of the grout. The height of such dam shall be at least 25mm above the bottom of the base. Suitable size and number of chains shall be introduced under the base before placing the grout, so that such chains can be moved back & forth to push the grout into every part of the space under the base.

46.05.02 The grout shall be poured either through grout holes if provided or shall be poured at one side or at two adjacent sides to make the grout move in a solid mass under the base and out in the opposite side. Pouring shall be continued until the entire space below the base is thoroughly filled and the grout stands at least 25 mm higher all around than the bottom of the base. Enough care should be taken to avoid any air or water pockets beneath the bases.

46.05.03 In addition to the above, recommendations of Grout manufacturer shall also be followed.

46.06.00 **Finishing of the Edges of the Grout**

The poured grout should be allowed to stand undisturbed until it is well set. Immediately thereafter, the dam shall be removed and grout which extends beyond the edges of the structural or equipment base plates shall be cut off, flushed and removed. The edges of the grout shall then be pointed and finished with 1:2 cement mortar pressed firmly to bond with the body of the grout and smoothened with a tool to present a smooth vertical surface. The work shall be done in a clean and scientific manner and the adjacent floor spaces, exposed edges of the foundations, and structural steel and equipment base plates shall be thoroughly cleaned of any spillage of the grout.

46.07.00 **Checking of Equipment After Grouting**

After the grout is set and cured, the Contractor shall check and verify the alignment of equipments, 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 such 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 Employer.

47.00.00 SHAFT ALIGNMENTS

All the shafts of rotating equipment shall be properly aligned to those of the matching equipments to as perfect an accuracy as practicable. The equipment shall be free from excessive vibration so as to avoid overheating of bearings or other conditions which may tend to shorten the life of the equipment. The vibration level of rotating equipments measured at bearing housing shall conform to Zone A of ISO 10816. All bearings, shafts and other rotating parts shall be thoroughly cleaned and suitably lubricated before starting.

48.00.00 DOWELLING

All the motors and other equipment shall be suitably doweled after alignment of shafts with tapered machined dowels as per the direction of the Employer.

49.00.00 CHECK OUT OF CONTROL SYSTEMS

After completion of wiring, cabling furnished under separate specification and laid and terminated by the Employer, the Contractor shall check out the operation of all control systems for the equipment furnished and installed under these specifications and documents.

50.00.00 COMMISSIONING SPARES

50.01.00 It will be the responsibility of the Contractor to provide all commissioning spares including consumable spares required for initial operation till the Completion of Facilities. The Contractor shall furnish a list of all commissioning spares within 60 days from the date of Notification of Award and such list shall be reviewed by the Employer and mutually agreed to. However. such review and agreement will not absolve the Contractor of his responsibilities to supply all commissioning spares so that initial operation do not suffer for want of commissioning spares. All commissioning spares shall be deemed to be included in the scope of the Contract at no extra cost to the Employer.

50.02.00 These spares will be received and stored by the Contractor atleast 3 months prior to the schedule date of commencement of initial operation of the respective equipment and utilised as and when required. The unutilised spares and replaced parts, if any, at the end of successful completion of guarantee tests shall be the property of the Contractor and he will be allowed to take these parts back at his own cost with the permission of Employer.

51.00.00 CABLING

51.01.00 All cables shall be supported by conduits or cable tray run in air or in cable channels. These shall be installed in exposed runs parallel or perpendicular to dominant surfaces with right angle turn made of symmetrical bends or fittings. When cables are run on cable trays, they shall be clamped at a minimum intervals of 2000mm or otherwise as directed by the Employer.

51.02.00 Each cable, whether power or control, shall be provided with a metallic or plastic tag of an approved type, bearing a cable reference number indicated in the cable and conduit list (prepared by the Contractor), at every 5 meter run or part thereof and at both ends of the cable adjacent to the terminations. Cable routing is to be done in such a way that cables are accessible for any maintenance and for easy identification.

51.03.00 Sharp bending and kinking of cables shall be avoided. The minimum radii for PVC insulted cables 1100 V grade shall be 15 D where D is the overall diameter of the cable. Installation of other cables like high voltage, coaxial, screened,

compensating, mineral insulated shall be in accordance with the cable manufacturer's recommendations. Wherever cables cross roads and water, oil, sewage or gaslines, special care should be taken for the protection of the cables in designing the cable channels.

51.04.00 In each cable run some extra length shall be kept at a suitable point to enable one or two straight through joints to be made, should the cable develop fault at a later date.

51.05.00 Control cable terminations shall be made in accordance with wiring diagrams, using identifying codes subject to the Employer's approval. Multicore control cable jackets shall be removed as required to train and terminate the conductors. The cable jacket shall be left on the cable, as far as possible, to the point of the first conductor branch. The insulated conductors from which the jacket is removed shall be neatly twined in bundles and terminated. The bundles shall be firmly but not tightly tied utilising plastic or nylon ties or specifically treated fungus protected cord made for this purpose. Control cable conductor insulation shall be securely and evenly cut.

51.06.00 The connectors for control cables shall be covered with a transparent insulating sleeve so as to prevent accidental contact with ground or adjacent terminals and shall preferably terminate in Elmex terminals and washers. The insulating sleeve shall be fire resistant and shall be long enough to over pass the conductor insulation. All control cables shall be fanned out and connection made to terminal blocks and test equipment for proper operation before cables are corded together.

52.00.00 EQUIPMENT DELIVERY AND ERECTION

52.01.00 General Requirements

(a.) This part covers Contractor's responsibilities for packing, shipping, ware-housing and the installation of all equipment and materials furnished and installed under this specification.

(b.) The Contractor shall submit for Employer's approval draft manual for Equipment Delivery and Erection (EDE Manual) covering detailed instructions, write up, technical data, drawings, check-lists, documentation formats for all activities after equipment manufacture upto installation of equipment. This manual shall cover general instructions for all equipment and specific instructions for individual equipment wherever required and shall include at least the following:

(1.) Instructions for packing, shipping, receiving handling, ware-housing and storage.

(2.) Instructions for location and installation of equipment furnished by this specification.

(3.) Installation drawings for field mounted equipment, panels, cubicles and other equipment covered under this specification.

(4.) Instruction relating installation of piping/ tubing, support and routing drawings of impulse pipes/signal tubes and tube/cable trays.

(5.) Check lists and quality assurance hold points.

(6.) Format for all related documentation.

(c.) The EDE Manual shall conform to the requirements of this specification, all applicable codes and standards, recommendations of equipment

manufacturers and accepted good engineering practices and shall be subject to Employer approval during detailed engineering.

(d.) The Contractor shall ensure that all work under this part shall be performed as per the requirements of this specification, Employer approved EDE Manual and drawing/documents approved by the Employer during detailed engg.

52.02.00 **Crating**

(a.) All equipment and materials shall be suitably coated, wrapped, or covered and boxed or crated for moist humid tropical shipment and to prevent damage or deterioration during handling and storage at the site.

(b.) Equipment shall be packed with suitable desiccants, sealed in water proof vapour-proof wrapping and packed in lumber of plywood enclosures, suitably braced, tied and skidded. Lumber enclosures shall be solid, not slatted.

(c.) Desiccants shall be either silica gel or calcium sulphate, sufficiently ground to provide the required surface area and activated prior to placing in the packaging. Calcium sulphate desiccants shall be of a chemical nature to absorb moisture. In any case, the desiccant shall not be of a type that will absorb enough moisture to go into solution. Desiccants shall be packed in porous containers, strong enough to withstand handling encountered during normal shipment. Enough desiccant shall be used for the volumes enclosed in wrapping.

(d.) Review by the Employer of the Contractor's proposed packaging methods shall not relieve the Contractor of responsibility for damage or deterioration to the equipment and materials specified.

(e.) All accessory items shall be shipped with the equipment. ; Boxes and crates containing accessory items shall be marked so that they are identified with the main equipment. The contents of each box and crates shall be indicated by markings on the exterior.

(f.) All boxes, crates, cases bundles, loose pieces, etc. shall be marked consecutively from No.1 upward throughout all shipments from a given port to completion of the order without repeating the same number.

(g.) An itemized list of contents shall be enclosed inside each case and one other copy securely fastened to the outside of the case in a tin or light weight sheet metal envelope or pocket. The lists shall be plainly marked and placed in accessible locations to facilitate receipt and inspection. The packing list shall indicate whether shipment is partial or complete and shall incorporate the following information on each container, etc., according to its individual shipping number:

a) Export case markings
b) Case number
c) Gross weight and net weight in Kilograms
d) Dimensions in centimeters
e) Complete description of material

(h.) Packaging or shipping units shall be designed within the limitations of unloading facilities and the equipment which will be used for transport. Complications involved with ocean shipment and the limitations of ports, railways and roads shall be considered. It shall be the Contractor's

responsibility to investigate these limitations and to provide suitable packaging to permit safe handling during transit and at the job site.

(i.) Electrical equipment, control and instrumentation shall be protected against moisture and water damage. All external gasket surfaces and flange faces, couplings, motor pump shafts, bearing and like items shall be thoroughly cleaned and coated with rust preventive compound as specified above and protected with suitable wood, metal or other substantial type covering to ensure their full protection.

(j.) Equipment having antifriction or sleeve bearings shall be protected by weather tight enclosures.

(k.) Coated surfaces shall be protected against impact, abrasion, discolouration and other damage. Surfaces which are damaged shall be repaired.

(l.) All exposed threaded parts shall be greased and protected with metallic or other substantial type protectors. All female threaded openings shall be closed with forged steel plugs. All pipings, tubing, and conduit equipment and other equipment openings shall be sealed with metallic or other rough usage covers and tapped to seal the interior of the equipment piping, tubing, or conduit.

(m.) Provisions shall be made to ensure that water does not enter any equipment during shipment or in storage at the plant site.

(n.) Returnable containers and special shipping devices shall be returned by the manufacturer's field representative at the Contractor's expense.

(o.) While packaging the material, care shall be taken for the limitation from the point of view of availability of railway wagon sizes in India.

52.03.00 **Factory Assembly**

(a.) Instrument enclosures shall be supplied and erected completely in the factory with instrument, air supply and blow down piping with necessary valves, fittings, etc. and also all electrical wiring between the instruments and the enclosure terminal blocks. Control panel and cubicles shall also be fully wired in the factory. Control panel mounted equipments are to be dismounted from the panels before shipment and individually packed for shipment. Electronic control modules of the plug-in type are to be removed from equipment racks after factory checkout are individually packed for shipment. Other equipment shall be fully assembled at the factory, except for necessary shipping splits in panels.

(b.) All separately packaged accessories items and parts shall be shipped with the equipment. Containers for separately packaged items shall be marked so that they are identified with the main equipment. An itemized packing slip, indicating what is in that carton only, shall be attached to the outside and inside of each container used for packing.

A master packing slip covering all accessories items for a given piece of equipment which are shipped in separate containers, shall be attached to one container.

52.04.00 **Equipment Installation**

(a.) **General Requirements**

(1.) The Contractor shall furnish all construction materials, tools and equipment and shall perform all work required for complete installation of all equipments furnished under this specification.

(2.) Contractor shall prepare detailed installation drawings for each equipment furnished under this specification for Employer's approval. Installation of all equipment/systems furnished by this specification shall be as per Employer's approval.

(3.) Erection procedures not specified herein shall be in accordance with the recommendations of the equipment manufacturers. The procedures shall be acceptable to the Employer.

(4.) The Contractor shall coordinate his work with other suppliers where their instruments and devices are to be installed under specifications.

(b.) **Installation Materials**

All materials required for installation, testing and commissioning of the equipment shall be furnished by the Contractor.

(c.) **Regulatory Requirements**

All installation procedures shall confirm with the accepted good engineering practice and with all applicable governmental laws, regulations and codes.

(d.) **Cleaning**

All equipment shall be cleaned of all sand, dirt and other foreign materials immediately after removal from storage and before the equipment is brought inside the power plant building or to other installation sites. All piping and tubes shall be air blown.

(e.) **Equipment Assembly**

Equipment installed under these specifications shall be assembled if shipped unassembled. The equipment shall be dismantled and reassembled as required to perform the installation and commissioning work described in these specifications.

(f.) **Equipment Setting**

Field mounted instruments and accessories shall be bracket or sub panel mounted on the nearest suitable firm steel work or masonry. The brackets, stands, supports and other miscellaneous hardware required for mounting instruments and accessories such as receiver gauge, air set, valve manifold, purge-meter etc. shall be furnished and installed. No field mounted instruments shall be installed such that it depends for support or rigidity on the impulse piping or on electrical connection to it.

Indicating type field mounted instruments shall be installed in such a way that centre of indicating dial shall be about 1600-1800mm from operating floor level. Non-indicating type field instruments shall be installed such that operating handle of manifold block / isolating cock comes within 1600 mm from operating floor level.

(g.) **Free-Standing Equipment**

Free-standing Cabinets shall be attached to the floor, concrete equipment bases or supporting steel as indicated on the manufacturer's drawings and the Employer's Plant Arrangement Drawings. The cabinets shall be shimmed for proper alignment before bolting them to the floor. Adjacent enclosures shall be shimmed to maintain mutually level appearance before they are attached to floor. Vibration dampening mounts shall be installed between supporting structures and panels when specified.

(h.) **Non-free Standing Equipment**

(1.) Non-free standing local enclosures and cabinets shall be mounted in accessible locations on columns, walls, or stands in locations as indicated on the Employer's Plant Arrangement Drawings. Bracket and stands shall be fabricated as required to install the local enclosures and cabinets in a workman like manner.

(2.) Rough edges and welds on all fabricated supports shall be ground smooth. The supports shall be finished with two coats of primer and two coats of paint as specified in this part.

(i.) **Equipment Location**

(1.) All individual items of equipment not located in cabinets or on panels and racks are located approximately according to the floor elevation and the nearest building column designated by the Employer.

(2.) Solenoid valves not located in enclosures or mounted on valves shall be mounted in easily accessible protected locations near the components with which they are associated.

(3.) All brackets, stands, supports and other miscellaneous hardware required for mounting devices shall be furnished and installed.

(4.) Thermometers shall be installed in the process lines and ducts as required and adjusted for ease in reading.

(5.) Permanent temperature wells on the main steam, hot reheat and cold reheat piping shall not be installed until steam blowing has been completed. Temporary temperature wells shall be installed in the main and reheat steam piping during steam blow and discarded after completion.

(6.) Any required adapting hardware such as pipe bushings, nipples, drilled caps and the like shall be provided for complete installation of control devices into process connections.

For location of C&I related equipment/devices, the requirement specified elsewhere in the technical specification may be referred.

(j.) **Installation of Field Mounted Instruments and Devices**

The Contractor shall submit installation drawings for all field mounted equipment furnished under this specification for Employer's approval. These drawings shall meet the requirements of this specification, installation drawings, applicable codes and standards and recommendations of manufacturers of instruments/devices. All installation work under this specification shall be strictly as per installation drawings approved by the Employer during detailed engineering stage.

In addition to above relevant Portion as specified elsewhere in technical specification may be referred.

(k.) **Piping Connections**

(1.) All equipment having piping connections shall be levelled, aligned and wedged in place but shall not be grouted or bolted prior to the initial fitting and alignment of connecting piping. All equipment shall, however, be grouted or bolted to its foundation prior to final bolting or welding of the connection piping.

(2.) All flanged joints shall be checked and retightened after approximately 10 days of operation at normal operating temperature.

(l.) **Equipment Checkout**

(1.) All equipment shall be cleaned after installation. Equipment subject to pressure differentials shall be checked for leakage.

(2.) After erection, all equipment having moving parts, having electrical apparatus, or subject to pressure differentials shall be trial-operated.

(m.) **Defects**

(1.) All defects in erection shall be corrected to the satisfaction of the Employer and the Project Manager. The dismantling and reassembly of Contractor furnished equipment to remove defective parts, replace parts, or make adjustments shall be included as a part of the work

under these specifications.

(2.) The removal of control and instrument equipment in order to allow bench calibration, if required, and the re-installation of the said equipment after calibration shall also be included as a part of the work under these specifications.

(n.) **Equipment Protection**

(1.) All equipment to be erected under these specifications shall be protected from damage of any kind from the time of contract award until commissioning of each unit.

(2.) The equipment shall be protected during storage as described herein.

(3.) Equipment shall be protected from weld spatter during construction.

(4.) Suitable guards shall be provided for protection of personnel on all exposed rotating or moving machine parts. All such guards with necessary spares and accessories shall be designed for easy removal and maintenance.

(5.) Equipment having glass components such as gauges, or equipment having other easily breakable components, shall be protected during the construction period with plywood enclosures or other suitable means. Broken, stolen, or lost components shall be replaced by the Contractor.

(6.) Machine finished surfaces, polished surfaces, or other bare metal surfaces which are not to be painted, such as machinery shafts and couplings shall be provided temporary protection during storage and

constructional periods by a coating of a suitable non- drying, oily type, rust preventive compound.

53.00.00 WELDING - SPECIAL REQUIREMENTS

If the manufacturer has special requirements relating to the welding procedures for welds at the terminals of the equipments to be performed under separate specifications, the requirements shall be submitted to the Project Manager in advance of commencement of erection work.

54.00.00 DEVIATIONS DISPOSITIONING:

Any deviation to the contract and employer approved documents shall be properly recorded in the format prescribed by NTPC. All the deviations shall be brought to the knowledge of employer's representative for suitable dispositioning.

55.00.00 NON-DESTRUCTIVE TESTING (NDT):

The contractor shall record results of NDTs carried out at site in the format acceptable to employer. All the radiographs & its report duly signed & correlated to the job shall be handed over to the employer. Sensitivity of all the test equipment shall be compatible to the job & acceptance norms agreed.

Computed RT shall be used as an advanced Engineering Practice. Main contractor to ensure minimum 10% computed radiography of weld joint to be performed in construction phase for scope agreed in FWS for boiler pressure parts. Main contractor to ensure the transfer & storage of these records in Server

55.01.00 Sub contracting of NDT & PWHT / SR Agencies- NDT & PWHT / SR contract shall be directly awarded by the main contractor to their approved NDT & PWHT / SR agencies .

56.00.00 TESTING EQUIPMENT & FACILITIES:

Contractor shall provide the testing equipment and facilities necessary to carry out tests & inspections.

ANNEXURE-I

STANDARD CHECKLIST

COMMISSIONING/TESTING ESSENTIAL PRE-REQUISITE

1. MECHANICAL

(A.) **VALVES**

(1.) MANUALLY OPERATED VALVE
(2.) ELECTRICALLY OPERATED VALVE
(3.) PNEUMATICALLY ACTUATED VALVE
(4.) HYDRAULICALLY ACTUATED VALVE
(5.) SAFETY VALVE
(6.) ELECTROMATIC RELIEF VALVE
(7.) STEAM TRAP
(8.) BUTTERFLY VALVE (ELECTRICALLY OPERATED)
(9.) BUTTERFLY VALVE (MANUALLY OPERATED)
(10.) BUTTERFLY VALVE (FOUR WAY-ELECTRICAL)
(11.) NON-RETURN VALVE (INCLUDING HYDRAULIC/PNEUMATIC FCNRVS)
(12.) THREE WAY CONTROL VALVE
(13.) RELIEF VALVE
(14.) DIFFERENTIAL PRESSURE REGULATING VALVE
(15.) FLOAT OPERATED VALVES

(B.) TANKS AND PRESSURRE VESSELS

(1.) TANKS (METAL) UPTO 20 M2
(2.) TANKS (LARGE STORAGE)
(3.) PRESSURE VESSEL (BELOW 17 BARS)
(4.) AIR RECEIVER
(5.) PRESSURE VESSEL-ACCESS DOOR
(6.) TURBINE MAIN OIL TANK

(C.) PUMPS

(1.) PUMP LOW PRESSURE CENTRIFUGAL (MOTOR DRIVEN)
(2.) PUMP UP TO 350 HP (260 KW)
(3.) PUMP SUMP INSTALLATION
(4.) GEAR PUMP/SCREW PUMP

(D.) PIPE WORK SYSTEM

(1.) STEAM SERVICES

(2.) WATER SERVICES
(3.) OIL/FIRE RESISTANT FLUID SYSTEM
(4.) AIR SERVICES (COMPRESSOR)
(5.) HIGH PRESSURE SERVICES
(6.) CONSTANT LOAD SUPPORT
(7.) SPRING SUPPORTS
(8.) HANGERS AND OTHER SUPPORTS

(E.) STRAINER AND FILTER
(1.) STRAINER/FILTER BASKET TYPE
(2.) STRAINER ROTARY (LOW PRESSURE)
(3.) FILTER & STRAINERS CENTRIFUGAL SEPARATORS
(4.) FILTER & STRAINER Y-TYPE
(5.) FILTER & STRAINER (PLATE TYPE)
(6.) PURIFIER
(7.) FILTER-COMPRESSED AIR LINE

(F.) HEAT EXCHANGER
(1.) HEAT EXCHANGER (GENERAL)
(2.) HEAT EXCHANGER-OIL/WATER
(3.) ROTARY AIR HEATER

(G.) FANS AND COMPRESSORS
(1.) FANS-NON-PRESSURE LUBRICATED
(2.) FANS-AXIAL FLOW PRESSURE LUBRICATED
(3.) COMPRESSORS-GENERAL
(4,) DAMPERS & GATES

(H.) CRANES AND ELEVATORS
(1.) AUXILIARY OVERHEAD/GANTRY CRANE
(2.) TRAVEL SUPPORT STRUCTURE FOR CRANE
(3.) LONG TRAVEL & CROSS TRAVERSE MOTION OF CRANE
(4.) MAIN AUX. HOIST MOTION (CRANE)
(5.) ELECTRIC HOIST

(I.) POWER TRANMISSION
(1.) POWER TRANSMISSION GEAR BOX
(2.) BEARING
(3.) FLUID COUPLINGS

2. ELECTRICAL

(1.) SWITCHYARD

(2.) POWER TRANSFORMERS, LT INDOOR TRANSFORMERS, OUTDOOR TRANSFORMERS.

(3.) BATTERY CHARGERS, DC BATTERIES, DG SETS, STATION LIGHTING, OVERHEAD LINES.

(4.) MV BUS DUCTS

(5.) D.C. MOTOR

(6.) HV SQUIRREL CAGE INDUCTION MOTOR

(7.) 415 V SQUIRREL CAGE INDUCTION MOTOR

(8.) MOTOR OPERATED ACTUATORS

(9.) LT SWITCHGEARS/MCC

- (I.) STANDARD CHECLISTS FOR ALL TYPES OF RELAYS USED IN SWITCHGEARS PROTECTION SYSTEM
- (II.) PT CARRIAGE AND CUBICLES
- (III.) CABLE/BUS DUCT/BUS BARS
- (IV.) CONTRACTOR MODULE
- (V.) SWITCH FUSE MODULE
- (VI.) MASTER PANEL OF LUBE OIL PANEL
- (VII.) FEEDER PANEL OF LUBE OIL PANEL
- (VIII.) SPACE HEATER AND CABLE MODULE
- (IX.) CONTROL TRANSFORMER MODULE
- (X.) HT CIRCUIT BREAKER
- (XI.) 415 V CIRCUIT BREAKER

(10.) POWER CABLE

(11.) CONTROL CABLE

(12.) AUXILIARY CABLE

(13.) D.C. CABLE

(14.) EXPLOSION PROOF ELECTRICAL EQUIPMENT

(15.) JUNCTION BOX

(16.) CONTROL TRANSFORMER MODULE

(17.) BRUSH GEAR ASSEMBLY

(18.) AUX. CONTROL AND RELAY PANEL DESK

(19.) INDICATING INSTRUMENT

(20.) RECORDING INSTRUMENT

(21.) INTEGRATING INSTRUMENT

3. CONTROL & INSTRUMENTATION

(A.) CONDUCTIVITY ANALYSING EQUIPMENT INCLUDING TEST PROCEDURES

(B.) PH ANALYSER INCLUDING TEST PROCEDURE

(C.) SILICA ANALYSER

(D.) LEVEL SWITCH (FLOAT ACTUATED)

(E.) LEVEL SWITCH (ELECTRODE TYPE)

(F.) LEVEL SWITCH (DISPLACER ACTUATED)

(G.) TRANSMITTER (FLOAT OPERATED PNEUMATIC OUTPUT) INCLUDING TESTING PROCEDURE

(H.) LEVEL INDICATOR (FLOAT/PULLEY TYPE)

(I.) LOCAL TEMPERATURE INDICATORS INCLUDING TEST PROCEDURE

(J.) RESISTANCE THERMOMETER ELEMENT INCLUDING TEST PROCEDURE

(K.) THERMOCOUPLE ELEMENT AND CONNECTING CABLE

(L.) THERMOCOUPLE AND RESISTANCE THERMOMETER CONVERTOR/TRANSMITTER INCLUDING TEST PROCEDURES.

(M.) TEMPERATURE SWITCH/THERMOSTAT INCLUDING TEST PROCEDURES

(N.) COLD JUNCTION BOXES

(O.) ZENER BARRIER

(P.) O2 ANALYSER

(Q.) O2 IN HYDROGEN INCLUDING TEST PROCEDURES

(R.) PRESSURE AND VACUUM GAUGE

(S.) PRESSURE AND VACUUM SWITCH INCLUDING TEST PROCEDURE

(T.) DIFFERENTIAL PRESSURE TRANSMITTER INCLUDING TEST PROCEDURE

(U.) DIFFERENTIAL PRESSURE SWITCH INCLUDING TEST PROCEDURE.

(V.) FLOW INDICATOR (VARIABLE AREA)

(W.) ORIFICE PLATE

(X.) TURBINE FLOW TRANSMITTER

(I.) FLOW SWITCH

(II.) WEIR

(III.) NOZZLE

(IV.) FLOW INDICATOR (PNEUMATIC INPUT) INCLUDING TEST PROCEDURE

(V.) FLOW INTEGRATOR (PNEUMATIC INPUT) INCLUDING TESTPROCEDURE

(VI.) FLOW INDICATOR (FLOAT OPERATED) INCLUDING TEST PROCEDURE

(VII.) VENTURI (FLUID)

(VIII.) FLOW SWITCH (MAGNETIC TYPE)

(IX.) AVERAGING INLET

(X.) LIMIT SWITCHES

(Y.) TURBINE SUPERVISORY MEASURING SYSTEM

(Z.) POSITION MEASUREMENT AND INDICATION INCLUDING TEST PROCEDURES

(AA.) TACHOMETER

(BB.) VIBRATION MEASUREMENT

(CC.) DIGITAL INDICATOR

(DD.) MOVING COIL INDICATOR INCLUDING TEST PROCEDURE

(EE.) RECORDER INCLUDING TEST PROCEDURE

(FF.) FLAME SCANNER

(GG.) ELECTRICAL AUTO MANUAL CONTROL STATION

(HH.) PUSH BUTTON MODULE

(II.) ALARM ANNUNCIATOR EQUIPMENT INCLUDING TEST PRO

(JJ.) TEST PROCEDURE FOR ELECTRONIC MODULES OF DDCMIS

KK.) THERMO CONTROL VALVE

(LL.) TEST PROCEDURE FOR ADJUSTMENT OF MODULATING CONTROLLER - PID TERMS

(MM.) TEST PROCEDURE INDICATING CONTROLLER-ELECTRICAL INPUT AND PNEUMATIC OUTPUT

Note: The items which are not part of this specification may be considered as not applicable.

ANNEXURE-II

BRIEF WRITE UP ON THE CONTENTS OF TESTING SCHEDULE / COMMISSIONING SCHEDULE

Testing Schedules should be designed to ensure that the plant area, equipment or apparatus are tested and commissioned and will operate as per the employer's specifications and good engineering practices.

Testing Schedule/Commissioning Schedule is required to be of a standard format in order to maintain consistency of presentation, content and reporting.

Testing Schedule/Commissioning Schedule should contain the following sections to make the document a self-contained one:

1. Plant Details/Design data
2. Testing Objective/Proposals
3. State of the Plant
   a) Erection Status with respect to Mech. Elect and C&I
   b) Availability of the services required
   c) Safety requirements as per Manufacturer's
4. Test method including completion/acceptance criteria
5. Results
6. Appendix
   a) Testing Programme
   b) Mech/Elect/C&I -Plant item completing list
   c) List of Drawing/documents required for carrying out the testing.

ANNEXURE - III

SAFETY PLAN

01. Safety Policy of the Contractor to be enclosed:
02. When was the Safety Policy last reviewed:
03. Details of implementation procedure / methods to implement Safety Policy / Safety Rules:
04. Name, Qualification, experience of Safety Officer
05. Review of Accidents Analysis Method, Methods to ensure Safety and Health:
06. Unit executive responsible to ensure Safety at various levels in work area:
07. List of employees trained in safety employed before execution of the job. Give the details of training:
08. Safety Training Targets, Schedules, methods adopting to providing safety training to all employees:
09. Details of checklist for different jobs / work and responsible person to ensure compliance (copy of checklist to be enclosed):
10. Regular Safety Inspection Methods and Periodicity and list of members to be enclosed:
11. Risk Assessment, Safety Audit by Professional Agencies, Periodicity:
12. Implementation of Recommendations of Audit / Inspections. Procedures for implementation and follow up:
13. Provision for treatment of injured persons at work site:
14. Review of overall safety by top Management and Periodicity:
15. System for Implementation of Statutory legislations:
16. Issue of PPEs to employees, Periodicity / stock on hand etc:

Signature

Head of the Organisation with date & stamp

ANNEXURE-IV

Health Safety and Environment (HSE) Policy and HSE Management Manual

1. INTRODUCTION

1.1 Background

NTPC safety policy and various safety requirement has already been indicated in the site regulation and safety section of GCC. This document shall be supplementary to above document and shall be read in conjunction with site regulation and safety section of GCC. In case of any contradiction, the stringent of the two requirements (in the opinion of the employer) shall prevail.

NTPC being India's largest power utility and a responsible corporate entity, the statement of policy on health and safety at work sets out the commitment of NTPC to manage health and safety effectively, and what shall be achieved by NTPC, the Contractor and any appointed sub- contractor.

NTPC, the Contractor and any appointed sub-contractor is committed to provide and maintain a safe and healthy workplace for all staff, and to provide the information, training and supervision needed to achieve this.

All involved parties are committed to protect the fundamental rights of all appointed workers and feel obliged to create a sound worker-management relationship as a key ingredient in a sustainable and successful project execution.

All involved parties will have to assume the responsibility for H&S procedures, and need to be made aware of their responsibilities and to comply with NTPC's H&S Policy.

The following requirements are mandatory for each worker in maintaining a safe and healthy workplace through:

- Being involved in the workplace H&S System;
- Sticking to correct procedures and equipment;
- Wearing protective clothing and equipment whenever required;
- Reporting any pain or discomfort as soon as possible;
- Ensuring that all accidents and incidents are reported;
- Helping new workers, trainees and visitors to the workplace understand the right safety procedures and why they exist;
- Telling the responsible managers immediately of any H&S concerns;
- Keeping the work place tidy to minimise the risk of any accidents.

The aim of all the stake holders is to achieve the following goals:

- Zero fatalities of workers, visitors or the public;
- Zero accidents and incidents of workers, visitors or the public;
- Zero harmful, hazardous or dangerous situations or occurrences;
- Zero environmental concerns or impacts;
- Continuous improvement of the health & safety performance at site under practical conditions.

1.2 Definition of Occupational Health & Safety

Since 1950, the International Labour Organization (ILO) and the World Health Organization (WHO) have shared a common definition of occupational health. It was adopted by the Joint ILO/WHO Committee on Occupational Health at its first session in 1950 and revised at its twelfth session in 1995 and is defined as follows:

Occupational health should aim at the promotion and maintenance of the highest degree of physical, mental and social well-being of workers in all occupations; the prevention amongst workers of departures from health caused by their working conditions; the protection of workers in their employment from risks resulting from factors adverse to health; the placing and maintenance of the worker in an occupational environment adapted to his physiological and psychological capabilities; and, to summarize, the adaptation of work to man and of each man to his job.

"The main focus in occupational health is on three different objectives:

- the maintenance and promotion of workers' health and working capacity;
- the improvement of working environment and work to become conducive to safety and health and
- the development of work organizations and working cultures in a direction which supports health and safety at work and in doing so also promotes a positive social climate and smooth operation and may enhance productivity of the undertakings.

The concept of working culture is intended in this context to mean a reflection of the essential value systems adopted by the undertaking concerned. Such a culture is reflected in practice in the managerial systems, personnel policy, principles for participation, training policies and quality management of the undertaking."

Workers safety has to be understood as the practice of an employer using preventative measures to prevent hazards to the employees' personal safety. This practice includes creating plans and procedures for employees and managers in the workplace. In addition, workplace safety involves creating policies and keeping emergency materials available for employee and manager use while at a work site.

1.3 Purpose of the H&S Management Manual

The present H&E Management Manual shall delineate the Health and safety Requirements, incl. policies and guidelines, and outline the roles and responsibilities of the different parties involved in the implementation and oversight of Health, Safety and Environment Measures to ensure community, worker and public health and safety during construction.

The H&S Management Manual considers the applicable national occupational health, safety and welfare legislation as well as guidelines and standards established by the relevant Ministries and Authorities.

The H&S Management Manual other than Site Regulation and Safety provisions provided in Bidding Documents takes the following applicable IFC Performance Standards (PS) into account:

- PS 2: Labour and Working Conditions, dated January 1, 2012
- PS 3: Resource Efficiency and Pollution Prevention, dated January 1, 2012
- PS 4: Community, Health, Safety and Security, dated January 1, 2012.

The H&S Management Manual includes the Occupational Health & Safety Requirements and arrangements that are mandatory for the Contractor for consideration and implementation.

In case the provisions in Site Regulation and Safety provisions provided in Bidding Documents are superior than the provisions indicated in this manual, the provisions provided in Site Regulation and Safety provisions provided in Bidding Documents shall prevail.

The defined H&S Standards are part of the contractual obligations, and no changes are possible without a prior written approval by NTPC.

1.4 Content of the H&S Management Manual

The H&S Management Manual contains an outline of the required H&S Organization at site and to be implemented by the Contractor.

It describes the overall H&S Management required for the organization of a safe and healthy working environment for the workers and to ensure that the public will not be affected by the construction activities. In addition to the organizational arrangements roles and responsibilities of the required H&S Staff of the Contractor are defined.

Attention is paid to the need for training to be implemented by the Contractor. It starts with the evaluation of training needs and defines the requirement of developing a training schedule as well as workers and visitorinduction.

Communication procedures are addressed and needed H&S Reporting is specified for the entire construction period.

As one of the most important subjects, the entire risk management process is comprehensively described, specifying the risk management process, the hierarchy of control and the safe system of work.

Reporting and monitoring procedures are developed for the fulfillment bythe Contractor and the standards for PPE are included.

The H&S Management Manual shall highlight the entire H&S Management System and also provide information on the H&S Standards to be followed by the Contractor.

2. HEALTH & SAFETY MANAGEMENT SYSTEM

An H&S Management System is implemented for the Project. The management system comprises of different components to be developed bythe Contractor.

That the Contractor must implement human resource policies and procedures that set out the approach to manage workers consistent with the requirements of IFC PS 2 as well as the applicable national laws and standards.

2.1 Health & Safety Management Manual

Contractor will implements this H&S Management Manual in order to delineate the Project's H&S Requirements, Policies and Guidelines as well as to outline the roles and responsibilities of the different parties involved in the implementation and oversight of measures to ensure community, worker and public health and safety during construction.

2.2 Contractor's H&S Plans

All Contractors shall establish an effective project specific H&S Plan. TheH&S Plan will be subject of NTPC's written approval. The H&S Plan shall be submitted by the Contractor not later than 4 weeks prior to any commencement of works at site.

Any work at site, incl. mobilization to the site will not be allowed to commence until NTPC deems the Contractor's H&S plan to be suitableandsufficient.

The H&S Plan shall describe how health and safety will be managed at site, incl. mobilization and transport to the site, and how the specified H&S Standards will be applied in practice. In

addition the Contractor shall ensure adequate communication of these requirements throughout the supply chain,its supervision, and the workers themselves.

The H&S Plan shall specify the management arrangements for carrying outthe work including but not limited to:

- Overview of the project;
- Clearly identified risks associated with the scope of works;
- Program and milestones;
- Site management and organization;
- Key contractors and sub-contractors;
- Communication, Cooperation and Co-ordination;
- Site security;
- Traffic management;
- Welfare facilities and provision;
- Arrangements for supervision of contractors on site;
- Arrangements for information, instruction and training includinginduction;
- Management of hazards on site;
- Arrangements for identification of hazards, assessment of risk and production of Method Statements;
- Arrangements for hazardous undertakings e.g. confined space, work at height, hot work, excavations, cofferdams etc.;
- Permit to work system;
- Site rules;
- Arrangements for managing plant and equipment;
- Management or lifting operations;
- Management of temporary works;
- Arrangements for monitoring and auditing etc.;
- Requirements as defined by relevant statutory planning authorities e.g.traffic, noise, working hours etc.;
- Incident & accident investigation.

The H&S Plan shall also consider the site rules outlining the H&S Requirements for all workers. The site rules shall include but should not belimited to:

- Site access;
- Access to and transport on the site;
- Entering and leaving the site;
- Use of mobile phones;
- Smoking;
- PPE requirements;
- General behaviour;
- Transport to the site;
- Vehicle traffic within the site area;
- Access to the site and Working Areas;
- Restricted areas.

The H&S Plan shall consider related plans and the corresponding direct and indirect H&S Requirements. This refers especially to the following related plans and assessments:

- Hazardous materials and waste management plan;

A checklist for the review and approval of project specific H&S Plans shall be developed prior to the construction contract. The checklist shall define the minimum requirements to be met by the Contractor.

2.3 Contractor's H&S Procedures

The Contractor is requested to develop workplace specific H&S Procedures. In this matter, it should be noted that procedures are similar to method statements probably better known by Contractors. The required content of H&S Procedures is described below.

H&S Procedures are part of the Project framework for effective H&S Management. The H&S Policy states the intention to provide a safe andhealthy workplace, and states the H&S goals of a workplace.

Specific health & safety workplace procedures shall address particular issues or hazards and the measures how to control those identified hazards. The procedures should be used together with other hazard control measuresto eliminate or reduce the risks of accidents and incidents and illness and/orinjuries at the working place.

H&S Procedures shall be developed for the following activities expected to apply during construction:

- Site access control and site security procedure;
- Health & safety protection at transmission line worksites;
- Isolation and lock-out;
- Use of hazardous chemicals;
- Simultaneous activities;
- Live line work;
- Shift work, shift rotation and fatigue;
- X-ray and NDT;
- Risk assessment;
- Job Safety Analysis;
- Working at height;
- Working in confined spaces;
- Use of personal protective equipment;
- Excavation works;
- Hot works;
- Welding;
- Emergency response procedure;
- Evacuation procedure (if applicable);
- First aid;
- Working in water (if applicable);
- Use of electrical equipment;
- Work on high voltage.

This checklist shall define the minimum requirements to be met by the Contractor.

2.4 Contractor's Safe Work Instructions

Safe work instructions shall be developed by the Contractor identifying the health and safety issues that may arise from use of the machinery and equipment. The safe work instruction must be based on the H&S Plan.

A safe work instruction should identify:

- the hazard associated with the use of a specific tool or equipment;
- the required control measures to be checked to ensure a safe use of aspecific tool or piece of equipment;
- the specific training and/or qualification required;
- the personal protective equipment to be worn.

Safe work instructions do not replace the requirement for a risk assessment,preparation of a workplace procedure, the need of a permit to work or the need for training.

A risk assessment of the equipment must be performed before developing safe work instruction procedures to identify the hazards and risk controls.

A checklist for the review and approval of project specific Safety Work Instructions will be developed by the PIC prior to the first construction contract. The checklist will define the minimum requirements to be met bythe Contractor.

2.5 Contractor's H&S Forms

The Contractor must develop forms like checklists for risk assessment etc. to support the support the use of workplace procedures, instructions, audits etc.

These forms must be attached to the respective documents, and must be read in closed conjunction with the corresponding document(s).

The checklists shall be subject of an update and revision in case improvements or needed changes were found suitable and required.

The checklists must be subject of project documentation, in the same wayand considering the same procedure that is applicable for the project documentation in general.

H&S Forms have to comprise the following subjects as a minimum:

- Contractor Audit Questionnaire
- Basic Risk Assessment
- Permit to Work
- Workplace Inspection Checklist
- Accident/Incident Report/Investigation
- Fire Risk Assessment
- Hazardous Substance Risk Assessment
- Ladder Inspection Checklist.

The forms to be used by the Contractor must include all pertinent information. Additional forms like inspection checklists, workplace inspection checklists might be necessary and should be prepared by the Contractor and are subject of approval by NTPC.

2.6 Contractor's Grievance Management System

2.6.1 Workers Grievance Management System

The Contractor must implement a grievance management system to enable the workers to raise complaints and to inform about non-compliances with the implemented H&S

Management System. The grievance management system should provide the possibility to issues complaints in case of discrimination and/or the non-consideration of equal opportunities.

The grievance management system shall consider the possibility to contact directly a member of the H&S Staff. The contacted staff members must take a note of the reported complaint or non-compliance and must report it to thesite manager and the H&S Manager.

The H&S Management is requested to solve a complaint or non-compliancewithin 3 working days. In case the problem could not be solved an action procedure specifying the needed activities together with a final deadline until the problem is expected to be solved must be prepared and submitted to NTPC.

The Contractor is requested to provide the possibility for the workers to notify a complaint or non-compliance in a confidential way.

2.6.2 Public Grievance Management System

The grievance management system shall also be open for public complaints.

A respective procedure must be developed by the Contractor for review and approval. The grievance management system for the public must consider areporting procedure to the local authority to demonstrate to the administrative body that the complaint was identified, noted, managed and solved.

The responsible authorities at the community level must be identified by the Contractor 4 weeks prior to the start of the construction activities or 4 weeksprior to the mobilization to the site.

The reporting procedure should be discussed and agreed upon together with the administrative body and specific attention should be paid to any specific requirements to be announced by the authority. The contact with the authority should be established by having a face-to-face meeting. This meeting should be attended by an H&S Representative of the Contractor.

2.7 H&S Committee

It shall be governed by site regulation and safety requirement as stipulated in GCC

3. ROLES, RESPONSIBILITIES AND ACCOUNTABILITY

It shall be governed by site regulation and safety requirement as stipulated in GCC

3.2.1 Child Labour

The contractor shall not deploy any person below the age of 18 years.

3.2.2 Pregnant Woman

Pregnant employees have the following four major prerogatives:

- paid time off for antenatal care
- maternity leave
- maternity pay
- protection against unfair treatment, discrimination or dismissal.

In addition, the contractor must not change a pregnant employee's contract terms and conditions without agreement. If this will be done by a contractor, it has to be handled as a breach of contract.

It's illegal for contractor to refuse to give pregnant employees time off for antenatal care or refuse to pay their normal rate for this time off.

The following rights shall be considered:

- Pregnancy-related illnesses
  If the employee is off work for a pregnancy-related illness in the 4 weeks before the expected date of birth of the child, maternity leave and statutory maternity pay by the employer has to start automatically.
- Compulsory maternity leave
  In case the employee does not take statutory maternity leave, they musttake 4 weeks off after the child is born.
- Telling the contractor about the pregnancy
  Employees are obliged to inform their contractor about the pregnancy at least 15 weeks before the beginning of the week of the expected date ofbirth or, in case of unawareness of the pregnancy during this timeframe,the contractor must be told as soon as possible.

  Employees must also tell the contractor when they want to start their statutory maternity leave and pay.
- Health and safety for pregnant employees
  After the receipt of information about the pregnancy of an employee, theemployer should assess the risks to the woman and her baby.

  Risks could be caused by:

  - heavy lifting or carrying
  - standing or sitting for long periods without adequate breaks
  - exposure to toxic substances
  - long working hours
  - vibration and mechanical shocks
  - extreme heat
  - noise
  - ionising radiation
  - non-ionising (electromagnetic) radiation
  - carbon monoxide
  - lead
  - polychlorinated Byphenyls
  - organic solvents
  - pesticides and herbicides
  - tobacco smoke.

The MSDS to be provided together with each chemical substance to be in use or to be delivered at the construction site, storage area etc. should highlight the category.

Where there are risks, the contractor should take reasonable steps to removethe risks or by offering the employee different work or work places or by changing the working hours by the adaption of sufficient breaks.

In case the contractor can't remove any risks, the contractor must suspend theemployee on full pay and without any reduction.

Pregnant worker who think they're at risk but their employer disagrees should report to NTPC's H&S Manager during a site audit.

The contractor is obliged to inform every pregnant employee about theirrights in writing and this information must be recorded.

Apart from above, all the provisions of Maternity Benefit Act, 1961 as applicable from time to time, shall be complied with by the contractor.

4. TRAINING

It shall be governed by site regulation and safety requirement as stipulated in GCC

5. HEALTH & SAFETY REPORTING

5.1 Contractors Reporting Obligations

Independent from the general requirement and contractual obligations to implement a reporting scheme with respect to the progress, construction schedule and project reporting in general, the Contractor will be obliged to implement an H&S Reporting.

The H&S Reporting should provide an overview of the H&S Performancewithin a particular timeframe and with specific topics as mentioned below:

The H&S Reports should be submitted to NTPC Project Manager

5.1.1 Health & Safety Performance

5.1.1.1 Weekly Reports

The Contractor shall prepare weekly H&S reports. The weekly reports shall be submitted by close of business on the first working day after a completedworking week, e.g. the reporting timeframe is from Monday to Saturday and the respective following working day is the upcoming Tuesday, if not a public holiday.

The weekly reports shall comprise of the following information with respect to the reporting timeframe:

- Originator
- Name of the project
- Activities performed
- Health occurrences
- Safety occurrences
- Resulting accidents, incidents or dangerous situations
- Undertaken measures.

5.1.1.2 Monthly Reports

The Contractor shall prepare monthly H&S reports. The monthly reports shall be submitted by close of business of the last working day of the first working week after the reporting timeframe, e.g. the reporting timeframe is from 1st of January until 31 of January and the due day of the submission ofthe report is the Friday of the first working week in February, if not a publicholiday.

The weekly reports shall comprise of the following information with respect to the reporting timeframe:

- Originator
- Name of the project
- Activities performed
- Health occurrences
- Safety occurrences

- Resulting accidents, incidents or dangerous situations
- Investigation results
- Undertaken measures
- Lessons learned
- Informed authorities and resulting obligations/conditions
- Results of workplace inspections.

5.1.2 **Hazards Reporting**

The H&S Staff of the contractor is requested to undertake workplace inspections. In case that hazards and risks are identified during workplace inspections, it is needed that the identified hazard or risk has to be solved immediately and without delay during the inspection.

In case that the problem could not be solved, a written report has to be prepared and issued to the H&S Manager or site manager highlighting:

- a description of the problem;
- the reason why it could not be solved during the inspection;
- the needed action;
- the responsible person;
- the associated hazards and risks;
- the deadline until the problem must be solved.

The occurrence must be reported in the monthly H&S Report.

Any other reporting requirements with respect to H&S, e.g. audit reports,weekly and monthly H&S Reports, remain unchanged.

6. **HEALTH & SAFETY RISK MANAGEMENT**

The risk management process with specifically requested forms requires a careful document administration and control. The Contractor should be aware that the documents resulting from the risk management process, in particular, the risk assessments, permits to work and job safety analysis, must be available during construction site audits and/or exemplary as part of a monthly report.

6.1 Risk Management Process

Risk management is the identification, assessment and prioritization of risks to avoid impacts on workers and the public.

The Contractor has to implement a suitable and appropriate risk management process to enable his site staff to prevent any non-compliances resulting in critical, harmful or dangerous situations followed by incidents, accidents or fatalities.

Alternatively suggested risk management processes shall be provided in theH&S Plan.

6.2 Hierarchy of Control

The first part of evaluating the risk stage, consideration must be given how likely each hazard could cause harm. When the potential for harm has been decided, the existing control measures should be identified. In this course, each step of the activity has to determine what control measures might already in place. When evaluating a risk it is imperative to check the

applicable legislation and to ensure that everything required by law is in place or has to be done.

When considering current controls and further required control measures, the general principles of control should be applied:

Eliminate

- It has to be checked if the risk associated with the hazard could be eliminated.

Reduce

- It has to be assessed if the possible amount of the hazard or the exposure to the hazard could be reduced.

Isolate

- It must be evaluated if the hazard could be isolated. Isolating is the principle of preventing the contact with the hazard.

Control

- It must be assessed if a safe system of work, permit to work and/or procedures are in place to control the hazard to prevent that some bodybecomes injured.

Personal Protective Equipment

- As a final result of running through the hierarchy of control, the supply of personal protective equipment is the final result of controlling the hazard. The provision of PPE must not be the first and final stage of risk mitigation.

6.3 Safe System of Work

6.3.1 Risk Register

The Contractor is requested to develop and prepare a risk register. A risk register is a document that summarizes and defines the possible risks resulting from a particular activity, in the present case from particular construction or construction related activities. The concept of a risk registerrecognises that risk elements arising from proposed or actual activities fall into one of following three categories:

- Risks which are deemed to have a low risk and do not need to be managed;
- Risks that have a medium or high risk and will need to be managed;
- Risks which have an extreme risk and therefore the activity should probably not proceed.

The risk register records details all the risks identified for the construction phase and associates them in terms of likelihood of occurring and seriousness of impact.

The risk register to be prepared should identify:

- a description of each risk and its potential consequences;
- factors that may impact upon the likelihood and severity of the risk;
- an assessed risk ranking, such as
  - low,
  - medium
  - high or
  - very high;

- whether the risk ranking is acceptable or not;
- actions and controls that currently exist to mitigate risks

The definition of the risks from low to very high is explained in the following risk ranking table:

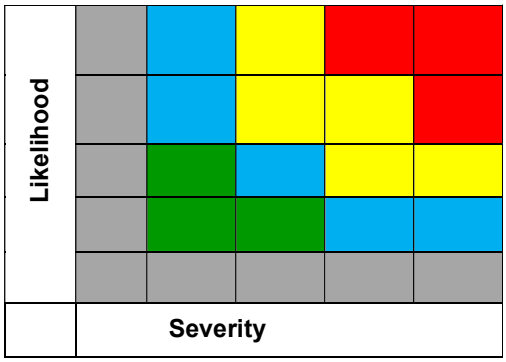

Table 6-1: Risk ranking table

It is recommended to develop the risk register at the beginning stage before start of a construction site by following the following steps:

- Identification of potential risks;
- Identification of the consequences;
- Identification of the likelihood and severity that the risk would result in adverse consequences;

Where risks have been ranked as medium, high or very high, mitigation measures must be addressed:

- **Medium (Risk ranking 3 to 4):** Mitigation actions to reduce the likelihood and severity should be identified and appropriate actions mustbe endorsed.

- **High (Risk ranking 6 to 9):** If uncontrolled, a risk event at this level may have a significant impact for the actions and tasks at a construction site as a whole. Mitigating actions need to be very reliable and should be approved and monitored by the Contractor. Even with mitigating actions in place, the construction site staff potentially exposed to that risk shouldbe advised of identified or potential risks which have been graded at this level.

- **Very High (Risk ranking 12 to 16):** Activities and projects with unmitigated risks at this level should be avoided or terminated. Mitigation actions of these types of risks may outweigh the benefits of the execution method. This is because risk events graded at this level have the potential to have significant adverse effects with the potential to cause serious accidents and incidents resulting in fatalities.

It needs to be identified if any risk mitigation procedures are in place.

If it is found that there are none, procedures must be developed consideringthe following:

- Planned actions:
  Reduction the likelihood a negative risk will occur and/or reduce theseriousness should it occur (What should you do now?)

- Contingency actions:
  Planned actions to reduce the immediate seriousness of a negative risk when it does occur. (What should you do when?)
- Recovery actions:
  Planned actions taken once a negative risk has occurred to allow you to move on. (What should you do after?)
- Risk Transfer:
  e.g. through assignment of contractual responsibilities or insurance.
- Actions:
  Necessary to ensure the realisation of opportunities (positive risks).

A risk register for every single construction site must be developed by the responsible Contractor considering as well the tasks and activities to be undertaken and execute by sub-contractors. The risk register has to be prepared by a competent and experienced group of engineers and workers approx. 4 weeks before mobilization to the site and start of any works at site even if they deemed to be of general nature and without having a risk potential. The risk register has to consider as well every transportation activity to the construction site.

The risk register will be subject of review and approval by NTPC.

6.3.2 **Risk Assessment**

The Contractor is requested to undertake a risk assessment for all activities assessed to be of a medium, high or very high risk.

The risk assessment has to be carried out with the participation of the staff experienced with the tasks and activities and the equipment:

- the responsible H&S Manager or a H&S Supervisor
- the foreman for the execution of the activity
- the worker(s) asked to undertake the activity.

The risk assessment has to be performed prior to the execution of the activity and it must be done in written. The written risk assessment must be documented and stored in the project file.

The risk assessment has to be undertaken in a simple and comprehensive way, understandable by each participant.

6.3.3 **Permit to Work**

It shall be governed by site regulation and safety requirement as stipulated in GCC

Stage 1- Highlight Potential Hazards:

Worker(s) and the foreman guided by the H&S Advisor highlight potential hazards of a task and identify all necessary safety measures. The hazard identification must consider all required electrical and mechanical equipment. Stage 1 has to be carried out in writing.

Work is not permitted to commence until Stage 4.

Stage 2-Application of Permit:

The Foreman applies for permission to start work on a prescribed form and submit the application to the H&S Advisor only when all requirements and conditions

described in the permit to work have been fulfilled. The Foreman has to indicate in the written permit to work that risk assessment was conducted. The risk assessment must be attached to the permit to work.

Stage 3-Evaluation of Permit:

The H&S Advisor will evaluate and verify that all safety conditions specified in the permit to work have been fulfilled and are adequate described. He may also recommend additional measures in the permit to work when necessary. He will need to inspect the location of work wherethe permit to work has been applied for, with the Foreman during this process.

Only when all safety requirements and conditions stated in the permit to work are fulfilled, the H&S Advisor will then endorse the permit to workform and forward to the Health & Safety Manager.

Stage 4-Approval of Permit:

The H&S Manager may approve and issue the permit to work only when heis satisfied that:

- Proper evaluation of risk and hazards for the work concerned has beenconducted;
- No incompatible work will be carried out in the same time and locationof the permit to work, which may pose a risk to the persons at work;
- All reasonably practicable safety measures have been taken and all persons involved in the work have been informed of the work hazardsunder the PTW;
- All electrical and mechanical equipment is demonstrable checked and in safe conditions.

A work permit is valid for one working day and for the specified working time. In case the tasks could not be finalised within the validity of the permitto work, the permit to work must be renewed before commencement of work on the day the work may continue.

The permit to work form must include at least the following information:

- Originator
- Date
- Description of task activity
- Duration of the task
- Needed equipment
- Security certificates of equipment
- Risk Assessment
- Already implemented mitigation measures
- Further mitigation measures
- Needed training or induction
- Approved by
- Date and time of approval.

6.3.4 Job Safety Analysis (JSA)

The Contractor has to undertake a JSA which is a procedure to integrate safety and health principles and practices into a particular job operation. In aJSA, each basic step of the job related hazards has to be identified and recommendations have to be provided to choose the safest way to do the job.

For conducting a JSA four main steps have to be considered:

- selecting the job to be analyzed
- breaking the job down into a sequence of steps
- identifying potential hazards
- determining preventive measures to overcome these hazards.

The Contractor must provide a specific methodology for conducting a JSA .

7. EMERGENCY RESPONSE

7.1 Emergency Response Procedures

An emergency is a serious, unexpected, often dangerous situation that requires immediate action. The emergency procedure is the strategy of actions to be outlined in the emergency response plan to response to anemergency event.

This could include, but not limited to rescue:

- from working at height;
- in confined spaces, shafts and tunnels;
- from fire & smoke, etc.

7.2 Emergency Response Plan (ERP)

The Contractor has to develop an ERP for review and approval by NTPC.

The ERP has to consider at least the following information and instruction for an adequate management of emergency situations:

- Result of a risk assessment to determine the most probably emergencysituation;
- Identification of suitable emergency response procedures, such as:
  - Determination of safe evacuation areas;
  - Determination of safe evacuation routes;
  - Determination of accurate and suitable fire fighting equipment;
  - Determination of fire brigade;
  - Training and induction of emergency response procedure.

Note: Specific attention should be paid to the investigation of the nearest hospital or first aid station. The contact numbers of the hospital or first aid station together with at least one contact of a medically examined staff team member of the hospital or first aid station must be included in the ERP in case of injuries at night-time hours or during weekends or during bank holidays.

7.3 First Aid at Site

It shall be governed by site regulation and safety requirement as stipulated in GCC

7.4 Fire Protection and Control

The Contractor shall undertake a suitable and adequate fire risk assessmentfor whatever is applicable under the scope of work of the respective construction contract.

The Contractor shall ensure that the necessary fire prevention, protection and control measures are installed and maintained. This shall commenceduring mobilisation and updated accordingly.

The Contractor shall nominate certain of his employees who shall be trainedin fire fighting duties. Nominated fire fighting personnel shall be available at all times during ongoing works on site.

7.4.1 **Fire Prevention, Protection & Control**

The following requirements apply with respect to fire prevention, protection& control and must be considered wherever applicable:

- Adequate and suitable means for extinguishing fire shall be provided andmaintained.
- All stocks of inflammable substances shall be kept in a fire resisting storeor in a safe place outside any occupied building.
- Provided that no such store shall be so situated as to endanger the meansof escape from the workplace or from any part thereof in the event of a fire occurring in the store.
- Chemical fire-extinguishers shall be freshly charged at intervals not greater than those specified by the manufacturers, or otherwise once annually, and tested by the application of such hydraulic pressure thereto as shall be suited to the type of extinguisher tested, at intervals of not more than four years; and the dates of recharging the extinguisher and thelast hydraulic test shall be clearly marked on the body of the extinguisheror on a tab securely attached thereto.
- Install a temporary or permanent water supply with sufficient flowvolume and duration to supply the standpipes, hose stations, and sprinkler systems, before the construction of the facility to be protected. In permanent structures under contract in which standpipes are installed, connect the standpipe to the water supply, install the standpipe concurrently with construction of the structure, and maintain the standpipe in operable condition for fire protection use. Provide the standpipes with fire department connections on the outside of the structure, conspicuously marked, and located in an accessible location atstreet or road level.
- No fire, flame, open light or other agent likely to ignite volatile and inflammable substances shall be allowed or used in any part of a workplace in which volatile and inflammable substances are used.
- No person shall smoke in any part of a workplace where volatile and inflammable substances are used, and a notice prohibiting smoking shall be posted in a conspicuous place in every such part of the workplace.
- Inform workers of the fire hazards of the materials and processes to which they are exposed. Brief new workers on the parts of the plan that isessential for their protection and emergency evacuations.
- Provide additional training for personnel assigned tasks that require themto remain in a facility during a fire emergency.
- When working in potentially explosive atmospheres, safe non-electric tools and apparatus suitable for the use in such areas shall be employed.
- No plant, tank or vessel which contains or has contained any explosive orinflammable substance shall be subjected to any welding, brazing or soldering operation, or to any cutting operation which involves the application of heat, until all practicable steps have been taken to remove the explosive or inflammable substance and any fumes arising there from, or to render them non-explosive or non-inflammable; and if any plant, tank or vessel has been subjected to any such operation as aforesaid, no explosive or inflammable substance shall be allowed to enter the plant, tank or vessel until the metal has cooled sufficiently to prevent any risk of igniting the substance.

7.4.2 Means of Fire Escape

Every workplace shall have adequate means of escape in case of fire.and must be properly maintained and kept free from obstruction.

7.4.3 Fire Alerts

The Contractor has to set up a system to alert workers on site and the public in the neighbourhood. This should be a permanent installed fire alarm (which must be tested on a weekly basis), a klaxon, an air horn or a whistle,depending on the size and complexity of the site.

Any warning needs to be distinctive, audible above other noise andrecognizable by everyone in case of fire.

8. HEALTH, SAFETY MANAGEMENT & MEASUREMENT

8.1 Noise Management

The Contractor is requested to develop a working noise monitoring plan to identify those areas at site where noise levels are occurring in a harmful range.

Generally, a reasonable mitigation measure, of more importance than wearing hearing protection devices, is the reduction of noise levels to a levelas low as reasonable possible. Avoidance has always the priority in comparison to passive reduction.

Noise levels must be kept below 80 dB (A) wherever possible. In case of exceeding this value, hearing protections must be provided to the workers and warning signs must be installed.

The noise monitoring must be repeated every week in case that the location of the construction site remains unchanged. In case of a change of the site, the noise monitoring has to be undertaken after implementation of site arrangements.

In case that a construction site could not be demarked in detail, the noisemonitoring has to be done for different activities.

The following table provides the standards, exposure times and need forpersonal protective equipment.

dB(A)	Exposure time[1)]		Need for PPE	Comment
	hours	minutes		
80	25	24	No	
85	8	0	No	
86	6	21	Yes	Suitable hearing protection must be provided. The hearing protection must be able to insulate the noise level to a value of 89 dB(A) or below.
87	5	2	Yes	
88	4	0	Yes	
89	3	10	Yes	
90	2	31	Yes	
95	0	47	Yes	
100	0	15	Yes	
105	0	4	Yes	

110	0	1	Yes

Table 8-1: Noise standards, exposure times and need for PPE

1) Applicable to a 8h-working-shift

Source: US Department of Health and Human Services, Occupational Noise Exposure, page 18, dated June 1998.

Contractor shall ensure at a construction site that adequate measures are taken to protect workers against the harmful effects of excessive noise or vibration at such construction site and the noise level in no case exceeds the limits laid down in BOCW act. Additionally, compliance of The Noise Pollution (Regulation and Control) Rules, 2000) is to be ensured by the agency w.r.t ambient noise level.

8.2 Air Quality Management

The air quality at site could be affected by different emissions resulting from combustion engines or resulting from the generation of dust during dryweather conditions.

Emissions from combustion engines are difficult to reduce. Some efforts notto affect the air quality are the switch-off of machines whenever possible and to limit the number of machines and equipment to a level as low as reasonable possible. The Contractor is requested to consider these recommendations during the construction phase.

Considering this requirement, the Contractor must undertake all necessary actions to reduce the generation of dust to the lowest possible levels. Project specific measures shall be included in the H&S Plan.

Mitigation measures to prevent increased dust generation include using

dust-suppressing water spray in areas of active earthmoving and on unpaved roads, using aggregate-covered access roads to minimize dust emissions and minimizing the areas of exposed soil or cleared of vegetation. Truck beds should be covered with a tarp or similar material to minimize dust during the transport.

Mitigation measures during project activities to prevent increased air emissions would include using requiring emission control devices on equipment, maintaining properly tuned engines, avoiding unnecessary idling, using electric motors instead of internal combustion engines, usinglow-sulfur diesel fuel where available, preparing asphalt away from populated areas.

8.3 Pre-employment Health Assessment

Pre-employment health checks for construction site workers shall be mandatory. These checks shall ensure that in no case the state of health ofemployed workers can be impaired by possible pre-existing diseases. TheContractor shall deploy a suitable experienced medic and appropriate materials and premises for these checks.

Workers shall be checked, and all the results shall be analysed, before hisfirst workday, in order to mitigate any risk.

Therefore, the Contractor shall provide the abovementioned medical staff and material during the entire year. Usage of hospital capacities is an often used option to fulfil these

requirements, where those capacities are available. Only personnel with appropriate health condition with respect totheir particular job shall be employed.

All workers who are subject to an exposure to occupational health risksshall undergo periodic medical surveillance. This would be required forworkers:

- exposed to noise levels exceeding 85dB(A);
- exposed to hazardous materials, e.g. chemicals;
- carrying heavy loads.

In addition to the pre-employment health checks and periodic medical surveillance, the Contractor shall enable the site workers to pass an exit medical check after finishing their jobs on site. The exit medical check shallbe provided to all workers who worked more than 3 months constantly on the construction site.

All pre-employment, periodic or exit health checks must be documented foreach worker. The assessment records must be kept confidential and for the use by the project management only. The workers will have the right to askfor the results of the health checks.

The workers will have the right to decline any pre-employment, periodic or exit medical checks. In this case they will not have the possibility to apply for any compensation in case of health interferences resulting from their work activities in connection to existing diseases.

All pre-employment, periodic or exit health checks must be provided to the workers free of charge. The application for a health check must not result in a negative treatment of the respective worker.

The Contractor must ensure that any health checks requiring specific facilities, equipment or medical staff will be available at the constructionsite or in a reachable distance to travel.

8.4 Covid-19 Prevention

Contractor shall take all necessary measures related to Covid-19 prevention as per guidelines issued by Government authorities as well as NTPC guidelines (if any).

8.5 Health Surveillance

8.5.1 **Management of Alcohol and Drugs**

Smoking shall be prohibited at all times at the construction site, at worker's camp and at storage and fabrication areas. This includes the operating or use of all electrical or manual work equipment.

Smoking shall be restricted to clearly defined and highly visible areas, only.

The presence and consumption of non prescription drugs and alcohol is strictly prohibited at all areas.

Drug and, especially, alcohol testing shall be arranged after weekends and especially for workers appointed for works consisting of potentially high-risk activities. The drug and alcohol test shall be undertaken in case of indications of a respective consumption.

Until the result of the test is public, the worker(s) must refrain from anywork at site.

In case of a positive test result, the worker has to be expelled from the sitewithout any undue delay until the completion of the project.

9. PERSONAL PROTECTIVE EQUIPMENT

It shall be governed by site regulation and safety requirement as stipulated in GCC

10. INCIDENT & ACCIDENT MANAGEMENT

It shall be governed by site regulation and safety requirement as stipulated in GCC

11. HEALTH & SAFETY REVIEWS

11.1 MCA H&S Audits and Reviews

Prior to commencement of the main construction phase, NTPC will conduct a pre-construction phase H&S Review to ensure that all the necessary arrangements are in place and suitable for the work being undertaken at that time. This will include compliance with this H&S Standards document, the project H&S Plan and country specific legislation.

NTPC will conduct site specific H&S Reviews on a regular basis and formal H&S Audits of the Contractor and its supply chain. Formal H&S Audits will be conducted at least, every 6 months. The duration of this audit will be a minimum of 1 day and will require the full co-operation of the Contractors project management team.

In addition to H&S Reviews to be undertaken by NTPC, it is possible thatfurther H&S Audits and Reviews will be carried out by relevant stakeholders i.e. Ministry of Labour or Ministry of Health etc.

The Contractor is obliged to provide any necessary support to the stakeholders to enable them to undertake their tasks and duties and to allowthe access to the sites for undertaking the audits and reviews.

11.2 Contractors Health & Safety Review Programme

The Contractor shall implement an H&S Review Programme applicable for his construction site(s) that shall include a systematic evaluation of the implemented management system, compliance with this H&S Standards document, and the project H&S Plan and local legislative requirements.

11.2.1 Contractors H&S Audits

H&S Construction Site Audits must be undertaken on a monthly basis. Theaudits should be performed by the Site Manager, the H&S Manager and theH&S Advisor.

The audits should comprise the construction site itself, material andequipment storage areas, workshop areas and accommodation areas(Worker's camp area).

These audits shall be recorded and the results should be slipped into the monthly H&S Reports. A copy of the audit report must be attached to themonthly report.

11.2.2 Contractors H&S Inspections

H & S Inspections must be carried out on specific work areas and work places associated with the project on a weekly basis but independent thereofif they are assessed as medium or high risk areas or workplaces according to the risk register. The results of the inspections must be considered in the weekly H&S reports to be submitted to NTPC. A copy of the H&S Inspection report must be attached to the weekly report. The H&S

Inspections shall be executed by the H&S Manager together with the H&S Advisor.

11.2.3 Contractors Health & Safety Surveys

H & S Surveys shall be conducted by the Contractors' H&S Advisor on a daily basis. The date and time of the surveys must be documented but the results must not be recorded in a written report but significant findings mustbe communicated to the H&S Manager.

11.2.4 Contractors Management Surveys

Management surveys to be undertaken by the Contractors General Manager or his representatives shall be conducted at least every 3 months. The surveys must not be done by the responsible Site Manager, H&S Manager or H&S Advisor of the particular construction site. The results shall be recorded.

11.3 Reporting

The results of H&S Audits and H&S Inspections must be recorded and the reports must be submitted to NTPC within 3 working days after finalisation of the audit or inspection respectively. Forms to be used for theaudits and audit reports respectively, inspections and surveys will be provided by NTPC.

The reports must include all relevant subjects according to the purpose of the H&S Reviews, but at least the results and the needed corrective actions.

An reporting schedule for each particular construction site must be developed by the Contractor and should be submitted to NTPC for reviewand approval.

11.4 Corrective Actions

The H&S Review reports must include the need for corrective actions. The list corrective actions must include the following information:

- Identified risks and non-compliances;
- Needed corrective actions;
- Needed personal and material resources;
- Responsible person;
- Date for latest finalisation.

The effectiveness of the corrective actions will be subject of NTPC'sH&S Audits.

11.5 Compliance Reviews

One week after the implementation of the corrective actions, the H&S Manager is requested to undertake a compliance review. After observation of the full compliance of the corrective actions, the H&S Manager has to report the finalisation to NTPC.

12. SITE H&S REQUIREMENTS

It shall be governed by site regulation and safety requirement as stipulated in GCC.

13. **STAYING & FOOD ARRANGEMENT FOR WORKERS**

The contractor may consider providing hygienic food, beverages and refreshments during period of Project construction which may enhance the productivity level of the workers.

The contractor shall also arrange quarters in workers habitat area for accommodation of workers during period of stay at SIPAT STPP. The proper cleaning and hygiene shall be maintained in quarters. The random checks for hygiene and cleanliness shall be done by Employer and any violation on cleanliness shall not be acceptable. Employer may take action for the same as deemed fit.

SUB-SECTION–A-09

LOW PRESSURE PIPING

LOW PRESSURE PIPING

1.00.00 **EQUIPMENT SIZING CRITERIA**

1.01.00 All the piping systems and equipment supplied under this package shall be designed to operate without replacement and with normal maintenance for a plant service life of 30 years, and shall withstand the operating parameter fluctuations and cycling which can be normally expected during this period.

1.02.00 For all Low-Pressure piping systems covered under this specification, sizing and system design shall be to the requirements of relevant codes and standard indicated. In addition to this, requirements of any statutory code as applicable shall also be taken into consideration.

1.03.00 Inside diameters of piping shall be calculated for the flow requirements of various systems. The velocities for calculating the inside diameters shall be limited to the following:

a) **Water Application**

	Pipe Size	Water Velocity in m/sec Below 50 mm	50-150 mm	200 mm & above
(a)	Pump suction	------	1.2-1.5	1.2-1.8
(b)	Pump discharge and recirculation	1.2-1.8	1.8-2.4	2.1-2.5
(c)	Header	------	1.5-2.4	2.1-2.4

Pipeline under gravity flow shall be restricted to a flow velocity of 1 m/sec generally.

WILLIAM & HAZEN formula shall be used for calculating the friction loss in piping systems with the following "C" value:

(i)	Carbon steel pipe	100
(ii)	Ductile Iron.	140
(iii)	Rubber lined steel pipe	120
(iv)	Stainless steel pipe	100

For calculating the required pump head for pump selection, at least 10% margin shall be taken over the pipe friction losses and static head shall be calculated from the minimum water level of the tank/ sump/ reservoir from which the pumps draw water.

(b) **Compressed Air Application**

Compressed air 15.0 m/sec.

1.04.00 The pipes shall be sized for the worst (i.e. maximum flow, temp. and pressure values) operating conditions.

1.05.00 Based on the inside diameter so established, minimum thickness calculation shall be made as per ANSI B 31.1 OD. Manufacturing allowance shall be added to minimum calculated thickness and next higher standard thickness of pipes shall than be selected as per ANSI B 36.10/IS-1239 Heavy grade/IS-3589/ASTM-A-53/API-5L/ANSI B36.19 as the case may be. Alternatively, manufacturers standard thickness can also be accepted subject to that such thickness shall be equal to or more than the minimum calculated thickness after considering manufacturing allowance. Selected thickness then shall be checked for vacuum loading criterion as per the guidelines given in AWWA-M-11. However, in no case, the selected Thickness for various pipe sizes shall be less than the following for indicated Pipe Sizes as below:

200 NB - 6mm 250 NB – 6 mm 300 NB - 6 mm 350 NB- 6mm 400 NB- 6 mm 450 NB- 6 mm 500 NB- 6 mm	600 NB- 6mm 700 NB- 7mm 800 NB- 8 mm 900 Nb – 10 mm 1000 Nb – 10 mm 1100 Nb – 10mm 1200 Nb – 12 mm

1.06.00 Corrosion allowance of 1.6 mm will be added to the calculated thickness being considered (except stainless steel piping).

1.07.00 Bend thinning allowance/manufacturing allowance etc. shall be as per the requirement of the design code provision.

1.08.00 Material of construction for pipes carrying various fluids shall be as specified elsewhere.

1.09.00 Compressed air pipe work shall be adequately drained to prevent internal moisture accumulation and moisture traps shall be provided at strategic locations in the piping systems.

1.10.00 Depending upon the size and system pressure, joints in compressed air pipe work shall be screwed or flanged. The flange shall be welded with the parent pipe at shop and shall be hot dip galvanized before dispatch to site. Alternatively, the flanges on GI pipes may be screwed-on flanges also.

1.11.00 Threaded joints shall be provided with Teflon sealant tapes.

1.12.00 Following types of valves shall be used for the system/service indicated.

SYSTEM	**TYPES OF VALVES**					
	Butterfly	Gate	Globe	Check	Ball	Plug
Water	x	x	x	x	x	
Air		x	x	x	x	
Drains & vents		x	x	x		
Fuel oil (if any)		x	x	x	x	x

1.13.00 Recirculation pipes along with valves, breakdown orifices etc. shall be provided for important pumping systems as indicated in respective process and instrumentation diagrams

(P&IDs). The recirculation pipe shall be sized for minimum 30%design flow of single pump operation or the recommended flow of the pump manufacturer whichever is higher.

2.00.00 **TECHNICAL SPECIFICATION**

2.01.00 **GENERAL**

Specific technical requirements of low-pressure piping, fittings, supports, valves, specialties and tanks etc. have been covered under this Sub-section. It includes details pertaining to design and material of construction for piping, fittings, valves, equipment, etc. cleaning/surface preparation application of primer and painting on over ground piping. It also includes detailed technical requirement of laying underground/buried piping including water proofing/anti corrosive protection. It also covers design, engineering, manufacturing, fabrication, technical details of piping, valves, specialties, piping hangers / supports, tanks etc.

2.02.00 **Pipes and fittings**

2.02.01 All low-pressure piping systems shall be capable of withstanding the maximum pressure in the corresponding lines at the relevant temperatures. However, the minimum thickness as specified in the following clauses and or respective codes for pipes and fittings shall be adhered to. The bidder shall furnish the pipe sizing/ thickness calculation as per the criteria mentioned above under LP piping equipment sizing criteria of this Technical Specification.

2.02.02 Piping and fittings coming under the purview of IBR shall be designed satisfying the requirements of IBR as a minimum.

2.02.03 Supporting arrangement of piping systems shall be properly designed for systems where hydraulic shocks and pressure surges may arise in the system during operation. Bidder should provide necessary protective arrangement like anchor blocks/anchor bolt etc. for the safeguard of the piping systems under above mentioned conditions. The requirement will be, however, worked out by the contractor and he will submit the detailed drawings for thrust/anchor block to the Employer. External, and internal, attachments to piping shall be designed so as not to cause flattening of pipes and excessive localized bending stresses.

2.02.04 Bends, loops, off sets, expansion or flexible joints shall be used as required in order to prevent overstressing the piping system and to provide adequate flexibility. Flexibility analysis (using software packages such as Caesar-II etc.) shall be carried out for sufficiently long piping (straight run more than 300M).

2.02.05 Wherever Bidder's piping coming under this specification, terminates at an equipments or terminal point not included in this specification, the reaction and the thermal movement imposed by bidder's piping on equipment terminal point shall be within limits to be approved by the Employer.

2.02.06 The hot lines shall be supported with flexible connections to permit axial and lateral movements. Flexibility analysis shall be carried out for pipelines which have considerable straight run as indicated above and necessary loops/ expansion joint etc. shall be provided as may be necessary depending on layout.

2.02.07 Piping and fittings shall be manufactured by an approved manufacturer of repute. They should be truly cylindrical of clear internal diameter, of uniform thickness, smooth and strong, free from dents, cracks and holes and other defects.

2.02.08 For rubber lined ERW pipes, beads shall be removed for pipe size 80 NB and above.

2.02.09 Inspection holes shall be provided at suitable locations for pipes 800 Nb and above as required for periodic observations and inspection purposes.

2.02.10 At all intersection joints, it is Contractor's responsibility to design and provide suitable reinforcements as per the applicable codes and standards.

2.02.11 For large size pipes/ducts, at high point and bends/change of direction of flow, air release valves shall be provided as dictated by the system requirement and operation philosophy & tripping conditions of pumping system. Sizing criteria for air release valves shall be generally on the basis of valve size to pipe diameter ratio of 1:8. Requirement shall be decided as per relevant code.
Transient analysis /surge analysis wherever specified and required shall be conducted in order to determine the location, number and size of the Air-Release valve on certain long distance/high volume piping systems, if applicable within the scope of work of the package.

2.03.00 **Material**

2.03.01 Alternate materials offered by Bidder against those specified. shall either be equal to or superior to those specified. The responsibility for establishing equality or superiority of the alternate materials offered rests entirely with the Bidder and any standard code required for establishing the same shall be in English language.

2.03.02 No extra credit would be given to offers containing materials superior to those specified. Likewise, no extra credit would be given to offers containing pipe thickness more than specified.

2.03.03 All materials shall be new and procured directly from the manufacturers. Materials procured from traders or stockists are not acceptable.

2.03.04 All materials shall be certified by proper material test certificates. All material test certificates shall carry proper heat number or other acceptable references to enable identification of the certificate that certifies the material.

2.03.05 Material of construction for pipes carrying various fluids shall be as follows:

Sl No	Type of Fluid	Material
1.	i) Ordinary Water (Raw Water, Clarified Water, etc.) ii) Equipment cooling water including Both primary & secondary circuit (DMCW pH corrected & ACW drain water)	IS-2062 Gr.-E-250B/ASTM A-36/ASTM A-53 type 'E' Gr. B/IS-3589 Gr. 410 /IS-1239 Heavy.
2.	i) Demineralised water, ii)Alkaline solution (ECW system chemical dosing)	Stainless Steel to ASTM A312, Gr. 304 welded for sizes 65 mm NB and above. Stainless steel to ASTM A312, Gr. 304 sch.40s seamless for sizes 50mm and below
3.	i) Drinking (potable) water ii)Compressed air (Instrument & service air)	ASTM A-53 type E Gr. B galvanized/ IS 1239 Gr heavy galvanized/IS 3589 Gr 410 galvanized. Galvanized shall be to IS- 4736 or equivalent.
4.	(Condensate) spill water	ASTM A 106 Gr. B
5.	Effluents from Neutralization pit	MSRL

2.03.06	In water lines, pipes up to 150mm Nb shall conform to ANSI B36.10/ASTM-A-53, Type-E Gr. B /IS:1239 Gr. Heavy and minimum selected thickness shall not be less than IS:1239 Grade Heavy except for demineralised water, drinking water and condensate spill lines.
2.03.07	Pipes of above 150mm Nb shall be to AWWA-C200/ANSI B 36.10/ASTM A-53/IS 3589 Gr.410. Pipe to be fabricated by the bidder shall be rolled and butt welded from plates conforming to ASTM A-53 type 'E' Gr. B/IS 2062 Gr. E-250B/ASTM-A-36. However, larger pipes, i.e. 1000mm Nb and above shall be made from plates conforming to ASTM A 36/IS 2062 Gr. E-250B and shall meet the requirements of AWWA-M-11 (for deflection & buckling criteria considering water filled pipe as well as vacuum condition that may prevail during transient/surge conditions, truck-load, rail-load and weight density for compacted soil or any other load as the case may be).
2.03.08	In demineralised water service, the pipes up to 50 Nb shall be of stainless-steel ASTM A 312, Gr. 304 sch. 40 Seamless. The size for these pipes shall be to ANSI B 36.19. These shall be socket welded. The material for pipe from 65mm NB up to and including 400 NB shall be to ASTM A 312, Gr. 304 (welded). In no case the thickness of fittings shall be less than parent pipe thickness. Bidder/Contractor shall note that pipes offered as per a particular code shall conform to that code in all respects i.e. Dimension, tolerances, manufacturing methods, material, heat treatment, testing requirements, etc. unless otherwise mentioned elsewhere in the specification.
2.03.09	Instrument air, Plant (service) air lines and Drinking water lines shall be to ASTM A 53 type E grade B/ANSI B 36. 10/IS 3589, Gr. 410 / IS: 1239 Heavy (in case thickness calculated is more than gr. Heavy, ANSI B 36.10 Schedule numbers shall be followed) and galvanized to IS 4736 or any equivalent internationally reputed standard. The material of the pipes shall be to ASTM A 53 type 'E' Gr. B / IS: 3589, Gr. 410 / IS: 1239 Gr. Heavy. The fittings shall be of either same as parent material or malleable iron to IS-1879 (galvanized).
2.03.10	Spiral welded pipes as per API-5L/IS-3589 are also acceptable for pipe of size above 150 NB. However minimum thickness of the pipes shall be as elaborated in above clauses.
2.03.11	Condensate lines shall be to ASTM A 106 Gr. B and dimension to ANSI B 36.10 schedule "standard" as minimum to be maintained.
2.03.12	If carbon steel plates of thickness more than 12 mm are used for manufacture of pipes, fittings and other appurtenances, then the same shall be control-cooled or normalized as the case may be following the guidelines of the governing code.
2.04.00	**Field routed pipes:**
2.04.01	Pipelines of NB 50 size and below are regarded as field run piping. It is Bidder's responsibility to plan suitable layouts for these system insitu. Bidder shall prepare drawings indicating the layout of field run pipe work. These drawings shall be approved by Project Manager to the installation of the field run pipe work. Based on these approved layouts the Bidder shall prepare the BOQ of field run pipes and submit to Employer for approval.
2.05.00	**Slope/Drains and Vents**
2.05.01	Suitable slope shall be provided for all pipelines towards drain points. It is Bidder responsibility to identify the requirements of drains and vents, and supply the necessary pipe work, valves, fittings, hangers and supports etc. As per the system requirement low points in the pipelines shall be provided with suitable draining arrangement and high points shall be provided with vent connections where air or gas pockets may occur. Vent for use during hydrostatic test shall be plugged after the completion of the test. Vent shall not be less than 15mm size. Drains shall be provided at low points and at pockets in piping such that

complete drainage of all systems is possible. Drain shall not be less than 15mm for line size up to 150mm, not less than 20mm up to 300mm and not less than 25mm for 350mm to 600mm pipes and not less than 50mm for 600mm and above pipes. Material for drain and vent lines shall be compatible with that of the parent pipe material.

2.05.02 Air piping shall be sloped so that any part of the system can be drained through the shut-off drain valve or drain plugs.

2.06.00 **Pipe Joints**

In general, all water lines 65mm NB and above, are to be joined generally by butt welding except the locations where valves/fittings are to be installed with flanged connections and 50mm and below by socket welding unless mentioned otherwise specifically. All air lines shall be of screwed connection and rubber lined pipes of flanged connections.

2.06.01 **Screwed Joints**

(a) Threading of pipes shall be carried out after bending, heat treatment etc. If not possible, threading may be done prior to these operations but proper care should be taken to protect them from damage. Threads shall be to ANSI B 2.1 (taper) NPT / ANSI B1.20.1 (taper) NPT / IS: 554 unless specified otherwise.

(b) Galvanized pipe shall generally be joined by screwing into sockets. The exposed threaded portion on the outside of the pipes shall be given a zinc silicate coating. Galvanized pipes shall not be field joined by welding for protection of Galvanising Zinc layer. Screwed ends of GI pipes shall be thoroughly cleaned and painted with a mixture of red and white lead before jointing. For galvanized pipe sizes above 150 mm NB, screw & socket jointing as per ASTM-A-865 shall be employed for both pipe-to-pipe and pipe-to-fitting jointing. For pipe to fitting connection since no direct threading can be done on the fittings (supplied as per ASTM-A-234 Gr. WPB and ANSI B-16.9) necessary straight pipe lengths acting as match pieces shall be welded to the fitting at both ends and subsequently the free ends of the straight lengths shall be threaded as per ASTM A-865 for jointing with main pipe. Once welding of fittings with match pieces and threading of free ends of match pieces are over, the entire fabricated piece shall be galvanized, or in case match pipes and fittings are already galvanized before the above mentioned fabrication then suitable application of Zinc-Silicate paste adequately at the welded surface (both in side & outside) after welding, along with the nascent threaded metal portions at both free ends given the same application of Zinc Silicate paste. Alternatively, flanged jointing may be employed for pipe sizes 100 NB and above. However, the bidder shall ensure the galvanized pipe joints do not fail during hydro test.

(c) Teflon tapes shall be used to seal out screwed joints and shall be applied to the male threads only. Threaded parts shall be wiped clean of oil or grease with appropriate solvent if necessary and allowing proper time for drying before applying the sealant. Pipe ends shall be reamed, and all chips shall be removed. Screwed flanges shall be attached by screwing the pipe through the flange and the pipe and flange shall be refaced accurately.

(d) For pipe sizes from 350 mm NB to 550 mm NB (including 350 NB & 550 NB) the GI pipes shall be of flanged connection. However, the pipes after welding of flanges shall be completely galvanized. All the welded surfaces whether inside or outside shall be coated with zinc-silicate paste. Seal welding of flanges will be permitted only when any flange is leak-prone during hydro testing.

(e) For pipe sizes 600 mm NB and above, the GI pipes shall be of welded connection followed by application of zinc silicate coating at welded surfaces both inside and outside the pipe, except for the last blank/blind flange, or, equipment connection where application of zinc-silicate paste after welding cannot be done due to inaccessibility of the inside welded surface and where galvanic protection has been

impaired due to welding of pipe-to-pipe joint. Thus, the last erection joint shall be flanged joint.

2.06.02 **Welded Joints**

(a) For making up welded joints (butt weld or socket weld) the welding shall be performed by manual shielded metal arc process in accordance with the requirements specified elsewhere in the spec. Any welder employed for carrying butt welding shall be qualified as per ASME section IX for the type of joints he is going to weld. Jointing by butt weld, or socket weld shall depend upon the respective piping material specifications.

2.06.03 **Flanged Joints**

(a) Flanged connections for pipes are to be kept to the minimum and used only for connections to vessel, equipments, flanged valves and other fittings like strainer/traps/orifices etc. for ease of connection and maintenance etc. Rubber lined pipes shall be flange joined only.

(b) All flanged valves intended for installation on steel piping system, shall have their flanges drilled to ANSI B 16.5 (or equivalent) and according to the pressure class stated in their respective piping material specification.

(c) Drilling on flanges of flanged valves must correspond to the drilling of flanges on the piping system on which the valves are installed.

2.07.00 **Bends / elbows / mitre bends / Tees / Reducers & other fittings**

2.07.01 For pipe fittings such as elbows (long radius), reducers, tees, etc. the material shall be to ASTM-A-234 Gr. WPB/ASTM-105 up to 300 NB. For pipe fittings above 300 NB, the fittings may be fabricated conforming to parent pipe material. Provision of compensation pads shall be kept as per ANSI B 31.1. The fitting shall conform to the dimensional standard of ANSI B-16.9/ 16.11. Further branching in pipes for sizes 65nb and above is also acceptable (ANSI B 31.1).

However, for pipes up to 150 NB, pipe fittings may be supplied with material and dimension conforming to IS 1239 in case parent pipes also conform to IS 1239.

2.07.02 For pipe size 350Nb and above mitre bends may be used for all pipes except rubber lined pipes. However, mitre bends are also acceptable for rubber lined pipes above 1200 NB. The bend radius shall be 1½ times the nominal pipe diameter. 90 deg. bends (mitre) shall be in 4 pieces (3 cuts) and 45 deg. mitre bends shall be in 3 pieces 22½ deg. Fabrication of mitre bends shall be as detailed in BS 2633/BS534.

2.07.03 For pipes, above 1200 NB, reducer and tees shall be to dimensional standard of AWWA-C-208.

2.07.04 Stainless steel fittings shall conform to either ASTM-A-182 Gr. 304 or ASTM-A-403 Grade WP. 304 Class-S, for sizes up to and including 50 mm NB, i.e. the fittings shall be of seamless construction. However, for stainless fittings above 50 mm NB, the same shall conform to ASTM-A-403 Gr. WP 304 Class W i.e. the fittings shall be of welded construction strictly in accordance with ASTM-A-403.

2.07.07 In no case, the thickness of fittings shall be less than the thickness of parent pipe, irrespective of material of construction.

2.08.00 **Flanges**

2.08.01 Flanges shall be slip on type or weld neck type. Welding of flanges in tension is not permitted.

2.08.02 All flanges and-flanged drilling shall be to ANSI B 16.5/BS EN-1092 / AWWA C-207 of relevant pressure/temperature class. Flanges shall be fabricated from steel plates conforming to ASTM A 105/IS 2062 Gr. E-250B. However stainless-steel flanges shall be fabricated from SS plates to ASTM-A-240, Gr. 304 or equivalent.

2.09.00 **Specific technical requirement of laying buried pipe with anti-corrosive treatment**

The pipe in general shall be laid with the top of the pipe minimum 1.0 (one) meter below finished general ground level.

2.09.01 **Trenching**

(a) The trench shall be cut true to the line and level and shall follow the gradient of the pipeline. The width of the trench shall be sufficient to give free working space on each side of the pipe. Trenches shall conform to IS 5822 or any international standard.

2.09.02 **Preparation and cleaning of piping**

(a) The pipeline shall be thoroughly cleaned of all rust, grease, dirt, weld scales and weld burrs etc. moisture or other foreign matter by power cleaning method such as sand or grit blasting, power tool cleaning, etc. Grease or heavy oil shall be removed by washing with a volatile solvent such as gasoline. Certain inaccessible portions of the pipeline (which otherwise not possible to be cleaned by power cleaning methods) may be scrubbed manually with a stiff wire brush and scrapped where necessary with specific permission of the Project Manager.

(b) On the internal surface for pipes 1000 Nb and above, a coat of primer followed by a hot coal-tar enamel or coal tar epoxy painting (cold) shall be applied.

2.09.03 **Coating and wrapping/ Anti corrosive Protection Coal tar tape**

a. Buried piping shall be coated and wrapped, as per specification, after completion of welded and/or flanged connections, and after completion and approval of Hydro testing. Materials to be used for coating and wrapping of underground pipelines are:

(1) Coating primer (coal tar primer)

(2) Coating enamel (coal tar enamel)

(3) Wrapping materials.

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.

Protective coating shall consist of coal tar primer, coal tar enamel coating, glass fiber, tissue inner wrap followed by glass fiber or coal tar impregnated Kraft outer wrap or finish coat.
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. Soil data-for this purpose shall be made available.

Total thickness of completed coating and wrapping shall not be less than 4.0 mm.

b. Alternatively, the anti-corrosive protection for buried pipes can consist of anti-corrosive 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.

2.09.04 **Trench bed preparation and back filling**

Prior to lowering and laying pipe in any excavated trench, the bottom of the trench may require to be back filled and compacted (or as the case may be) to provide an acceptable bed for placing the pipe. Bed preparation in general shall be as per IS: 5822.

2.09.05 **Laying of galvanized steel (GI) pipes**

All the joints shall be screwed with socket or flanged. Screwed ends of GI pipes shall be thoroughly cleaned and painted with a mixture of red and white lead before jointing Threaded portion on either side of the socket joint shall be applied with Zinc silicate paste.

All the provisions for trenching' bed preparation' laying the pipe application of primer' coating' wrapping with tapes and back filling etc. as indicated for "laying of buried piping" and " anti-corrosive protection for buried piping" are applicable for buried galvanized steel (GI) pipes also.

2.10.00 **Cleaning and flushing**

2.10.01 All piping shall be cleaned by the Bidder before and after erection to remove grease, dirt, dust, scale and welding slag.

2.10.02 Before erection all pipe work, assemblies, sub-assemblies, fittings, and components, etc. shall be thoroughly cleaned internally and externally by blast cleaning or by power driven wire brushes and followed by air-blowing. However, for pipe sizes below 100nb the pipes may be cleaned internally by compressed air blowing as an alternative to internal blast cleaning. The brushes shall be of the same or similar material as the metal being cleaned. Cleaning of Galvanized pipes shall be done by air blowing only.

2.10.03 After erection, all water lines shall be mass flushed with water. The cleaning velocities in water lines shall be 1.2-1.5 times the operating velocities in the pipelines.

2.10.04 All compressed air pipe work shall be cleaned by blowing compressed air.

2.11.00 **Specification for hangers and supports**

2.11.01 All supports and parts shall conform to the requirement of power piping code ANSI B 31.1 or approved equivalent.

2.11.02 The maximum spans of the supports of straight length shall not exceed the recommended values indicated in ANSI B 31.1.

2.11.03 At all sliding surfaces of supports suitable arrangement is to be provided to minimize sliding friction.

2.12.00 **Design/Construction/Material Particulars of Gate/ Globe /Check /Butterfly / Ball / Air release /Float valves / Moisture Traps.**

2.12.01 **GENERAL**

(a) All valves shall have indicators or direction clearly marked on the hand-wheel so that the valves opening/closing can be readily determined.

(b) Special attention shall be given to operating mechanism for large size valves with a view to obtaining quick and easy operation ensuring that a minimum of maintenance is required.

(c) The valves coming in vacuum lines shall be of extended gland type and/or water sealed.

(d) The actuator-operated valves shall be designed on the basis of the following:

(1) The internal parts shall be suitable to support the pressure caused by the actuators.

(2) The valve-actuator unit shall be suitably stiff so as not to cause vibrations, misalignments, etc.

(3) All actuator-operated valves shall be provided with hand operated gearing mechanism also.

(4) All actuators operated valves shall open/ close fully within time required by the process.

(e) Valves coming under the purview of IBR shall meet IBR requirements.

(f) All valves shall be provided with embossed name plate giving details such as tag number, type, size etc.

(g) Wherever required valves shall be provided with chain operator, extension spindles and floor stands or any other arrangement approved by employer so that they can be operated with ease from the nearest operating floor. Wherever necessary for safety purpose locking device shall be provided. Further, necessary small platforms for facilitating easy valve operation shall be provided by the contractor wherever necessary in consultation with project manager within the bid price at no extra cost to employer

2.12.02 **VALVE BODY MATERIAL**

Valve body material for various services shall be as follows:

Valve body material for water application like Secondary circuit auxiliary cooling water of ECW system, Raw water, Ash water make-up, service water, clarified water, DM cooling water (pH corrected) , drinking water etc. shall be cast iron for sizes 65NB and above; gun-metal for sizes 50 Nb and below.

For compressed air application, valve body material shall be cast carbon steel or forged carbon steel for sizes 65 mm NB & above and Gun metal for sizes 50 NB and below.

DM water: SS body and disc along with SS internals. However, for butterfly valves, Cast Iron /Ductile Iron/SG iron/carbon steel body and disc with elastomer lining are also acceptable.

Condensate: Cast Carbon Steel / Forged Carbon Steel.

2.12.03 The design, material, construction, manufacture, inspection, testing and performance of valves shall comply with all currently applicable statutes, regulations and safety codes in the locality where the valves will be installed. The valves shall conform to the latest editions of applicable codes and standards as mentioned elsewhere. Nothing in this specification shall be construed to relieve the Bidder of his responsibility. Valves in general shall conform to the requirements of the following standards.

Standards and Codes

AWWA-C-504	Rubber seated butterfly valves.
BS-5155/EN-593	Cast iron and steel body butterfly valves for general purpose.
IS-778	Gun-metal gate, globe and check valves for general purpose.
BS-5154	Copper alloy globe/globe stop and check and gate valves for general purpose.
IS-780	Sluice valves for water works purpose (50-300 mm size)
IS-2906	Sluice valves for water works purpose (350-1200 mm size)
IS-5150	Cast iron wedge and double disc gate for general purpose.
BS-5152	Specification for cast iron globe valves.
BS-5153	Cast iron check valves for general purpose.
IS-5312	Swing check type reflux (non-return) valves.
ANSI B 16.34	Standard for valves.
API-594	Standard for Dual-check valves.
API-600	Steel gate valves.
ANSI-B-16.10	Valves face to face and other relevant dimension.
API-598	Valves inspection test.

2.12.04 **End Connections**

The end connections, shall comply with the following:

Socket welding (SW) - ANSI B 16.11

Butt Welding (BW) - ANSI B 16.25.

Threaded (SC) - ANSI B 2.1

Flanged (FL) - ANSI B 16.5& AWWA-C-207 (steel flanges), ANSI B 16.1 (Cast Iron flanges).

2.13.00 **Gate/Globe/Check Valves**

(a) All cast iron body valves (gate, globe and non-return) shall have flanged end connections; (screwed ends for Ductile D.2NI body valves are not acceptable).

(b) All steel and stainless-steel body valves of sizes 65 mm and above shall have flanged or butt-welding ends. Valves of sizes below 65mm shall have flanged or socket welded ends. Compatibility of welding between valve body material and connecting pipe material is a pre-requisite in case of butt-welded joints.

(c) All gun metal body valves shall have screwed ends.

(d) All flanged end valves / specialties shall be furnished along with matching counter flanges, fasteners, gaskets etc. as required to complete the joints.

(e) Gate/sluice valves shall be used for isolation of flow. All gate valves shall be of the full-way type, and when in the fully open position, the bore of the valve shall not be constricted by any part of the gate.

Gate valves shall be of the solid/elastic or articulated wedge disc. Gate valves shall be provided with the following accessories in addition to other standard items:

(1) Hand wheel

(2) Position indicator (for above 50 mm NB valve size)

(3) Draining arrangement wherever required.

(f) Globe valves shall be used for regulation purposes. They shall be provided with hand wheel, position indicator, draining arrangement (wherever required) and arrow indicating flow direction. Preferably, the valves shall be of the vertical stem type. Globe valves shall preferably have reduced or spherical seating and discs shall be free to revolve on the spindle.

The pressure shall preferably be under the disc of the valve. However, globe valves, with pressure over the disc shall also be accepted provided (i) no possibility exists that flow from above the disc can remove either the disc from stem or component from disc (ii) manual globe valves can easily be operated by hand. If the fluid load on the top of the disc is higher than 40-60 KN, bypass valve shall be provided which permits the downstream system to be pressurized before the globe valve is opened.

(g) Check valves shall be used for non-return service. They shall be swing check type or double door (Dual plate) check type with a permanent arrow inscription on the valve body indicating the fluid flow direction. In long distance pipes lines with possibility of surge-occurrence, dual plate check valves are preferable for its spring-controlled opening /closing of flaps/doors against flow reversals. However, dual plate check valves shall not be used for sizes more than 600mm NB.

(h) For bore greater than 2" the valves must be swing check type or dual plate check type suitable for installation in all positions (vertical and horizontal);

(i) For bore smaller than or equal to 2" the valves must be of the piston type to be installed, in horizontal position.

(j) All gate and globe valves shall be provided with back seating arrangement to enable online changing of gland packing. The valves shall be preferably outside screw & yoke type.

(k) All gate and globe valves shall be rising stem type and shall have limit switches for full OPEN and full CLOSED indication wherever required. This will include motor-operated valves also wherever required. In such cases the limit switches shall form

an integral part of the valve. Stop-gap arrangement in this respect is not acceptable.

(l) All valves except those with rising stems shall be provided with continuous mechanical position indicators; rising stem valves shall have only visual indication through plastic/metallic stem cover for sizes above 50 mm nominal bore.

(m) For CI gate, globe and check valves wherever thickness of body/bonnet is not mentioned in the valves standards, thickness mentioned in IS- 1538 for fitting shall be applicable.

2.13.01 **MATERIAL OF CONSTRUCTION (GATE/GLOBE/CHECK VALVE)**

(a) The materials shall generally comply with the following:

(1) **Cast Steel Valves**

Body & bonnet	ASTM A 216 Gr. WCB/ ASTM A 105
Disc for non-return Valves	ASTM A 216 Gr. WCB/ ASTM A 105
Trim.	ASTM A 182 Gr. F6 or Equivalent

(2) **Stainless steel valves**

Body & Bonnet	SS 304
Disc	-do-
Trim.	SS 316

(3) **Cast iron valves**

Body & bonnet	BS 1452 Gr. 14/ IS-210 Gr. FG 260
Seating surfaces and rings	13% chromium steel/ 13% Chrome overlay
Disc for non-return valves	BS 1452 Gr. 14/IS-210 Gr FG 260
Hinge pin for non-return valves	AISI 316
Stem for gate globe valves	13% chromium steel or Equivalent
Back seat	13 % chromium steel / 13% Chrome overlay

(4) **Gun Metal valves**

Body and bonnet	IS 318 Gr. 2/ Equivalent Standard
Trim.	-do-

(b) Cast iron body valves shall have high alloy steel stem and seat.

(c) Material for counter flanges shall be the same as for the piping.

(d) Forged carbon steel & Forged stainless-steel valves are also acceptable in place of Gun metal valves.

2.14.00 **Air Release Valve**

(a) The air release valves shall be of automatic double air valve with two orifices and two floats. The float shall not close the valve at higher air velocities. The orifice contact joint with the float shall be leak tight joint.

(b) The valve shall efficiently discharge the displaced air automatically from ducts/pipes while filling them and admit air automatically into the ducts/pipes while they are being emptied. The valve shall also automatically release trapped air from ducts/pipes during operation at the normal working pressure.

(c) Body material of automatic air release valves shall comply generally with BS 1452 Gr. 14/IS: 210 Gr. FG 260. and spindle shall conform to high tensile brass.

(d) Air release valves shall not have any integral isolation device within them. Each Air release valve shall be mounted, preceded by a separate isolation gate/ butterfly valve.

2.15.00 **Butterfly valves**

2.15.01 **Design/Construction**

(a) The valves shall be designed for the design pressure/temperature of the system on which it is installed and in accordance with AWWA-C-504, EN-593 or any other approved equivalent standard latest edition. Fabricated steel (IS: 2062 GR. E-250B) butterfly valves instead of cast iron body valves are also acceptable for size above 300 mm Nb diameter.

(b) The valves shall be suitable for installation in any position (horizontal/vertical etc.) and shall be generally of double-flanged construction. However, for sizes 600 NB and below the valves of Wafer construction are also acceptable

(c) Valves-350Nb and above shall have pressure equalizing bypass valves, wherever system parameters warrant the same.

(d) Valves-200Nb and above shall also be provided with gear operator arrangement as a standard practice suitable for manual operation. Manual operation of valve shall be through gear arrangement having totally enclosed gearing with hand wheel diameter and gear ratio designed to meet the required operating torque It shall be designed to hold the valve disc in intermediate position between full open and full closed position without creeping or fluttering. Adjustable stops shall be provided to prevent over travel in either direction.

Limit and torque switches (if applicable) shall be enclosed in watertight enclosures along with suitable space heaters for motor actuated valves, which may be either for On-Off operation or inching operation with position transmitter.

2.15.02 **Material of Construction (Butterfly Valves)**

Materials and other design details shall be as indicated below:

(a) **Cast Iron Butterfly Valves**

	Body & Disc	ASTM A48, Gr. 40 with 2% Ni / IS: 210. Gr. FG-260, with 2% Ni / SG iron BSEN 1563, Gr EN GJS-400-15 with 2%Ni and epoxy coated
	Shaft	BS 970 431 S: 291 / EN 57, or AISI-410 or AWWA-permitted shaft material equivalent to EN-57/AISI-410 or better.
	Seat ring	18-8 Stainless steel
	SEAL	NITRILE RUBBER

(b) **Stainless Steel Butterfly Valves**

Body & Disc	SS 304
Shaft	SS 316
Seat Rings	EPT/BUNA-N/Neoprene

(c) **Carbon steel Butterfly Valves**

Body & Disc	ASTM A 216, Gr. WCB
Shaft	SS 304
Disc & Seat Rings	EPT/BUNA-N/Neoprene

(d) **Elstomer lined Butterfly Valves**

Body & Disc	ASTM A48, Gr. 40 / IS: 210. Gr. FG-260 / SG Iron (ductile iron) IS 1865 Gr 400-15 or BSEN 1563, Gr EN GJS-400-15 / ASTM A 216, Gr. WCB with elastomer lining.
Shaft	SS 316

2.15.03 **Proof of Design Test (Type Test) for Butterfly Valves**

Proof of Design (P.O.D.) test certificates shall be furnished by the bidder for all applicable size-ranges and classes of Butterfly valves supplied by him, in the absence of which actual P.O.D. test shall be conducted by the bidder.

All valves that are designed and manufactured as per AWWA-C-504 / AWWA-C-516 shall be governed by the relevant clauses of P.O.D test in AWWA-C-504/AWWA-C-516. For Butterfly valves, designed and manufactured to EN-593 or equivalent, the P.O.D. test methods and procedures shall generally follow the guidelines of AWWA-C-504 in all respect except that Body & seat hydro test and disc-strength test shall be conducted at the pressures specified in EN-593 or the applicable code. Actuators shall also meet requirements of P.O.D. test of AWWA-C-504/AWWA-C-516.

2.16.00 **Float operated valves**

(a) Valve shall automatically control the rate of filling and will shut off when a predetermined level is reached and close to prevent over flow on pre-set maximum water level. Valve shall also open and close in direct proportion to rise or fall of water level.

(b) DESIGN AND CONSTRUCTION FEATURES
The following design and construction feature of the valve shall be the minimum acceptable.
(c) Valves shall be right-angled or globe pattern.
(d) Valves shall be balance piston type with float ball.
(e) Leather liner shall not be provided.
(f) The body and cover material shall be cast iron conforming to ASTM-A 126 Grade 'B' or IS: 210 Grade 200 or equivalent, and Float shall be of copper with epoxy painting of two (2) coats.
(g) Valves shall be suitable for flow velocities of 2 to 2.5m/sec.
(h) The valves shall have flanged connections.

2.17.00 **Tanks and Accessories**

2.17.01 The designer and manufacturer of storage tanks shall comply with and obtain approval of all currently applicable statutory regulations and safety codes in the locality where the equipment will be installed. The tanks shall conform to IS 803/IS804/IS 805/ IS 2825/ API 650/ IS 4049/ IS 4682 (part-I) and IS 4864 to 4870/ ASME B & PV code Sec.-VIII as the case may be.

2.17.02 **DESIGN AND CONSTRUCTION**

(a) Design of all vertical atmospheric storage tanks containing water, acid, alkali and other chemical shall conform to IS:803 & API 650.

(b) Design of all horizontal atmospheric storage tanks containing water, acid, alkali and other chemicals shall generally conform to IS:2825 as regards to fabrication and general construction taking care of combined bending, shear & hoop stresses developed due to supporting arrangement.

(c) Tank shall be made from mild steel plates to BS 4360/IS-2062 Gr.E-250B (or equivalent) for ordinary wafer application when it is not corrosive in nature.

(f) Tank shall be provided with suitable supporting joints. All vessels shall be provided with lifting lugs, eye bolts etc. for effective handling during erection.

(j) Tanks shall be provided with float operated level indicators / level gauges / level transmitters and level switches, as required, with complete assembly. Suitable flanged pads for level switches mounting shall also be provided. The level indicator can be top or side mounted as the case may be.

(k) In addition to inlet and outlet nozzles, the tanks shall be provided with vents, overflow, drain nozzles complete for various connections on tanks. Overflow lines from storage tanks is to be routed to the nearest surface drains. For tanks containing DM water, alkaline water or power cycle water the vent to atmosphere shall be through carbon-di-oxide absorber vessel suitably mounted on the tank. CO_2 absorber vessel shall be provided with the initial fill of chemicals.

(l) Tanks shall have suitable stairs/ladders on inside and outside of the tanks, manholes / inspection cover as required and also platform suitably located.

(m) Tank supporting arrangement as approved by Employer shall be provided with all plates/angles/joints/flats and supporting attachment including lugs, saddles, legs etc.

(o) Tank fabrication drawing and design calculations shall be approved by the Project Manager.

2.17.03 **Corrosion protection**

(a) A corrosion allowance, applicable to surface in contact with corrosive media, when required after thorough cleaning by blast cleaning preceded by wire brushing shall be taken into consideration.

(b) Manholes shall be provided for easy access into the vessels. The size shall be minimum 500 mm and will be with cover plate, nuts bolts, etc. to ensure leak tightness at the test pressure.

(c) Each tank shall be provided with drilled cleats welded to the tank for electrical grounding. Material of cleats shall be same as that of the shell.

Sl. No.	Description	Tech. Particulars
1.00	**CONDENSATE STORAGE TANKS**	
1.01	Number required	one for each unit
1.02	Capacity of each tank (Effective)	450 Cu. m (for 800 MW units)
1.03	Size (Dia. & Height)/Plate Thickness	8.6mX7.2m minimum, Shell & Roof plate Thickness 8mm and Base plate thickness 10mm
1.04	Type and pressure class	Vertical, cylindrical, atmospheric
1.05	Material of construction	MS- (IS-2062 Gr. B or equivalent) as per specified code, 8mm thickness (minimum)
1.06	Location	Outdoor
1.07	Overflow, drain, vent and Sample connection (piping &valve)	required
1.08	Level Indicator	
	a) Number	One for each tank
	b) Type	Mechanical float type with dial type indicator (Guide wire, Float and Housing of Stainless steel - 316 Gr. construction)
1.09	Manhole (minimum 500mm size)	Two (2)-one on shell and the other on roof
1.10	Special Fittings	
	a) Hydraulic Seal of Overflow/Drain	Required

	b)	Additional nozzle Connection	number and size to be indicated to successful Bidder
	c)	Nozzle connection for Instrument/spare	Three (3) nos. for each tank
	d)	CO2 Absorber for vent (not to be kept on roof of tank, but to be kept on ground level)	required
	e)	Outside stair case (spiral)	required
	f)	Inside Ladder	Required
	g)	Draw off sump	required
	h)	Root valve for level Transmitter	Root valves for two (2) nos. level transmitter for each tank Required

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2.18.00 **RUBBER EXPANSION JOINTS**

2.18.01 All parts of expansion joints shall be suitably designed for all stresses that may occur during continuous operation and for any additional stresses that may occur during installation and also during transient condition.

2.18.02 The expansion joints shall be single bellow rubber expansion joints. The arches of the expansion joints shall be filled with soft rubber.

2.18.03 The tube (i.e. inner cover) and the cover (outer) shall be made of natural or synthetic rubber of adequate hardness. The shore hardness shall not be less than 60 deg. A for outer and 50 deg. A for inner cover.

2.18.04 The carcass between the tube and the cover shall be made of high quality cotton duck, preferably, square woven to provide equal strength in both directions of the weave. The fabric plies shall be impregnated with age resistant rubber or synthetic compound and laminated into a unit.

2.18.05 Reinforcement, consisting of solid metal rings embedded in carcass shall be provided.

2.18.06 Expansion joints shall be complete with stretcher bolt assembly. The expansion joints shall be suitable to absorb piping movements and accommodate mismatch between pipe lines.

2.18.07 The expansion joints shall be of heavy duty construction made of high grade abrasion-resistant natural or synthetic rubber compound. The basic fabric for the' duck' shall be either a superior quality braided cotton or synthetic fiber having maximum flexibility and non-set characteristic.

2.18.08 The expansion joints shall be adequately reinforced, with solid steel rings, to meet the service conditions under which they are to operate.

2.18.09 All expansion joints shall be provided with stainless steel retaining rings for DM water application and IS 2062 Gr E-250B galvanized steel retaining rings for ordinary water for use on the inner face of the rubber flanges, to prevent any possibility of damage to the rubber when the bolts are tightened. These rings shall be split and beveled type for easy installation and replacement and shall be drilled to match the drilling on the end rubber flanges and shall be in two or more pieces.

2.18.10 The expansion joints shall have integral fabric reinforced full-face rubber flanges. The bolt on one flange shall have no eccentricity in relation to the corresponding bolt hole on the flange on the other face. The end rubber flanges shall be drilled to suit the companion pipe flanges. The flanges shall be as per ANSI B 16.5. For higher sizes, not covered under ANSI B 16.5, the same shall be as per AWWA.

2.18.11 All exposed surfaces of the expansion joint shall be given a 3 mm thick coating of neoprene. This surface shall be reasonably uniform and free from any blisters, porosity and other surface defects.

2.18.12 Each control unit shall consist of two (2) numbers of triangular stretcher bolt plates, a stretcher bolt with washers, nuts, and lock nuts. Each plate shall be drilled with three holes, two for fixing the plate on to the companion steel flange and the third for fixing the stretcher bolt.

2.18.13 Each joint shall have a permanently attached brass or stainless-steel metal tag indicating the tag numbers and other salient design features.

2.18.14 Bidder to note that any metallic part which comes in contact with DM /corrosive water shall be of Stainless-Steel material.

2.18.15 **Life cycle test for RE Joints of Condenser CW Inlet Outlet lines:**

Life cycle test certificates shall be furnished by the bidder for each type and size of RE joints supplied by the Bidder, in the absence of which actual Life cycle test shall be conducted on one rubber expansion joint of each type and size.

2.19.00 **STRAINERS**

2.19.01 **Simplex type**

The strainers shall be basket type and of simplex construction. The strainer shall be provided with plugged drain/blow off and vent connections. The free area of the strainer element shall be at least four (4) times the internal area of the connecting pipelines. The strainer element shall be 20 mesh. Pressure drop across the strainers in new condition shall not exceed 1.5 MCW at full flow. Wire mesh of the strainers shall be suitably reinforced, to avoid buckling under operation. Strainer shall have screwed blow off connection fitted with a removable plug. The material of construction of various parts shall be as follows:

(a)	Body	IS: 318, Gr. 2 up to 50 mm Nb, and IS: 210 Gr. FG 260 above 50 mm Nb. (For DM water/ -Body: AISI 316 or equivalent)
(b)	Strainer Element	Stainless steel (AISI 316)
(c)	End connection	Screwed up to 50 mm Nb, and Flanged above 50 mm Nb

2.19.02 **Duplex type**

(a) The strainers shall be basket type and of duplex construction. The strainer shall be provided with plugged drain/blow off and vent connections. The free area of the strainer element shall be at least four (4) times the internal area of the connecting pipe. The mesh of strainer element shall be commensurate with the actual service required. Pressure drop across the strainer in new condition shall not exceed 4.0 MWC at full flow.

(b) Wire mesh (if applicable) of the strainers shall be suitably reinforced. The material of construction of various parts shall be as follows.

Body	IS: 318, Gr. 2 up to 50 mm Nb, and IS:210, Gr. FG 260 or ASTM-A-515 Gr. 75/IS-2062 Gr. E-250B and internally epoxy-painted above 50 mm NB.
Strainer element	Stainless steel (AISI 316)
End connection	Screwed up to 50mm Nb, and Flanged above 50 mm Nb. Gasket shall be of full-face type

(c) The strainer will have a permanent stainless-steel tag fixed on the strainer body indicating the strainer tag number and service and other salient data.

(d) The size of the strainer and the flow direction will be indicated on the strainer body casting.

(e) Thickness of the strainer element should be designed to withstand the pressure developed within the strainer due to 100% clogged condition exerting shut-off pressure on the element.

SUB-SECTION– E-24
FIRE PROTECTION SYSTEM

1.00.00	**FIRE DETECTION & PROTECTION SYSTEM**
9.01.00	HYDRANT SYSTEM: Shop Tests
1..01	**Hydrant Valve:**
	a) All valves shall be hydro tested for body and seat.
	b) Capacity test / flow test shall be done as per relevant standard.
1..02	Water Monitor, Hoses, Branch Pipes, Couplings and Nozzles:
	a) All tests including hydraulic test shall be done as per relevant Indian / International standard.
1..03	For Pumps, Diesel Engine, refer the requirements are indicated separately.
9.01.00	**HIGH / MEDIUM VELOCITY WATER SPRAY & SPRINKLER SYSTEM: Shop Tests**
1..01	For Pipes, Fittings, Valves and specialties, requirements are indicated separately.
1..02	Deluge Valves, Alarm Valves and Spray Sprinkler Nozzles
	a) All valves shall be hydro tested for body and seat.
	b) Performance test / functional test of 'Deluge Valves', 'Alarm Valves' and 'Spray Nozzles' shall be carried out.
1..03	**Detectors:** All 'Detectors' shall be tested as per relevant Indian / International Standards. Detectors shall also meet the requirements of UL / FM / LPC/VDS etc.
9.01.00	**HORIZONTAL CENTRIFUGAL PUMP:**
1..01	SHOP TESTS
	(a.) UT on Pump Shaft (>= 50mm dia) and MPI / DPT on Pump Shaft and Impeller shall be carried out.
	(b.) All rotating components of the pumps shall be statically and dynamically balanced as per IS: 21940 Gr. 6.3 or better.
	(c.) Hydraulic test shall be conducted on pump casing with water at 1.5 times the shut off pressure or twice the rated pressure whichever is higher for a minimum duration of 30 minutes.
	(d.) Performance test and Standard Running test:
	(1.) All the pumps shall be tested in the manufacturer's works for capacity, efficiency, head and brake horsepower. Pump shall be

given running test over the entire operating range covering the shut off head to the maximum flow. The duration of test shall be minimum one hour. A minimum of five readings approximately equidistant shall be taken for plotting the curves with one point at design flow. Testing of pump shall be in accordance with stipulations oh Hydraulic Institute Standard (HIS) and / or as per applicable Indian Standard or equivalent. Tolerance of parameters shall be as per HIS.

(2.) The test shall be conducted at the rated speed preferably with the type tested contract drive motor being furnished. However, in case of any limitation test bed motor duly calibrated can also be used.

(3.) Noise and vibration shall be measured.

(4.) Pumps shall be subjected to strip down examination visually to check for mechanical damages after testing at shop in case abnormal noise level / vibration performance are observed during the shop test.

9.01.00 COMPRESSION IGNITION DIESEL ENGINE

1..01 Shop Tests:

a) All pressure parts shall be subjected to hydraulic pressure tests at 1.5 times the design pressure.

b) All Diesel engine shall be performance tests as per relevant IS / equivalent code.

1..02 Performance Test :

Performance test of diesel engine shall be carried out as per BS-5514 to determine the rated power and specific fuel consumption and governor's function. Performance test of engine in shop shall be done with actual job accessories for minimum four hours (three hours for full load and one hour for over load at 110% of full load). All the engine parameters like RPM, inlet airs temp and pressure, water inlet and outlet temp. And pressure, lub. Oil pressure, fuel consumption, ambient condition shall be measured and recorded for every half an hour. No positive tolerance shall be allowed on the specific fuel consumption (contractor to specify in the offer.)

9.01.00 STORAGE VESSELS: Shop Test

1..01 Atmospheric Tank

(a.) All weld joints shall be DP Tested and complete tanks shall be water fill tested.

(b.) All atmospheric storage tanks fabricated and erected at site shall be subjected to all tests (Hydro, NDT, and Vacuum) according to design code as applicable.

1.06.00 PIPING, VALVE AND SPECIALITIES

1.06.01 SHOP TESTS

(a.) All pipes and fittings shall be tested as per applicable code.

(b.) DPT of pipe welds (in case of rolled and welded pipes only) shall be carried out for root and finished welds.

(c.) All strainers shall be subjected to hydraulic pressure test for leakage and Pressure drop v/s Flow for each type and size.

(d.) All valves shall be hydraulically tested for body, seat and back seat (if applicable) as per relevant standard. Check valves shall also be tested for leak tightness test at 25% of the specified seat test pressure.

(e.) Valves shall be offered for hydro test in unpainted condition.

(f.) Functional checks of the valves for smooth opening and closing shall also be done.

(g.) Anti-corrosive protection shall be tested as per applicable code.

1.07.00 PORTABLE & MOBILE FIRE EXTINGUISHERS

1.07.01 SHOP TEST

(a.) All fire extinguishers shall be tested as per relevant standard.

(b.) Performance / function test shall be carried out on sampling basis as per relevant code / standard.

1.08.00 EOT Crane

a) Chain pulley Blocks shall be tested as per IS: 3832.

b) Electrical wire rope hoists shall be tested as per IS : 3938

c) Following NDT requirements shall be met:

(i) 100% RT of Butt welds in tension and 10% RT of butt welds in compression.

(ii) DP at random on all weldments.

c) Deflection, load, overload & travel check on EOT crane assembly shall be carried out as per IS: 3177.

1.09.00 **SITE TESTS**:

a) Fire Extinguishers: A performance demonstration test at site of five (5) percent or one (1) number, whichever is higher, of each type and capacity of the extinguisher shall be carried out by the contractor. All consumables and replaceable items require for the contractor without any extra cost to employer would supply this test would be supplied by the Contractor without any extra cost to employer.

b) Piping Protection:

(1.) Thickness, Holiday by spark test, Adhesion test shall be carried out as per relevant standard.

(2.) Complete piping shall be Hydro pressure tested, at 1.5 X DP or 2 X MWP whichever is higher, before protection.

(c.) Welding of Pipes:

(1.) ERW Black / rolled welded:

100% DPT on root of butt and finish weld of butt and fillet.

RT on 10% randomly selected joints shall be carried out (for underground piping).

(2.) GI Pipes

Welding on GI Pipes in general shall not be done. Welding of GI Pipes, if permitted by design, (butt / socket / fillet weld) shall be done strictly as per approved drawing and procedure approved by NTPC Engineering. For all such welds 100% DP test and random 1% RT shall be done.