1.0 GENERAL DESCRIPTION AND SCOPE OF WORK

1.01 General

The 1,020 MW Tala Hydropower Plant (THP), located at Tabji under Chhukha dzongkhag in western Bhutan downstream of Chhukha Hydropower Plant, is the largest power plant (profit centre) of Druk Green Power Corporation Limited (DGPC). DGPC is a wholly owned subsidiary of Druk Holding and Investments Limited established in 2008 with the merger of the erstwhile hydropower corporations in the country.

With a mandate to promote, develop and maintain major hydropower assets of Bhutan in a sustainable manner, DGPC operates and maintains four hydropower plants with a total installed capacity of 1,480 MW, which are 64 MW Basochhu Hydropower Plant, 336 MW Chhukha Hydropower Plant, 60 MW Kurichhu Hydropower Plant and 1,020 MW Tala Hydropower Plant. DGPC also has shareholdings in the subsidiaries namely 126 MW Dagachhu Hydro Power Corporation Limited (59%) and 118 MW Tangsibji Hydro Energy Limited, and Joint Venture companies namely 600 MW Kholongchhu Hydro Energy Limited (50%), Bhutan Hydropower Services Limited (51%) and Bhutan Automation & Engineering Limited (51%).

The biggest project to be considered by the Royal Government of Bhutan (RGoB), it was completed with financial assistance from the Government of India (GoI).

1,02 PURPOSE AND DESCRIPTION OF WORK

Sewage Treatment Plant (STP) is to be installed in *the* underground powerhouse located at Tabji for treatment the sewage collected in the collection tank before flushing out in the river. The STP must be based on hybrid design & Semi-Automatic being compact in size and technologically suitable fulfilling the environment requirements and specified standards.

1.03 SEWAGE TREATMENT PLANT

Major components of a sewage treatment facility are but not limited to the followings.
Bar Screen
Grit Chamber
Comminutors
Pre-aeration tanks
Main settling tanks
Aeration tank
Secondary settling tank
Biological filter
Sludge handler

The components may differ based on different technology available in the market

1,04 DESIGN BASIC

Nature of Waste: Domestic Sewage
Max. Daily Average Flow: 5m3/day
Average Flow Rate: 0.25m3/hr.

Raw sewage & treated sewage characteristics:

For the design purpose for the proposed STP following parameters can to be adopted or Bidder can take sample at their own level.

Characteristics of Influent Sewage Parameters

pH	6-8
TSS mg/l	200
COD mg/l	550
BOD mg/l	450
TDS mg/l	2000
O&G mg/l	5

The treated wastewater should comply with the standards given in consent order by NEC standards with (not limited to) following parameters:

a) pH Value	6.0 to 9.0
b) BOD	250mg/l
c) COD	500mg/l
d) Total Suspended solids	400mg/l
e) Total nitrogen as N	20 to 40 mg/l
f) Total Phosphates as P	4 to 8 mg/l

DISPOSAL WORKS.: The two existing sewage treatment plant installed at Machine and MIV floor level have been nonfunctional for many years. Before the STP is installed, the bidder should dismantle and remove the existing STP and transported as directed by the Project manager.

ESTIMATION OF SEWAGE FLOW: **STP** will be designed for a flow of 5 KLD

1.04 Treatment Step>

The raw sewage will be treated as per the steps given below. However, the system may differ from one technology to another that are available in the market

- Screening and Pumping.
  The incoming wastewater passes through screening equipment where objects such as rags, wood fragments, plastics, and grease are removed. The material removed is washed and pressed and disposed of in a landfill. The screened wastewater is then pumped to the next step: grit removal

- Grit Removal.
  In this step, heavy but fine material such as sand and gravel is removed from the wastewater. This material is also disposed of in a landfill.

- Primary Settling.

  The material, which will settle, but at a slower rate than step two, is taken out using large circular tanks called clarifiers. The settled material, called primary sludge, is pumped off the bottom and the wastewater exits the tank from the top. Floating debris such as grease is skimmed off the top and sent with the settled material to digesters. In this step, chemicals are also added to remove phosphorus.

- Aeration / Activated Sludge.
  In this step, the wastewater receives most of its treatment. Through biological degradation, the pollutants are consumed by microorganisms and transformed into cell tissue, water, and nitrogen. The biological activity occurring in this step is very similar to what occurs at the bottom of lakes and rivers, but in these areas the degradation takes years to accomplish.

- Secondary Settling
  Large circular tanks called secondary clarifiers allow the treated wastewater to separate from the biology from the aeration tanks at this step, yielding an effluent, which is now over 90% treated. The biology (activated sludge) is continuously pumped from the bottom of the clarifiers and returned to the aeration tanks in step four.

- Filtration.
  The clarified effluent is polished in this step by filtering through 10-micron polyester media. The material captured on the surface of the disc filters is periodically backwashed and returned to the head of the plant for treatment.

- Disinfection
  To assure the treated wastewater is virtually free of bacteria, ultraviolet disinfection is used after the filtration step. The ultraviolet treatment process kills remaining bacteria to levels within our discharge permit.

- Oxygen Uptake.
  The treated water, now in a very stabilized high-quality state, is aerated if necessary to bring the dissolved oxygen up to permit level. After this step, the treated water passes through the effluent outfall where it joins the Oconomowoc River. The water discharged to the river must meet stringent requirements set by the DNR. Pollutant removal is maintained at 98% or greater.

- Sludge Treatment
  The primary sludge pumped from the bottom of the primary clarifiers in step three, along with the continuous flow of waste activated sludge from the aeration /

activated sludge process in step four, must be treated to reduce volume and produce a usable end product.

SCOPE OF WORK

The main scope of work includes dismantling of the existing 2 nos. nonfunctional STP installed in the underground powerhouse and to Design, Supply, Erect, test & Commission of Sewage Treatment Plant (STP) for underground power house of Tala Hydro Power plant including all civil, electrical and mechanical works required for successful commissioning of the STP. The tank and pipeline should be of high-quality stainless steel make including fittings, bolts, nuts etc.

a) It is not the intention of these specifications to specify the complete details of equipment, however the contractor shall supply the equipment, which will meet in all respect, the requirements of the owner regarding performance, durability and satisfactory operations. The equipment supplied shall conform to the latest applicable specifications of the BIS, DIN, ASTM or equivalent.
The broad scope of the work for the Sewage Treatment Plant (STP) as specified in the following paragraphs shall include the following: -
Design, Supply, Erect, Test & Commission of Sewage Treatment Plant (STP) with. The STP must be of latest Technology with Hybrid Design and Semi-Automatic Plant which should be compact plant requiring less space and technologically suitable fulfilling the environmental requirements and specified standards. The works includes all civil, electrical and mechanical required for successful installation and commissioning of the plant.

Supply and installation of all incidentals not specified but necessary for the proper completion and satisfactory functioning of equipment and guarantee of the permanent equipment, along with all auxiliary equipment shall also be in the scope of work.

2.0 TECHNICAL SPECIFICATIONS FOR STP

2.01 Quality

Products, materials and articles incorporated in work shall be new, not damaged or defective, and of best quality purposes intended. **The tank, pipeline shall be made of stainless-steel. All nuts, bolts, fittings etc. should be made of stainless steel wherever applicable.**

2.01 General

1. The work shall be strictly as per the Detailed Design to be submitted by the bidder only after the approval of Engineer-In-Charge.
2. Piping Arrangement & Manhole for Sewage Treatment Plant and Collection

Tank.

3. Bidder has to submit all manufacturers test certificates, Chemical/Mechanical Test for material of Major Components of STP and other Tests as & when directed for Quality Control at site have to be included in the bid.
4. All the Lap, Anchors, Bolts & Nuts, Rods, Hooks, S S plates, Splices, Bends, Clamps, Shackles, Eyes, Channels, Hooks, Steel etc. shall be conforming to IS:456, IS:1786, IS:2502, IS: 1239, IS:2801 S:2602, IS:1363, IS:2266 and other relevant Indian Standards/International Standard.
5. Staging, Scaffolding and other necessary arrangements for erection of STP shall be in the scope of Contractor.
6. All the necessary Equipment, Machineries, Boats, Tools & Tackles etc. for Erection of STP at THP Underground powerhouse shall be in the scope of the Contractor. THP will not take no liability of any kind.
7. Working with required Materials, Machineries, Manpower, Tools & Tackles and Technology shall be in scope of the Contractor.
8. All the test of Aggregate (Coarse & Fine) shall be as per IS: 383 and IS: 456.
9. Cement shall be conforming to IS: 8112/ IS:12269.
10. The exact Quantities and dimensions shall be as per site requirement and Bill of Material for Fabrication/Erection shall be submitted by the Contractor.
11. All components shall be manufactured with material of approved quality with best workmanship. The spares of equipment shall be shop assembled as possible to check operation and accuracy of parts; however final erection, testing/ installation shall be done on site only.
12. Metal parts of STP shall be painted by 350 micron of epoxy paint after proper cleaning, sand blasting and primer coating. Make of primer and paint shall be approved by the owner.
13. The welding joints shall be made as per approved drawing and procedure approved by the owner.
14. Any defects noticed during the installation of STP shall be rectified by the contractor as per instruction of the engineer in charge.
15. All facility to approach work front for installation of STP shall also be under in the scope the Contractor.
16. All tools, tackles, plant, man & machineries and consumables required for factory installation of STP shall be included and prices for the same deem to be included in the quoted price
17. Any other item which are not specifically mentioned in scope but required for successful performance of the STP shall also be in the scope of the contractor.
18. The Contractor shall provide QAP for the equipment for client's approval. All inspection shall be carried out as per approved QAP.

Only the broad scope covering technical requirements for the STP to be supplied is indicated. It is not the intent of this specification to specify complete details of the equipment including design and manufacture. The successful bidder shall carry out detailed design and engineering and manufacture in a manner that will ensure smooth

and trouble-free performance of the STP as a whole.

2.1 SUBMISSION OF DRAWINGS AND DOCUMENTS

The supplier is required to follow procedure for submission of designs and drawings and other documents for approval.

1. Two copies of all the design calculations, drawings, and technical data of the commercial equipment, and other bought out items will be submitted for approval.
2. After completion of the job the Supplier will submit one complete set of reproducible/transparencies of all the drawings and design calculations in as-built conditions,
3. Before start of the erection of the equipment's the supplier will submit two copies of the draft operation and maintenance manual. The O & M manual should indicate the details of equivalent/substitute manufacturer of any brought-out items, grade of lubricant /grease oil and other such details, which are essential. The manual shall also include the necessary electrical diagrams as well as the manufacturer's technical data sheets and operating/maintenance instructions in respect of all the commercial equipment.

   The Supplier will submit 2 complete sets of operation and maintenance manual for use with the equipment.
4. Supplier shall also submit soft copies of all and documents/reports/OM Manual etc. for record and owner's use.

3.0 MANUFACTURE ANO WORKMANSHIP, PAINTING

4.01 GENERAL

The purpose of these prov1s1ons is to provide the contractor with the general technical requirements applicable to the equipment called for in the technical specifications.

These technical provisions are, therefore, to be read in conjunction with the Technical Specification and drawings.

4,02 WORKMANSHIP

The workmanship shall conform to relevant Indian/International Standard codes. The contractor shall be responsible for the accurate manufacture and fabrication of equipment in accordance with the best modern practice in the manufacture and fabrication of materials of the types covered by these specifications notwithstanding the minor errors or omission there from. The contractor shall warrant all materials and workmanship furnished by him to be free from injurious defects. He shall replace free of

cost any defective material or workmanship discovered during erection or in guarantee period and shall pay the actual cost of the correction in the field of any errors for which he is responsible.

4.03 FABRICATION OF STAINLESS STEEL

1 Structural steel work shall conform to the requirements hereinafter specified, unless otherwise called for in these specifications or on the drawings. Finished members shall be free from twists, bends, and open joints. Compression joints depending upon contact bearing shall have surfaces truly faced so as to have full contact bearing when aligned and bolted.

2. straightening of materials: Before being laid off or worked, rolled material shall be straight and shall be cleaned of all rust and dirt, if straightening is necessary, it shall be done by methods that will not injure the metal. Sharp corners and bends will be cause for rejection of the material.

3. Shearing and cutting: Shearing and cutting by torch shall be performed carefully, and in all work, which will be exposed to view after completing shall be finished neatly. Sheared or cut edges of plates more than 16 mm thick which carry computed stresses shall be planed to a depth of 6 mm. Re-entrant cuts shall be filleted before cutting_

4. Holes: Holes in structural steel members carrying calculated stresses shall be sub- punched to 3 mm less than the nominal diameter of the bolt as dreamed to full size or drilled after assembly. All other members may be punched to full size. Main members shall be assembled in the shop prior to reaming or drilling holes for field connections.

5. Punching: For sub-punching and for punching to full size, the diameter of the punch shall be 5 mm smaller and 1.6 mm larger, respectively, than the nominal diameter of the bolt. The diameter of the die shall not be more than 2.5 mm larger than the diameter of the punch. All holes shall be clean cut and without torn or ragged edges. If any hole has to be enlarged to admit the bolt it shall be reamed.

6. Accuracy of punched holes: Holes shall be punched so accurately that after assembling the component parts of a member, a cylindrical pin 3 mm smaller in diameter than the nominal diameter of the punched hole may be entered, perpendicular to the face of the member without drifting in not less than 75 percent of any group of continuous holes in the same plane. All holes shall pass a pin 5 mm smaller in diameter than the nominal diameter of the holes

7. Reaming: Reamed holes shall be cylindrical, perpendicular to the member, and not less than 1.5 mm or more than 2.5 mm than the nominal diameter of the bolts. Built up members shall be assembled and firmly bolted together before any reaming is done. Reamed parts shall not be interchanged. Burrs and shavings from reaming shall be removed and, if necessary, reamed pieces shall be taken apart before being bolted and the shavings removed

8. Drilling: Drilled holes shall be cylindrical, perpendicular to the member 1.5 mm larger than the nominal diameter of the bolts.

9. accuracy of reamed and drilled holes: Holes shall be drilled and reamed so accurately after assembly that not less than 85 percent of any group of continuous holes in the same plane shall show no offset greater than 0.8 mm between adjacent thicknesses of metal.

10. Removal of burrs: Burrs resulting from reaming or drilling shall be removed with a tool making a 1.5 mm bevel.

11. All connection joints should be carried out by bolted/welded connections and not by riveting

4.04 BOLTS/FASTENERS

Permanent bolts shall be furnished in the amount of five percent plus ten bolts in excess of the nominal number of each size required. All bolts shall have unified threads. Bolts in tension shall have a net section at root of thread equal to 15 percent in excess of the net section required in tension. All bolts and fasteners shall be made of stainless steel

4.05 WELDING

Members to be joined by welding shall be cut accurately to size, and where required, shall be rolled or pressed to proper curvature in accordance with the approved drawings. The dimensions and shape of edges to be joined shall be such as to allow thorough fusion and complete penetration and plates shall be planed, if necessary, to accomplish this result. Members to be welded together shall be in sufficient intimate contact at the time of welding so that members will not force closely together with the cooling of the weld, thus setting up additional strains and distortions in the weld and parent metal.

The cut surface shall be free from all visible defects such as lamination surface defects caused due to shearing or cutting or flame cutting operations. The surfaces of plates to be welded shall be free from dust, grease and scale for a distance of 12 mm back from the welding edge at the time of welding. Flame cutting maybe used in the preparation of the various

member provided in the operation is performed carefully, and the edge so cut are cleaned thoroughly after being cut so as to expose clean metal. Any contour irregularities shall at point of critical stress shall be removed by grinding.

All welding shall be carried out using a suitable welding sequences /procedure approved by the Engineer-in-Charge and in such a way that harmful effects of welding are avoided.

When the welding process has been approved by the Engineer-in-charge, the Contractor shall produce a record drawing to show the approved process. The drawing shall include details such as the form of edges to be welded, electrodes and other welding materials, welding sequence etc. changes in the welding process after the welding method has been approved shall require the consent of the Engineer-in- charge.

Additional copies of all records of all welding procedures, including preheating and stress relieving, chemical analysis and physical properties, shall be made available to the engineer-in-Charge upon request. All welded parts to be welded shall be manufactured of steel produced by open hearth or electric furnace with carbon content not more than 0.20% and a Phosphorous content nor more that 0.05%.

All welding shall be done by the electric arc method or by a process which will exclude the atmosphere from the molten metal, expect where otherwise specifically permitted. The welding electrodes shall be heavily coated type designed for all position welding. In assembling and during welding, the component parts of built-up members shall be held in place by sufficient number of clamps or other adequate means to keep all parts in proper position.

The Contractor shall follow the steel manufacturers instructions or recommendations concerning electrodes and other materials and post and preheat treatment. Notwithstanding the above, the suitability of electrodes to be used for welding for both shop and field welding shall be demonstrated by trials to the satisfaction of the Engineer-in-Charge.

The strength of welding of all equipment subject to high and/or alternating stresses, vibrations etc. shall be at least equal to the strength of the parts being welded. Between plates and other sections where such stresses are to be transmitted only butt welds shall be permitted. At welded butt joints, where the weld material is required to be deposited on both sides of the joints, the weld shall be chipped thoroughly to obtain a clean surface prior to the application on the first head of the welding on the opposite site of the joint, where fillet welds are used the lapped sections shall fit closely and shall be held together during the welding operation. Surface to be welded shall be cleaned of loose

scale, slag rust, paints, and other foreign matter, except that a thin coat of linseed oil need not be removed before welding. When weld material is deposited in two or more layers, each layer shall be brushed with a wire brush or otherwise cleaned before subsequent layer is deposited. In welding, precautions shall be taken to minimize stresses due to expansion or contraction by penning the welds while hot, or by other satisfactory methods. Correction of distortion by blows, after welding is completed and the place is cold, will not be permitted. Upon completion, the welds shall be brushed with wire brushes and shall show uniform section, smoothness of weld metal, feather edges without excessive overlaps and freedom from porosity and clinkers. Visual inspection at edges and ends of fillets and butt joints welds shall indicate good fusion and penetration into base metals.

The specification regarding welding including the technique of welding employed, the appearance and quality of welds made, and the methods used in testing of the welds, and in correcting defective work shall conform to relevant Indian Standard/International standards.

All shop and field welding performed on the work shall be subject to inspection by Engineer-in-Charge Low hydrogen electrodes shall be used whenever necessary, particularly if the temperatures are below 10°c. Penning of multiple pass welds to control distortion or to minimize residual stresses may be carried out with light blows from a power hammer using an elongated round nosed tool. Penning shall be done after the weld has cooled to a temperature warm to the hand. Care shall be exercised to prevent scaling, flaking or rupturing of weld and base metal from over penning. Neither the first nor the last pass of a multiple pass weld shall be penned.

All welds on stress-carrying members shall be done in Manufacturer's shop unless otherwise agreed by Engineer-in-Charge. In general, only non-load carrying seal welds will be permitted in the field. Tack welds shall be permitted only as a temporary weld required for assembly purposes.

The welding sequence shall be planned to control and minimize distortion and, where necessary shall include stress relief to minimize residual stresses. Minimum stress-relieving requirements are specified in the appropriate sections of these specifications. Welded components subject to vibration and stress reversals shall be fabricated with full-penetration welds.

For welding of principal stress carrying parts, the standards of welding procedures, qualification of welders and welding accessories shall conform to relevant Indian/International Standards or equivalent to the requirements of the ASME Boiler and pressure vessel codes Section VIII and IX, or DIN EN 287. All welders assigned to the works shall have passed a performance qualification test. If more than one year has elapsed since the welder passed his last test,

than he shall be tested and qualified again.

4.01 **STRRESS RELIEVING**

Stress relieving of the parts where required shall be accomplished by heating the member in closed stress relieving furnace to a temperature of 540° degrees to 650°(for one hour for each 25mm of metal thickness and allowing the member to cool slowly in the furnace. Below 315°C the member may be removed from the furnace, and allowed to cool in still air. Details will be as per ASME boiler Code / IS: 2825.

All forgings shall be normalized and all castings shall be annealed.

4.02 **MACHINE FINISH**

Where finished surfaces are specified or required for parts shown on the drawings the class of finish provided shall be as specified on the drawings or if not specified shall be the class most suitable for the junction of the part involved. The four general classes of finish to be specified on drawings and the general finish requirements are defined as follows:

i. Very smooth: The surface smoothness shall be comparable to a lapped, honed or finely ground finished or the surface shall be polished if so specified. This grade of finish is required for surfaces with very close tolerance, for surfaces in sliding contact which must be very smooth to prevent leakage or friction, for highly loaded bearing surfaces, or for surfaces which must be polished for appurtenance.

ii. Smooth finish: The surface smoothness shall be comparable to the best finish obtainable using standard machine tools and shall be practically free from tool marks. This grade of finish is required for surfaces with close tolerance and for surfaces in ordinary sliding contact.

Average finish: The surface smoothness shall be comparable to a commercial finish such as is normally obtained by ordinary machining methods, and slight tool marks will be allowable. This grade of finish is required for ordinary work.

iv. Rough finish: The surface smoothness shall be of a degree necessary only to assure a uniform surface true to dimensions and fairly coarse tool marks will not be objectionable. This grade of finish is used primarily for

surfaces which are not in contact, but which require finish for dimensional accuracy.

4.03 BOLTS, STUDS, NUTS AND SCREWS

They shall have standard threads and be of high-quality stainless-steel. All standard size bolts, studs, nuts and screws (including their washers) shall be heavily protected against corrosion or made of stainless steel if so, specified in the technical specifications. Nuts and bolts heads shall be hexagonal in shape and truly faced.

Nuts, bolts and screws which might become loose during operation shall be locked in fastened position. All bolts, studs, nuts and screws shall be of high quality stainless-steel

4.04 PAINTING

1. Surface Treatment and Protection

All Surfaces before painting shall be cleaned by abrasive blasting conforming to SA 2½. The manufacturer shall provide as parts of his work/supply the surface treatment, priming, corrosion protection and painting of the equipment furnished. Such work shall include the coating and painting work at the workshop and at the site and including the finish painting. Unless otherwise specified the coating and painting shall be carried out in accordance with the latest Indian Standards or equivalent approved standards.

All priming and painting material shall satisfactorily fulfill the requirements imposed by the site conditions, as well as the stresses to which the respective equipment is subjected during operation of the works. Shades of the finishing coating shall be as approved by the Engineer-In-Charge.

Each coat of primer and paint shall be compatible with the previous and subsequent coats. All pigmented primers and paints which will be used for priming and painting at the site shall be delivered in original and led containers packed by the manufacturer, bearing brand name, our designation, storage cum maintenance and handling instruction.

The manufacturer shall supply full details regarding the extent to which sand- blasting, priming and paintings will be carried out in his workshops (or his sub- contractors, as the case may be) at the site and after erection. A properly equipped paint shop shall be

set up at the site using a specialist organization, experience and skilled in the preparation and application or protective coatings at the conditions prevailing at the site.

Materials shall be thoroughly mixed at the time of application. It is essential that before any primer and coat of paint is applied, the surface is properly prepared. Such preparation shall include any cleaning, soothing, drying and similar operation that maybe required to ensure that the primer and /or paint is applied on suitable surfaces. Clean cloths and clean fluids shall be used to avoid having film or grease residue on the surfaces being cleaned.

Each coat shall be free from runs, drops, pinholes, wave's laps, sags and unnecessary brush marks and shall be allowed to dry or to harden before the succeeding coat is applied.

Machinery paint may be thinned, if necessary to permit satisfactory application, but the amount of thinner shall be kept to a minimum.

For removing rust and mill scale from structural steel, plate sheets, piping and other steel surfaces, as well as from other parts blast cleaning shall be carried out to clean bare metal. The average surface roughness after sand blasting shall not exceed 40 microns. Sand blasting shall be performed with corundum or sand of type approved by Engineer-in-Charge. Parts which cannot be blast-cleaned shall be cleaned free from rust and scale by power tool cleaning to the highest possible degree.

All ferrous surfaces including non-mating finished surfaces, portion of frames etc. exposed to atmosphere or water shall be given a coat of rust inhibitive phosphate wash by brush immediately following the cleaning operation. Proper reaction of the phosphate wash is indicated by a light grey film after drying. A dark sticky residue results if the reaction is not complete. This should be wiped off with dampened rags and area retreated. If the surface is very hot, it may be necessary to dilute the phosphate wash solution with water to obtain proper reaction Within one hour after the rust inhibitive wash has dried thoroughly, one coat of priming shall be applied by brushing, without thinning

Stainless steel and bronze surfaces shall only be cleaned but not painted. All finished surfaces of the Log boom system that will exposed to atmosphere during shipment or while awaiting installation shall be given a coat of gasoline soluble rust

preventive compound.

2. **Color Scheme**

Sl. No.	Item	Color Scheme
1.	STP	As per Contractor's/ Supplier's/ Manufacture's recommendation

3. **Repair of Primer and Finish Coats**

For touching up, the same paint shall be used as for the original painting work. Repaired finish coats shall be of identical appearance with the original and no difference in the colour shall occur. The Engineer-in-charge may require severely damaged coatings to be removed and repainted.

4. **Quality Control**

The Contractor has to submit painting schedule for shop painting as well as field painting to the Engineer-in-Charge for approval. The first and each successive coat shall not be applied without the approval by Engineer-in-Charge.

The minimum dry film thickness prescribed in these Specifications shall be observed. Of each 100m sq. area of 10m sq. will be measured for dry film thickness. No measured thickness shall be less than the specified thickness. Where the minimum thickness is not achieved, the coat shall be repaired to reach the specified minimum dry film thickness.

The dry film thickness shall be measured by approved gauges, and the cost of two new electronic gauges shall be included in the Tender for the use of Engineer.

/ For checks on porosity, the Contractor shall furnish a D.C. variable high tension test instrument with built-in pre-counter. The test voltage shall not exceed 2000V. The tests shall not be performed within 0.5m distance from uncovered, corrosion resistance surfaces.

Upon completion of each coat, the painter shall make a Detailed inspection of the painting finish and shall remove from all adjoining works all splattering of paint material. He shall make good all damage that can be caused by such cleaning operations.

A detailed inspection of all painting work shall likewise be made, and all abraded, stained, otherwise disfigured portions shall be touched up satisfactorily or refinished as required to produce a first-class job throughout and to leave the entire work clean and acceptable condition.

5. MATERIAL AND SHOP TESTS, SHOP INSPECTION

5.01 SHOP ASSEMBLY AND TESTS

All components shall be tested in accordance with the appropriate Standard/codes at either the STP maker's or equipment manufacturer's workshop or test certificates provided.

Equipment of STP shall be completely assembled in the shop to ensure that all parts are properly fitted. Surfaces of metal which will be in contact shall be cleaned before the parts are assembled. The parts shall be adjusted to line and fit and shall be well pinned and bolted so that the surfaces are in close contact before reaming, drilling, bolting or welding commenced. Drifting done during assembly shall be only that is necessary to bring the parts into position and not so much as to enlarge the holes or distort the members. If any hole must be enlarged, to admit a fastening, it shall be reamed. The field connections shall be fitted and checked in the shop to assume proper fit during field erection.

The contractor shall supply all material, equipment and labor required for shop assembly and tests, and cost there of shall be included in contract prices.

During shop and field tests, all 'the data needed for proper evaluation of the performance of the equipment shall be recorded. If the test data do not demonstrate compliance with the specified requirements, necessary remedial action shall be taken until complete compliance is demonstrated to the satisfaction of the purchaser.

TEST REPORTS

The contractor shall furnish to the Engineer-in-Charge certified copies for test results for the materials used as issued by the test Officer of the rolling mills and foundries. The contractor shall furnish the manufacturer's Standard test certificates in respect of steel, bolts and nuts, wire ropes and paints. Manufacturer's Standard test certificates shall also be supplied in respect of motors, starters, solenoids and other electrical equipment, certified copies of the records of tests carried out in manufacturer's workshop in respect of complete assembly or part assemblies shall also be supplied by the contractor.

5.03 **WORKSHOP INSPECTION AND TEST**

As far as practicable, quality of materials, workmanship and performance of all items of the works to be furnished under this Contract shall be inspected at the places of manufacture.

When placing orders for major material and equipment with sub-suppliers, the Contractor shall send un-priced copies of such orders in triplicate to the Engineer-In- Charge.

Arrangements shall be made for expediting the shop inspection by having all shop assemblies or pieces covering a single shipment ready at one time. Any painting works as well as transport to the site of the Works shall not be started before the approval of the Engineer-in-Charge has been obtained.

Free and unrestricted access to the Contractor's factory and shops (including those of his Sub-contractors) shall be granted to the Engineer-in-Charge, and upon reasonable notice by the Engineer or other nominated by him if deemed necessary by the same for additional witnessing of assembly work or inspection and tests.

Should an agreed inspection not be carried out as proposed because of lack of preparation, obvious negligence or material and/or equipment being presented in a state which does not correspond to the proposed procedure or is clearly not acceptable such an inspection shall be repeated.

The Contractor shall organize all shop tests and inspections which shall be witnessed by the Engineer-in-Charge or Engineer-ln-Charge's

representative.

Materials test

Unless otherwise, the quality of materials shall be verified generally by

Chemical analysis

Mechanical test (yield point, tensile strength, elongation's notch impact strength etc.)

Welding tests (welding procedure, welding material, welding tensile strength, welding bend test, welding reserved bend test, etc.)

Non-destructive X-rays, ultrasonic, magna-flux, liquid penetration tests visual inspection, magnetic properties etc.)

Certified mill test reports of plates will be acceptable. Test specimen and samples for the analysis shall be plainly marked to indicate the materials they represent.

Castings and forgings shall be tested in the rough state in order to detect flaws in time thus avoiding delays. Magnetic particle inspection of important casting shall cover the whole surface of the casting. After partial machining further tests can be conducted. The acceptable limit for ultrasonic testing of castings shall be Level-I to fSA-603 of ASM E Section 5 and that of forgings shall be as per SA 388 of ASME Section 5. Load tests on crane hooks, steel wire ropes etc. shall be considered as material tests.

2. **Checking of Dimensions**

The dimensions, especially clearances and fits (ISO 286) which are essential for operation and efficiency shall be carefully checked in an approved manner, as for example:

run out and round-less tolerances of shafts, pistons, etc., to be measured on single parts as well as (whenever possible) on the assembled components.

- fits and clearance of bearings, servomotor pistons, valves, guiding, distributing and actual actuating elements, etc. accuracy, surface roughness and shape of sliding and guiding surfaces of seals, bearings, water passages in hydraulic machinery, valves, etc. dimensions of couplings or connections for assembly with other deliveries from the Contractor, Sub-contractors or other Contractors.

3. **Functional Tests**

Functional tests shall be defined as tests of the function of assemblies,

assemblies or part of the Works under no load conditions. Functional shall be performed on all works prior to the execution of operational tests.

4. **Operational Tests**

As far as practicable operational test shall be carried out, simulating operating conditions.

Parts to be delivered by sub-suppliers shall be tested either at the premises of the sub- supplier or of the Contractor, as agreed by the Engineer-in- charge.

Before testing, the contractor shall submit a notice containing full information on the tests with detailed tables or graphs on the latest edition of the characteristic values of the works to be tested and on the test facilities and equipment.

5. **Electric Tests**

Electrical works shall be tested in accordance with applicable standards and agreed test programs and procedures.

5.04 MATERIAL SPECIFICATIONS

All the materials used in the manufacturing of equipment of STP shall conform to the latest applicable specifications of the BIS, DIN, ASTM or equivalent. The materials shall be selected as the best available for the purpose for which used, considering strength, ductility and best engineering practice. Defective material like overlapped steel plates etc. shall not be used for the fabrication of equipment of STP and its accessories and if found, the same shall be straightway rejected. All materials used in the manufacture of the equipment of STP shall conform to applicable Indian/International Standard Specifications. The contractor has the option to use equivalent Standards of the other countries subject to provisions of next paragraph.

5.05 SPECIFICATION STANDARDS

Indian/International Standard Specifications have been used in drafting these specifications. The contractor has the option to use equivalent standard of any other country, and if they do so they shall furnish two copies of the particular standard translate in English Language and shall see that the properties of part or materials offered are not inferior to the responding Indian/International Standard for that part or matter as stipulated in the specifications

All specifications referred to herein shall be latest revision, up to date and shall be subject to specific approval of the Engineer-in-Charge.

5.06 **CATALOGUE AND OPERATING INSTRUCTIONS**

Applicable part lists, catalogues and operating instructions in English language, specially prepared to cover all the equipment furnished under these specifications which may be needed or useful in operation, maintenance, repair, dismantling or assembling and for the repair and identification of parts for ordering replacement, shall be assembled under a common cover and submitted in triplicate to the Engineer-in-Charge.

5.07 **INSTRUCTION PLATES**

All gauges, meters, instructions, etc. shall have dials or scales calibrated in Metric system units. All name plates, instruction plates, warning signs and any marking what-so-ever on the equipment and its parts and accessories shall be in English language, using the idioms and words meanings in current use in India.

5.08 **WITNESSING SHOP TEST, INSPECTION AND TRAINING**

1. All materials furnished shall be of tested quality and all work performed shall be subject to rigid inspection and no articles or materials or supplies shall be dispatched until all tests, analysis and shop inspection have been completed or certified copies of reports or results of test and analysis shall have been accepted. Duplicate copies of manufacturer's tests certificate shall be submitted to the Engineer-in- Charge as soon as the tests are completed. In case tests certificates are not available for any of the materials, the same may be got tested and only those materials which fulfill the requirements of the specifications shall be used. From any part/item, it should be possible to locate its manufacturer's Batch/Lot mark, which shall be achieved by transferring the batch mark before parting the materials.

2. The purchaser or his representatives shall have free access to the software(s) used or being utilized by the Contractor for Planning & Design of equipment of STP both at his office premises and at his shop premises. The purchaser or his representative shall be free to check the design & drawings etc. from his software at any time.

3. The contractor shall state the place of manufacture, testing and inspection of the various portions of the work in the contract.

Authorize representative of the Engineer-In-Charge may be present at the time of tests and the contractor shall provide all necessary facilities for the same. Representative of the Engineer-in- Charge shall also be entitled to access to contractor's or sub-contractor's work at any time during the working hours for the purpose of inspecting the manufacture of equipment and materials.

4. The Contractor shall have to impart training to the THP on various aspects associated with the system and equipment to be supplied as well as on Software Programmed used in design and preparation of drawings for equipment of STP so as to enable them to become familiar with the same. The THP will depute Engineers for the following purposes;
   i) Witnessing shop testing: Five engineers for two weeks (two to three round trips)
   ii) Training in works & design: Five Engineers for two weeks (two to three round trips)

5. The full expenditure in respect of travel, lodging and boarding of the purchaser's Engineers for witnessing shop inspection and tests at the manufacturer's/ contractor's work in India shall be borne by THP, DGPC and outside India by the Contractor.

5.09 NAME PLATES

1. All equipment shall be provided with a securely fastened name-plate showing the maker's name, model, serial number, year of manufacture, main characteristic data of the respective equipment and further relevant information specified in the applicable standard or necessary for the proper identification of the equipment involved.

2. The contractor shall supply and also install all label plates and other labeling (of the screw-on type) on control boards, control desks, panels and other places where required for operational, functional and safety reasons. The number and sizes of the plates shall be a minimum. The label plates shall be in English.

6. TRANSPORT AND STORAGE CUM MAINTENANCE

6.01 GENERAL

Before shipment or transportation, the contractor shall ensure that all work test required to be completed in shops have been duly attended to and all parts have been suitably matched marked to facilitate assembly and proper ventilation in the field. Further such transportation will be started

only after obtaining approval of the Engineer-in- Charge for undertaking dispatch from the contractor's works.

The contractor shall include and provide suitable crating, packing or fastening, protecting log booms and its components in transit to avoid damage to them or to the paint done in shop. The contractor shall be fully responsible for all losses or damages caused by or occasioned by any d

defect in handling or transportation. All exposed, finished surfaces shall be adequately protected against abrasion, damage to their finish, size or shape during transport / shipment. All protruding pieces, long and slender parts shall be adequately supported and blocked.

Shipping, transportation, loading and storage-cum-maintenance shall be performed by or under the responsible direction of the Contractor. An appropriate period for transportation shall be considered.

The general coordination of storage cum maintenance and erection work as well as the civil engineering work at site will be done by the Engineer-in-Charge.

The delivery dates, transportation and erection periods shall be strictly adhered to as per approval of Engineer-In-Charge.

From the time of manufacturing until commissioning all parts of the STP shall be protected against damage of any kind. Parts which are damaged during transport shall be replaced at the contractor's expense.

6.02 PACKING

After the workshop assembly and shop inspection and tests including witness inspection by the Engineer-in-charge or his authorized representative wherever specified and prior to dismantling for shipment to the Site, all items shall be carefully marked to facilitate site erection. Whenever applicable, these markings shall be punched or painted so they are clearly visible.

Dismantling shall be done into convenient sections, so that the weights and sizes are suitable for transport to Site and for handling on the Site under the special conditions of the Project.

All individual pieces shall be marked with the correct designation shown on the contractor's detailed drawings and other documents (packing lists, spare part lists, in Operating and Maintenance Instructions, etc.).

Marking shall be done preferably by punching the marks into the metal before painting, galvanizing, etc. and shall be clearly legible after painting, galvanizing etc. In labeling, the Contractor shall endeavor to use as few

designations as possible and each part of identical size and details shall have the same designation, regardless of its final position in the plant.

All parts of the Works shall be packed at the place of manufacture; the packing shall be suitable for transportation and for all special requirements/limitations of the transportation to site. Where necessary, double packing shall be used in order to prevent damage and corrosion during transportation, unloading, reloading and during intermediate storage cum maintenance.

All parts including electrical parts shall be suitably protected against corrosion, water, sand, heat, atmospheric conditions, shocks, impact, vibrations, etc. by packing them into high pressure polyethylene foil.

The Engineer-in-charge reserves the right to inspect and approve the packing before the items are dispatched but the Contractor shall be entirely responsible for ensuring that the packing is suitable for transit and such inspection will not exonerate the Contractor from any loss or damage due to faulty packing.

All packing costs shall be included in the scope of Work.

6.03 **MARKING**

The Contractor shall mark all containers with the implementing document number pertinent to the shipment. Each shipping container shall also be clearly marked on at least two sides as follows:

Consignee
Contract No.
Port of destination
Item number (if applicable)
Packing number, in
sequence and Quantity per package
Description of works
Net and gross weight, volume

6.04

STORAGE CUM MAINTENANCE

The Contractor shall be responsible for all relevant transport facilities and requirements, loading gauges and other limitations and shall ensure that the equipment as prepared for transport shall conform to such limitations. The Contractor shall also be responsible for obtaining from the railway or highway authorities any permit that may be required for

the transport of loads exceeding the normal gauges.

The Contractor shall be responsible for all Custom clearance of the consignments from the Indian port if by sea and or from airport if shipped as air cargo, local storage cum maintenance and further transportation to site.

The contractor shall provide means for all unloading and reloading for all consignments of the plant, during transport to site. Unloading on the site will be provided by the contractor, Consignments shall be unloaded immediately on arrival at Site. The Contractor is required to take the necessary steps in order to provide the carriage, special supporting structures for heavy loads, etc.

The Contractor shall develop necessary storage cum maintenance facility for proper and safe storage cum maintenance of all the materials. The warehouses shall be waterproof, well ventilated and of designated floor etc.

If large parts are stored in the open air, they shall be provided with weather resistant and fire-resistant covers. Electrical parts which are not packed in heavy duty polyethylene foil and those so packed but whose packing has been damaged shall be kept in suitable places from the moment of storage cum maintenance to the moment of installation.

All insulation materials which will be taken from the warehouse for installation and which are stored temporarily in the station shall be protected from weather or humidity.

7. INSTALLATION, TESTING AND COMMISSIONING

7.01 INSTALLATION

The equipment covered in these specifications and specification drawings shall be furnished and erected by the contractor completely at the project Installation of STP and its allied components shall be done in such a manner that the intending operating characteristics are attained throughout the life of the equipment. The materials, equipment, controls and apparatus shall be installed in such a manner that essential parts will be readily accessible for inspection, adjustment or maintenance. Installation shall be carried out strictly as per detailed designs & drawing(s) to be supplied by the contractor and as approved by the Engineer-In- Charge. The contractor shall be responsible for satisfactory installation, adjustment, testing and commissioning of the Log boom with sliding system under the supervision of Engineer-in-charge of the purchaser as provided in these specifications.

Placing of Concrete

Concreting shall be done by the purchaser through the civil contractor. STP contractor shall give a detailed program of fixing and aligning the embedded parts to the Engineer-In-Charge for this purpose. Before placing the concrete, alignment tolerances shall be checked and remedial action taken by the contractor, if any displacement has occurred.

Erection personnel

Skilled as well as unskilled personnel shall be arranged by the contractor for erection of the equipment covered in these specifications.

7.02 SITE INSPECTION AND TESTING

Inspection and testing of equipment shall include all inspections, tests, checks, procedures etc., whether mechanical, hydraulic or electric, as required to ensure that the equipment supplied meets the requirements of the specifications.

General Checks

Make a general check of all main and auxiliary equipment. Include a check of the completeness, correctness and condition of hydraulic components, rails, limit switches, interlocks, end buffers, apron flap, hoisting system, rake assembly, paint surfaces, cables, wiring, pipe work, valves, illumination system, control and protection system and all other auxiliary and ancillary items.

Check for oil leaks, greasing of bearings, gears and that components are clean and free from external damage. Check that loose items, which are to be handed over to the Employer, e.g., tools, spares, are in order and are correctly stored or handed over

- Check shutters, interlocking, earth procedures and the interchangeability of components.
- Check all limit switches and interlocking arrangements, both electrical and mechanical.
- Check all the hydraulic system of the STP unit to ensure the proper functioning.

It is necessary for satisfactory function of the STP and its allied components/ equipment shall be neatly assembled and laid at appropriate place inside the cabinet and other places wherever they are needed. All the connections shall be adequately tight to avoid sparks and properly insulated. After installation, electric equipment switches & wiring

shall be tested by the contractor to the satisfaction of purchaser and results of such test shall be duly recorded.

The Contractor shall be prepared to cooperate with any special tests requested by the Employer.

The technique, equipment and instrumentation to be used for these tests, checks, inspections, examinations, etc. shall be in accordance with the pertinent and internationally accepted Standards, rules or codes, in particular those mentioned in the specifications.

7.03 COMMISSIONING

After Contractor has notified the Employer's Representative and received his agreement that the equipment is ready for the commissioning tests, the Contractor shall start with the following tests;

The tests shall comprise of the following stages:

a) Pre-Commissioning Test

b) Commissioning Test

c) Trial Run

The pre-commissioning test shall include but not limited to the following:

- Inspection of satisfactory installation of all components.

The commissioning test shall include but not limited to the following:

- Testing and inspection of equipment of STP is required to ensure that the overall components of the equipment have been maintained in a safe and serviceable condition and are functioning properly according to the original equipment manufacturers specifications

  During the trial operation period, the Contractor may request any minor adjustments which do not in any way interfere with or prevent the use of the equipment by the Employer or result in reducing the output or decreasing the efficiency.

If any failure or interruption occurs in any portion of the equipment covered by the Contract due to, or arising from faulty design, materials, workmanship (but not otherwise) sufficient to prevent full use of the equipment the trial operation period is to recommence after the Contractor has remedied the cause of defect.

Immediately upon termination of commissioning of a part or section of the Permanent Works which can operate as an independent unit a "Certificate of Suitability for Operation" shall be issued by the Engineer-

in-charge.

This document shall be signed by an authorized representative of the Employer, the Engineer-In-Charge and the Contractor.

This Certificate shall state:

The supplier of the Works concern

The quantity and type of Works concerned The conditions of commissioning
The names of the participants

The date of commencement of trial run The list of minor defects, if any

During the trial run, the Contractor shall make familiar the Employer's personnel with the properties, the operation and maintenance of the Works and its auxiliaries to such extent that thereafter the duties can be assigned to the Employer's trained personnel.

1. **Acceptance**

All equipment, necessary accessories of the log boom and its allied equipment / components complete in all respects shall be subjected to satisfactory acceptance test, to be carried out by contractor, after completion of installation at site, commissioning & adjustment(s), if any, Acceptance tests of equipment of STP & its allied equipment / components and controls shall span over a reasonable period of satisfactory operation of the free system as a whole to establish fulfillment of various design requirement as per these specifications.

While necessary electric power shall be supplied by the THP at its own cost, all special tools, gauges, meters, instruments and apparatus etc. required for acceptance tests shall be furnished by the contractor which shall ultimately become the property of the THP, DGPC.

Final acceptance tests of the log boom and its allied equipment, however, will not in any way absolve the contractor of his responsibility for any damage/ defect that may develop due to operation of the equipment, accessories of the STP and its allied equipment/ components within twenty-four months of the final acceptance tests, where such damage may be due to faulty design. defective materials, components supplied (whether fabricated / manufactured by the contractor or otherwise arranged by him as bought out items) or bad workmanship. All material shall be the

best of their respective kinds.

Immediately upon completion of such testing of the STP and its allied equipment, a "Protocol of Acceptance" which shall be deemed to be the Test Certificate required and shall be issued by the Engineer-in-charge.

The document shall be signed by an authorized representative of the Employer, the Engineer-in-charge and the Contractor and shall form an integral part of the later "Taking *Over* Certificate".

This "Protocol of Acceptance" shall state:

The date of testing
The quantity and type of Works concerned
Statement of all minor defects and/or irregularities, which have to be corrected by the Contractor
Confirmation that the guaranteed data have been proven
Confirmation all contractual documents have been submitted Confirmation that the employer's personnel has been familiarized with the works and that they will be able to operate and maintain the Works.

If any test for the verification of the guaranteed data could not be performed for operational reasons beyond the Contractor's responsibility, this part of the acceptance shall be stated in the "Protocol of Acceptance" and be postponed for a mutually agreed period.

2. **Records**

Maintain an up-to-date record of all comm1ss1oning activities on site.

The results of the tests clearly on forms approved by the Employer and clear references to the equipment and items tested, so that the record can be used as the basis for maintenance tests during the working life of the equipment. Submit the required number of site test result records to the Employer as soon as possible after completion of the tests. Record the details of the test equipment and instruments used in the test sheets, in those cases where the instrument or equipment characteristics can have a bearing on the test results. Keep an ongoing record of all changes on a master set of drawings. Produce and supply a minimum of Five (5) complete sets of marked-up "As Built" drawings before leaving the Site. Correct and re-issue the original drawings as soon as possible as per this specification

7.04 TRAINING OF THE EMPLOYER'S STAFF

a) The Contractor shall plan for the Employer's staff's participation,

training on a regular basis, during the commissioning work at his cost.

b) Contractor shall involve the Employer staff to become familiar with the operation and maintenance aspects of the new equipment.

c) Maintain a continuing assessment with the Employer of the precautions required in, or possible consequences of, initial energization of equipment.

d) The operation and maintenance (o & M) of the STP including training of THP, DGPC officials shall be the responsibility of the contractor for a period of two months from the date of completion.

7.05 WARRANTY PERIOD:

Any part/component proving defective within eighteen months from **date of its commissioning** shall be replaced free of charge by the manufacturer.

8. SPARE PARTS AND TOOLS

8.01 SPARE PARTS

All spare parts to be supplied shall be interchangeable with the corresponding parts of all the Work supplied under these Specifications and shall be of the same material and workmanship. They shall be replaceable without cutting or destruction of adjacent components. Before issue of the Taking-Over Certificate, the spare parts shall be checked and tested at the site by the Contractor in presence of the Engineer-in-charge. Acceptance of any spare parts will not take place before the Contractor has submitted the complete final detailed list of al spare parts and tools. THP reserves the right to purchase any or the entire spare parts listed above or as suggested by the manufacturer.

Spare parts required for field trials and acceptance testing shall be provided by the manufacturer at no additional cost to the THP, DGPC.

Spare parts supplied shall be packed in such a manner as to be suitable for storage in the climate at the site for a period of 5 years and each part shall be clearly marked with its description and purpose on the outside of the packing.

All spare parts, tools and materials shall be delivered in marked boxes of sufficient sturdy construction to withstand long term storage cum maintenance.

8.02 TOOLS AND TACKLES

The scope of work shall include all special tools and tackles, as well as all special cranes including lifting cranes, ropes, etc. necessary for total assembly and disassembly of all parts of the Supplied Works. The total price for these special tools and tackles as required by this article shall be included in the Total Tender Price. The list of special tools and tackles which are to be supplied by the contractor shall be given in the bid.

The tools, ropes etc. shall be unused and shall be provided with means for ready identification.

All delivered tools and tackles will be taken over by the Employer after finalizing the works.

9. SCHEDULE OF WORK AND PROGRESS REPORTS

9.01 SCHEDULE OF WORK

The time and the date of completion of work as stipulated shall be deemed to be the essence of the contract. The Contractor shall submit a detailed program for all the activities to perform the work as per the Contract. The schedule will be in the form of a detailed PERT network consisting of adequate number of activities covering various key phases of the work such as designs and drawings, procurement, manufacturing, shop assembly and shop painting. This network shall also indicate the interface facilities to be provided by the PH PA-II, if any, and the dates by which such, facilities are needed.

The contractor shall so organize his resources and perform his work as to Complete it not later than the date agreed to by him. The time for Completion of the supplies contracted for, shall be reckoned from the date of award of supplies to the Contractor.

During the performance of the contract, if in the opinion of the Engineer- in-Charge proper progress 1s not maintained suitable changes shall be made in the schedule to ensure proper progress.

9.02 PROGRESS REPORTS

The above PERT network shall be reviewed and periodic reports shall be submitted by the Contractor as directed by the Engineer-in-Charge. Before initiating the procurement/fabrication, the Contractor shall submit a detailed list of items/materials to be bought out from outside agencies/fabricated at his or any other supplies. The list should be exhaustive and should serve as a check list for reviewing the progress from time to time. It should be obligatory on the part of the Contractor to submit a detailed monthly report by 2nd of every

month (for the previous month) giving the progress of the following activities:

1. Designs and Drawings.
2. Procurement of materials and bought out items.
3. Fabrication of various assemblies and sub-assemblies indicating detailed status of fabrication of critical items involved and expected date of completion.
4. Stages of shop assembly.
5. Shop testing
6. Shop painting.
7. Dispatch of materials.

10. QUALITY ASSURANCE PLAN

The Contractor shall submit the Quality Assurance Plan of the STP and all its allied components in a proper format and shall be approved by the Engineer-In- Charge.