

**SECTION 12 - PERMANENT EQUIPMENT AND
MISCELLANEOUS METAL WORKS**

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S12.01 FABRICATION AND DELIVERY OF PERMANENT EQUIPMENT

(1) General

The work covered by this section shall include but shall not be limited to, the supply of materials, fabrication transportation, painting and delivery of the following permanent equipment and miscellaneous metalwork to be provided under the Contract:

Vertical gates (slide gate at Headrace and sluice gate at Sand Sluice), Gate valve, trashrack, Bulkhead gate, lifting system, embedded frames, staff gauges and miscellaneous metal works.

(2) Materials

The materials used under this Contract shall be such as to insure an efficient service life for each part of the equipment. In particular, material shall not be of inferior quality to that specified below.

All materials shall be new and without defects and comply with the specifications of the ASTM Standard or equivalent as listed below:

Material and Products	Standard Designation
Structural steel (bars, shapes, plates)	ASTM-A36/A36M, TIS 107-2533 or TIS 1227-2539
Corrosion resistant steel plates	ASTM-A240 Type 504 or 410
Cast iron	ASTM-A48 Class 35 or Class 30
Cast alloy steel	ASTM-A148 Grade 80-40
Forged steel for gears	ASTM-A291 Class 1
Forged steel for stems, trunnions, etc.	ASTM-A293 Class 2 or ASTM-A235 Class 6
Forged alloy steel for general use	ASTM-A237

Material and Products	Standard Designation
Steel bolts and nuts (not submerged)	ASTM-A307
High strength bolts and nuts	ASTM-A325
Welding electrodes for:	
- corrosion resistant steel	AWS-A5.9 or ASTM-A371
- cast iron	AWS-A5.15 or ASTM-A398
	AWS-A5.1-69 or ASTM-A233
Steel piping black or galvanized	ASTM-A120 or TIS 277-2532
Galvanization for:	
- Steel piping	ASTM-A120
- Section and plates	ASTM-A123
- Bolts and nuts	ASTM-A153
Cast bronze	ASTM-B143 Alloy 1B or 2B
Bronze for bearing, bushes, etc.	ASTM-B144 Alloy 3A
White metal for bearings	ASTM-B23 Alloy No.3
Brass for bolts and nuts	ASTM-B21 Alloy 485

Other materials not expressly specified in the list above shall conform to the most recently published ASTM standards regarding the class or type of those materials.

In case materials adopted are classified according to other material specifications, the Contractor shall submit the list of equivalence of adopted materials to ASTM standards.

(3) Tests on Materials

All materials used for the Contract shall be tested in accordance with the standards. The tests which must be executed and those which must be witnessed by the Engineer, in order to verify the compliance of the material characteristics with those established in these specifications.

At tests shall be carried out in accordance with the relevant ASTM Standards.

In particular, forged or cast pieces shall be provided with test billets for the execution of tests.

All equipment, services and costs for such tests will be the responsibility of the Contractor.

(4) Fabrication

(a) General: The fabrication of the permanent equipment shall be carried out in accordance with the highest current technical standards. In particular, identical parts shall be interchangeable.

(b) Plates and steel sections: Plates and steel sections must be perfectly straight with smooth surfaces. If straightening is necessary, hammering must be avoided. After the cutting of sheets and steel sections, the edges must be left sharp, clean and without burr.

High thickness plates may be flame-cut, provided that the material is not damaged and that the cut edges are ground clean or machined.

All tests shall be performed before the start of fabrication and the results submitted for approval to the Engineer or his authorized representative.

(c) Welding

(i) General: Welding shall be carried out with electric arc. The welding procedures shall be such as to ensure full penetration joints, free of internal and external defects. The edges to be welded must be prepared accurately and have smooth clean surfaces.

In the construction, welding procedures and welders qualification shall be accordance with the ASME Code for unfired pressure vessels.

Test procedure and result interpretation shall be in accordance with the ASME standards (American Society of Mechanical Engineers).

(ii) Examination of welds: In general all welds subject to pressure shall be radiographically examined if ordered or deemed necessary in the opinion of the Engineer. Ultrasonic, magnetoscopic or dye penetrant inspection may apply wherever radiography is not possible.

All welds examined will be counter marked with identification marks appearing in the radiographic film and the marks shall not be removed before the approval of the Engineer for the relevant weld has been given.

The Contractor shall submit to the Engineer the radiographic film of all welds to be approved together with a location plan of the relevant identification marks.

All radiographic records will remain in the Contractor's file and they shall be made available to the Engineer upon request.

Should any of the welds prove to be defective, then the number of the same group of welds to be tested shall be twice that originally required. Should any weld of the second increment prove to be defective, then all welds shall be examined.

Welds performed on automatic resistance butt-welding machine shall undergo an indirect control providing sampling pieces. For each piece mechanical tests and other tests according to Contractor's practice shall be performed on the welding. In case one welding proves to be defective, the adjacent welds shall be cut out and tested.

All defects detected by inspection shall be fully corrected and inspected again until the correction has been approved by the Engineer.

- (iii) Welding equipment at Site: The welding equipment at Site include all devices necessary to avoid arc extinguishing and to ensure a steady supply voltage within $\pm 5\%$. Voltage shall not be higher than 80 V.

The electrodes shall be shipped suitably packed and kept inside their packing up to the time of use. Should any package become damaged, the electrodes contained shall be rejected.

- (iv) Stress relieving: For all structures and equipment welding that create high stresses the welds shall be stress relieved.

In all other cases, stress relieving shall be made when required by ASME code for unfired pressure vessels.

Stress relieving methods shall comply with ASME standards.

- (v) Lubrication: All components in movement shall be properly lubricated.

Greasing or lubrication points shall be located in easily accessible positions.

The Contractor shall supply a lubrication schedule for the equipment, showing the recommended frequency of application and types and grades of required lubricants. The recommended lubricants shall be approved by the Engineer before ordering their supply.

Lubricant types shall be reduced to a minimum to facilitate maintenance.

After the Engineer's approval the Contractor shall supply all first application of lubricants, additional lubricant shall be applied at regular interval to maintain the Permanent Equipment is satisfactory condition until accepted.

- (vi) Shop preassembly: The Contractor shall preassemble in his shop, unless otherwise specified, those assemblies, sub-assemblies and piece of equipment which require a precise fit for field erection. Shop assembly shall be done after all shop welding and machining has been completed.

The Contractor shall make all assemblies available for checking by the Engineer. All interferences, errors in dimensions and inaccuracies in workmanship discovered during the shop assembly shall be corrected. Before dismantling, each item to be shipped separately shall be match-marked and identified in conformity with the erection drawings. Marking shall be done in such a manner as to retain its legibility until field erection is completed.

- (vii) Handling devices: All pieces heavier than 25 kg shall be equipped with hooks, eyebolts or lugs suitable for lifting, and in case the pieces are of such a shape as to make the above devices uneven or unaesthetic, handling belts and brackets shall be supplied.

Particular care shall be taken in making as easy as possible the handling and lifting of equipment which requires routine maintenance at Site.

(5) Tropicalization and Corrosive Protection

(a) General

All materials and equipment supplied under these specifications shall be suitable for being delivered, stored and operated under tropical

conditions of high temperature, high humidity, heavy rainfall and environment favorable to mildew and fungus growth.

Process for tropicalization shall be in accordance with the best commercial and industrial practices.

(b) Metals

Iron and steel shall generally be painted or galvanized or metal sprayed as appropriate. When it is necessary to use dissimilar metals in contact, these shall be so selected that the potential difference between them in the electro-chemical series is not such as to cause galvanic corrosion. If this is not possible, the contact surface of one or both of the metals shall be electro-plated or otherwise finished in such a manner that the potential difference is reduced within the required limits or, alternatively, the two metals shall be insulated from each other by a suitable insulating material.

(c) Bolts, Screws, Nuts

Steel bolts, screws and nuts, when used, shall be zinc, cadmium or chromium plated or, where plating is not possible owing to tolerance limitations, corrosion-resistant steel shall be used. All wood screws shall be brass or nickel-plated with other suitable finish. Corrosion-resistant steel, copper-nickel alloy or bronze shall also be used for bolts and nuts when either or both are subject to frequent adjustment or removal, and for bolts projecting from concrete with nuts subject to removal.

(6) Anchor Bolts

The Contractor shall supply all necessary anchor bolts to be embedded in the first stage concrete as shown on the Drawings.

(7) Lateral Guides and Sealing Surfaces

The lateral guides and sealing surfaces to be mounted on the structures shall be smooth, true to form and free from twists, warps and kinks.

The frames and guides shall be supplied complete with stiffening bars and other accessories including the welding pads to be embedded in the first stage concrete.

Hook bolts to be embedded in the first stage one concrete shall be provided with double nuts and washers for the precise alignment of the guides.

(8) Stems and Bearings

The stems shall be made of high tensile rolled steel.

The bearings of the operating stems shall be provided with bushing of antifriction metal.

(9) Gears

The tooth profile for all types of gears shall be carefully machined.

All gears having an outer diameter less than 500 mm shall be made of forged steel, with exception made for the work-wheel helicoidally gear, that shall have a replaceable outer crown made of high strength bronze. The worm-wheel shall not allow self-reversing motion.

According to their operating requirements, the bearings shall be made of bronze or antifriction metal, easily replaceable.

(10) Tolerances

In addition to tolerances stated in the standards and in the Drawings the following tolerances shall be taken into account:

- Maximum flatness tolerance of the gate leaf shall be ± 1.0 mm
- The bottom of the gates shall be straight within ± 3 mm per meter of length.
- The faces of side guides and sealing surfaces shall not depart from vertical planes by more than ± 1.5 mm.

(11) Test

(a) Test at Laboratory

(i) Tests on Materials

- Hardness and tensile stress tests, according to ASTM E 8 the method on sample of steel plates and steel sections for structural members (one sample for each delivery);
- Magnetic particles tests (Magnaflux inspection) on all major steel forgings.

(ii) Test on Welding

Welds shall be tested according to the specified standard AWS A 5.1-9.

(iii) Pre-assembly

The pre-assembly and checking in the workshop shall be such as to allow the direct measure of all the gate dimensions in order to have the guarantee that no major adjustment will be required at Site during final erection.

(b) Tests at Site

The Contractor shall be responsible for the tests at Site and shall supply all the necessary equipment that shall remain the Contractor's property. All defects discovered shall be promptly corrected by the Contractor at his own expense.

Tests to be performed shall include, but not limited to, the following:

- Operation of all lifting system.
- Measurement of the gate leakage.

The gate leakage shall be measured during the test at the Site, the maximum limit of water leakages to be accepted will be not greater than the following: (not applicable)

- | | | |
|------|--|---------------|
| (i) | large gate width of opening
of 1.00 meter or more | 1 liter/sec |
| (ii) | small gate width less
than 1.00 m | 0.5 liter/sec |

The leakage that occurred through the contact of steel guide from and concrete shall not be accepted.

(12) Transportation of Gate Supplied by the Contractor

Transportation to the Site is included in the supply; the Contractor is assumed to be conversant with the conditions of the ways of communication to the site, and with any and all existing limitations on transportation, such as load limits, width and height of bridges and the like.

(13) Painting for Permanent Equipment

All exterior surfaces of permanent equipment for this contract, except finished or bearing surfaces, shall be coated with non-bleeding type coal tar epoxy. The coal tar epoxy to be used shall be dark gray in color or other colors that shall be subject to approval by the Engineer. The coating system shall provide a total dry film thickness not less than 200 microns.

(14) Spare Parts (Not applicable)

The Contractor shall supply the spare parts listed hereinafter, which are to be considered as the minimum requirement, for all the gates supplied under this Contract:

- ten (10) percent of each type of stem used for the gates, with a minimum of one (1) of spare parts and shall be as follow :

Item	Gate Stem	Gate Lift	Gate Leaf
Vertical Turnout Gate ; Dia (m)			
- 0.3, 0.4, 0.5, 0.6	Supply	Supply	Supply
- 0.8, 1.0	Supply	Supply	Not
Overflow Rectangular Gates and Slide Gate, Bgx C (mxm)			
- Bg < 2.0 and C < 1.75	Supply	Supply	Not
- Bg > 2.0 and C < 1.75	Not	Supply	Not

S12.02 INSTALLATION OF PERMANENT EQUIPMENT

(1) General

The work includes the assembly, erection, installation, testing and commissioning of the permanent equipment supplied by the Contractor.

(2) Storage at Site

- (a) All materials and equipment to be installed shall be stored at Site at the care and expense of the Contractor.

All boxes and crates containing equipment, spare parts and small materials such as bolts, nuts, gaskets and accessories shall be stored under cover.

All equipment to be installed in open air may be stored out but the Engineer will have the right to request that some particular equipment be covered with tarpaulins in order to protect it.

The storage of the equipment both under cover and in the open air shall be done in an orderly manner, taking into account the safety regulations, leaving the required space for the maneuver of cranes and following as much as possible the erection sequence so to minimize the movement of the materials. The custody of all materials and equipments shall be the care of the Contractor store houses shall be locked and areas for storage in open air shall be fenced, even if located inside the Contractor's camp.

(b) Following the arrival of each set of materials and equipment the Contractor and the Engineer shall jointly perform the following checks:

- Correspondence of the contents to what is indicated in the "Packing List";
- Visual inspection of the condition of the crating;
- Partial or total opening of the crates to check that the contents have not been tampered with or damaged during transportation;
- Visual inspection of the surface;
- Inspection of unpacked steel structures for damage.

An inspection report shall be prepared, and signed by both parties.

All packing materials, unless otherwise indicated, shall be the Department's property, and, if requested, shall be delivered in good condition. The unpacking shall be done so to avoid any unnecessary damages to the packing materials.

All packing materials not requested by the Department shall be removed from the Site at the cost of the Contractor.

(3) Erection Equipment

All equipment necessary for the movement, lifting, operation, blocking and testing of all materials to be erected and commissioned shall be supplied by the Contractor. Special tools that may be needed for erection of the permanent equipment shall be supplied by its manufacturer.

(4) Positioning of Equipment

The installation of any equipment shall start only with the approval of the Engineer.

The blocking out of any important part to be embedded in the concrete shall be done only after the Engineer has ascertained the correct positioning of the parts. In the case that after the blockout some parts are not correctly positional the Contractor shall be expense of the Contractor and include remove and reinstall the said parts.

(5) Finishing of Metal Surfaces at Site

All metal surfaces shall be accurately finished. The Contractor at the end of the erection shall carry out all necessary operations to finish the surfaces, subject to the approval of the Engineer.

On arrival at Site all metal surfaces shall be in one of the following conditions:

- (a) Completely painted with primer and finish;
- (b) Painted with two coats of primer;
- (c) Galvanized;
- (d) Untreated;
- (e) Covered with protective layers to be removed.

After erection, or before, if requested by the Engineer, the Contractor shall perform the following operations:

In case (a) accurate cleaning of the surfaces with clothes first damp and then dried and final touch-up painting where required.

In case (b) accurate cleaning of the surface using, where the prime paint is damaged, emery-paper or sand-blast, then touching-up of the antirust paint and final painting.

In case (c) cleaning of the damaged parts and touching-up with cold zinc-plating.

In case (d) preparation of the surface and painting

In case (e) removal of the protective layer and preparation of the surface for the use it is allotted.

No surface treatment is required for all non-ferrous metals, stainless steel, and chrome plated steel and for the parts to be wholly embedded in the concrete.

(6) Safety Precautions

In addition to the existing regulation of the Kingdom of Thailand the Contractor shall comply with the following prescriptions:

(a) Railings

All platforms and gangways that are set at a height of more than four (4) m from the ground shall be provided with railings and toe boards on all sides. Railing height shall be at least 1 m.

(b) Lighting

All transit and open areas during night work shall be sufficiently lit. To satisfy this condition a lighting system shall be provided. In the working areas lighting shall not be less than 35 lux and in other areas shall not be less than 5 lux.

(7) Erection of the Permanent Equipment

(a) Embedded Parts

After the first stage concreting is completed the Contractor shall position all parts to be embedded in the second stage concrete. Said parts shall be temporarily fixed by u-braces, tie rods and struts and in the case of heavy pieces shall be supported by jacks.

Particular precautions shall be taken to avoid even minimal movements during second stage concreting.

The correct positioning shall be checked with a precision theodolite in respect to the fixed datum points. In the case of large parts controls shall be made on several points, possibly on machined surfaces.

Horizontality or verticality of the different parts or of the relative axis shall be checked with precision optical instruments.

The Contractor shall comply with the tolerances as stated in this Section. During concreting machined surfaces and threads shall be accurately protected to avoid damage.

(b) Mechanical Equipment

Before starting installation of the mechanical equipment, the Contractor shall inspect and clean all parts with particular care to the machined parts and to the nuts and bolts. The erection shall be carried out following the match marks made during shop assembly; with particular care to the matching of the reamed bolts and of similar elements.

The tightening of the nuts shall be done with appropriate wrenches. The Contractor shall tighten nuts and bolts applying the torque prescribed by the manufacturers.

Before the erection of any part the dimensions and tolerances shall be checked according to the drawings. No modification of tolerances shall be allowed without written approval of the Engineer.

(8) Tests

The Contractor shall perform all site tests as specified in Clause S12.01 (11).

S12.03 TRAVELING CRANE AND ASSOCIATED WORKS

(1) Installation and Operation

A traveling crane and associated work shall be installed at the powerhouse for installation and removal of turbine or motor using their respective monorail I-beam during the maintenance period.

(2) Design Data

The design and operation shall satisfy the following requirements:

Type	:	Traveling crane with manually operated hoisting unit and manually operated travel.
Service	:	Installation and removal of the pump or motor at pump station.
Number	:	one set
Capacity	:	As shown on the Drawings.
Length of Travel	:	The traveling crane beam shall be of sufficient length to give adequate hoist hook coverage of the areas to be served by the hoist.
Hook Lift	:	The traveling crane shall have a hook lift capable of lifting the pump or motor from their respective operating positions to maintenance positions.

(3) Design Loads

- (a) The capacity of the traveling crane shall be sufficient for lifting and lowering one pump or motor complete with monorail I-beam during erection and maintenance. In establishing the capacity, the dead load plus any possible friction or lifting forces occurring in combination with the dead load shall be considered.
- (b) The manual chain operated travel shall be grooved to give full control of the hoist during the travelling motion when carrying the maximum load. The effort on the load chain required to move the hoist under maximum load as shown on the Drawings.

(4) Traveling Crane Assembly

- (a) The hoisting motion shall be by manual chain operation. The longitudinal travel shall be by manual chain operation also.
- (b) The hoist design shall ensure closely controlled hoisting and lowering operation together with easy and accurate travel movements under all conditions of loading.

(5) Monorail

The monorail shall consist of a single rail designed to carry the hoist lifting a maximum load. The monorail shall be supplied with stainless hanging bolts, fittings and removable end stops.

(6) Maintenance Equipment and Special Tools

- (a) The Contractor shall supply a complete set of high quality tools and accessories for carrying out all adjustments and maintenance operations. The set shall include all necessary single-ended spanners, ring spanners, socket wrenches, special tools, and lubricating equipment for the hoist.
- (b) The tool shall be marked as to size and purpose and shall be supplied in a sheet steel cabinet of approved design. The cabinet shall be equipped with shelves, drawers, racks, fittings, lock and dyes for the secure and orderly storage of the tools, the cabinet shall be waterproof and shall be located as directed by the Engineer.

S12.04 STAFF GAUGES

(1) General

The Contractor shall supply and install staff gauges. The location and elevation of staff gauges shall be fixed to the requirements of the Drawings or as directed by the Engineer.

(2) Material

Staff gauge plates shall be made of steel sheet having a minimum thickness of 2 mm and surfaces shall be finished by enamel process. Graduation of the plate shall conform to the details as designated by the Contractor and approved by the Engineer. Color shall be white for both faces and all numerals and graduations shall be black.

Enamel faces shall consist of two undercoats and one top coat, applied and stoved, of uniform thickness, homogeneous and uniform in color with an egg-shell flat finish. All holes shall be drilled before enamel processing.

(3) Fixing

Where indicated on the Drawings or otherwise directed by the Engineer, staff gauges shall be mounted. All mounting holes shall be accurately located and fixed as detailed by the Contractor and approved by the Engineer. The gauge shall present an even surface free from twist, cracks, faults or other blemishes after complete installation.

S12.05 TRASHRACKS, LIFTING BEAMS AND EMBEDDED FRAMES

(1) Installation and Operation

The trashrack shall be provided at the pump station in set, as shown on the Drawings, to prevent debris from entering the sand sluice. Each element of the trashrack shall be removed or reinstalled by means of a gantry crane with lifting beam provided under the contract.

(2) Design Data

(a) Design Data

Number	:	Number of sets equal to the pump sets.
Size of Opening	:	as shown on the Drawings
Design Head Loss	:	0.20 m.
Sill Level	:	as shown on the drawings
Ancillary Equipment	:	Lifting Beam

(b) The design shall ensure that no adverse vibrations will occur under any operating conditions and that head losses across the trashracks are kept to a minimum.

(c) The leading edges of the trashrack bars shall be rounded to reduce head loss.

(d) The trashracks are capable of withstand and water head (i.e., completely blocked with debris and trash).

(3) Trashrack Assemble

(a) The trashracks shall be fabricated From welded steel construction and shall completely fill the opening. Each trashrack panel shall consist of vertical trash bars supported on the load framework. The framework shall be formed of horizontal structural members suitable braced and vertical side members which shall carry the load. The load shall be transferred to the embedded frame via vertical bearing plates bolted to the trashrack framework.

(b) The trash bars shall be hot-dip galvanized bound with stainless steel binding bolts and bar spacers. The framework shall be painted in accordance with Section 10.

(c) The clear spacing between the trash bars shall not exceed 20 mm. The trashrack panels shall be provided with locating pins and matching holes for proper alignment of upper and lower panels.

(d) Guide rollers and associated guide bars on the embedded frames, panel springs shall be provided to guide the trashracks onto its groove.

- (e) Lifting lugs and others necessary shall also be provided to facilitate handling of the trashracks or temporary storing on the deck of relating structure.

(4) Lifting Beam

- (a) The lifting beam shall be of fabricated steel construction designed to carry the maximum load due to the dead weight of trashrack, and any other related loads. Only 1 trashrack will be required to be lifted at any one time.
- (b) The lifting beam shall be fitted with lifting pins for connection to the gantry crane and with self-latching and unlatching counter-weighted lifting hooks which automatically engage or disengage with each trashrack when preselected to do so. Locating holes shall be provided on the lifting beam to engage with the locating pins on each trashrack to ensure positive alignment of the lifting beam with each trashrack. The lifting beam shall be guided in the guides and grooves provided for the trashracks and Bulkhead gates.

(5) Embedded Frames and Anchors

(a) Frame

- (i) The embedded frames shall be designed to serve for trashracks and Bulkhead gates. The frames shall consist of vertical members forming the guides and seal seats on the upstream and downstream sides respectively of the grooves and horizontal members forming the top and bottom seal seats. The guides shall be commonly used for trashracks or Bulkhead gates, the seal seats shall be used for Bulkhead gates only.
- (ii) The Frames shall be capable of being assembled in blockouts on anchor bolts embedded in first stage concrete, accurately located and aligned and then embedded in second stage concrete. All working surfaces shall be machined and free of twists and warps.
- (iii) All surfaces not covered by concrete shall be of solid stainless steel or clad with stainless steel of minimum thickness of 4 mm after machining.
- (iv) All frame joints shall be machine finished and bolted and dowelled and when assembled the joints shall be flush and shall butt firmly together with gaps at the joints not exceeding 0.03 mm.
- (v) The contractor shall provide:
 - all the anchor bolts to be embedded in the first stage concrete, and

- the anchor bolt extension, extension nuts and standard nuts to be embedded in second stage concrete.

- (vi) Embedded frames and anchors, and their attachment points shall be of rigid design such that they will not suffer distortion or damage during installation and embedment.

(b) Tolerances

- (i) The following manufacturing and installation tolerances shall apply. The manufacture of the various parts shall be such that the anchor bolts without additional jacking, straightening, correcting or grinding during erection and installation by the Contractor.
- (ii) Parts embedded in first stage concrete, anchor bolts and other parts embedded in first stage concrete shall be to location and level within ± 5 mm.
- (iii) Top and Side Seal Seats : Seating faces of top and side seal seats shall be in a common vertical plane perpendicular to the centerline, within ± 5 mm. overall.
- (iv) Bottom Seal Seat: The sealing face of the bottom seal shall be horizontal within ± 5 mm overall.
- (v) Guides: Faces of guides shall be plumb within mm. without gaps or offsets at joints.

S12.06 GANTRY CRANE AND ASSOCIATED WORKS (NOT APPLICABLE)

(1) Installation and Operation

A gantry crane and associated work shall be installed at powerhouse for installation and removal of trashracks or Bulkhead gates using their respective lifting beams during the maintenance period of trashracks.

(2) Design Data

The design and operation shall satisfy the following requirements:

Type	:	Gantry crane with manually operated hoisting unit and manually operated travel.
Service	:	Installation and removal of the trashracks or Bulkhead gates
Number	:	one set
Capacity	:	As shown on the Drawings.

- | | | |
|------------------|---|--|
| Length of Travel | : | The gantry crane beam shall be of sufficient length to give adequate hoisthook coverage of the areas to be served by the hoist. |
| Hook Lift | : | The gantry crane shall have a hook lift capable of lifting the trashracks or Bulkhead gates From their respective operating positions to maintenance positions or storage above the intake service deck. |

(3) Design Loads

- (a) The capacity of the gantry crane shall be sufficient for lifting and lowering one trashrack panel or Bulkhead gates complete with lifting beam during erection and maintenance. In establishing the capacity, the dead load plus any possible friction or lifting forces occurring in combination with the dead load shall be considered.
- (b) The manual chain operated travel shall be grooved to give full control of the hoist during the travelling motion when carrying the maximum load. The effort on the load chain required to move the hoist under maximum load shall not exceed load as specified from the manufacturer.

(4) Gantry Crane Assembly

- (a) The hoisting motion shall be by manual chain operation. The longitudinal travel shall be by manual chain operation also.
- (b) The hoist design shall ensure closely controlled hoisting and lowering operation together with easy and accurate travel movements under all conditions of loading.

(5) Monorail

The monorail shall consist of a single rail designed to carry the hoist lifting a maximum load. The monorail shall be supplied with stainless hanging bolts, fittings and removable end stops.

(6) Maintenance Equipment and Special Tools

- (a) The Contractor shall supply a complete set of high quality tools and accessories for carrying out all adjustments and maintenance operations. The set shall include all necessary single-ended spanners, ring spanners, socket wrenches, special tools, and lubricating equipment for the hoist.
- (b) The tool shall be marked as to size and purpose and shall be supplied in a sheet steel cabinet of approved design. The cabinet shall be

equipped with shelves, drawers, racks, fittings, lock and dyes for the secure and orderly storage of the tools, the cabinet shall be waterproof and shall be located as directed by the Engineer.

S12.07 BULKHEAD GATE AND EMBEDDED FRAMES

(1) Installation and Operation

- (a) The Bulkhead gate and associated metalwork shall be furnished and installed by the contractor, generally as shown on the Drawings.
- (b) The Bulkhead gate shall function as a bulkhead gate to close the inlet of the headrace for maintenance purposes.
- (c) To close the inlet the Bulkhead gate shall be placed in the Bulkhead gate groove and slide down to its position.
- (d) The Bulkhead gate shall be installed and removed only under balanced hydrostatic conditions.

(2) Design Data

The design and operation shall satisfy the following requirements.

Lift Fences	:	Gantry Crane Operation
Gate Type	:	Vertical lift, bulkhead gate with automatic balance valve
Service	:	Isolation of the pump pit for maintenance purpose.
Number	:	One (1).
Size of Opening	:	As shown on the Drawings.
Design Head	:	N.W.L- Sill Level
Sill Level	:	As shown on the Drawings.
Top Water Level	:	N.W.L.
Seals, Type and Orientation:		Sides and top synthetic rubber, solid music note. Bottom flat synthetic rubber strip downstream sealing.

(3) Design Loads

The design of the Bulkhead gate and embedded parts shall be based on the most severe combination of the following loads:

- (a) The full Hydrostatic pressure corresponding to N.W.L.
- (b) The dead load of the Bulkhead gate.

- (c) All possible lifting and friction forces occurring separately and in combination with the dead load stated above. The Bulkhead gate shall be designed to operate safely and smoothly under all conditions of operation. Under overload conditions caused by possible sticking or jamming during the lifting operation, the stresses induced shall not exceed 75 percent of the yield strength of the component material.

(4) Bulkhead gate Assembly

- (a) Gate Leaf: the gate leaf shall be of fabricated steel construction consisting of a downstream skin plate, seals and a supporting framework. The supporting framework shall be formed of horizontal structural members suitably braced and vertical side members which shall carry the hydrostatic Load. The hydrostatic load shall be transferred to the embedded frame via vertical bearing bars bolted to the skin plate.

(b) Seals

- (i) The Bulkhead gate shall be sealed at the bottom with a flat synthetic rubber strip attached to the Bulkhead gate so that the bottom edge of the strip seals tightly against the seating face of the bottom seal seat. The side and top seals shall be continuous and shall be of the synthetic rubber music note type.
- (ii) All seals shall be made of high-grade synthetic or natural rubber and shall be moulded. The upper seal corners shall be moulded pieces.
- (iii) The seals shall be fastened by stainless steel clamp strips to machined faces on the downstream side of the skin plate and shall be effective over their full length. Fixing screws for the clamps shall be of stainless steel.

(c) Resting Devices

The Contractor shall provide the resting devices located in the blockout of dogging device pit below deck level as shown on the Drawings.

(5) Embedded Frames and Anchors

(a) Frames and Anchors

The embedded frames shall consist of vertical member forming the seal on the downstream side of the Bulkhead gate groove and horizontal members forming the top and bottom seal seats. The Frames shall be capable of being assembled in blockouts on anchor bolts embedded in first stage concrete, accurately located and aligned

and then embedded in second stage concrete. All working surfaces shall be machined and free of twists and warps.

(b) Tolerances

As same as trashrack.

S12.08 VERTICAL GATES

(1) General

The work covered the assembly, erection, installation, testing and commissioning of vertical gates supplied by the Contractor.

(2) Materials

The steel to be used for fabrication of vertical gate shall meet the requirements as follows;

- (a) Steel plate in accordance with ASTM A283 Grade C or D or JIS G3101 SS400
- (b) Steel sheet of coil in accordance with ASTM A570 Grade 36
- (c) Steel conforming to JIS G3457 and TIS 427-2531

The thickness of vertical gate shall not less than the thickness of steel pipe. Tolerance on thickness of vertical gate shall be ± 0.25 millimeter, except otherwise as shown on the drawings.

(3) Erection

All equipment necessary for the movement, operation fitting and testing of all materials to be erected shall be supplied by the contractor

(4) Metal Surface

All metal surfaces shall be accurately finished. The Contractor at the end of the erection shall carry out all necessary operations to finish the surfaces, subject to the approval of the Engineer.

(5) Gate Lift and Gear Motor

- (a) Installation and Operation

A gate lift and gear motor and associated work shall be installed at the inlet of headrace and sand sluice installation and operation of vertical gates using their during the maintenance period.

(b) Materials

The steel and metal to be used for fabrication of gate lift shall meet the requirements as shown on the Drawing. The gear motor shall be the products of manufacturer holding an ISO 9002 certificate. The capacity and specification of gear motor shall also be submitted to the Engineer.

(6) Gate Assembly

(a) Gate Leaf: the gate leaf shall be of fabricated steel construction consisting of a skin plate, seals and a supporting framework as shown on the Drawing.

(b) Seals

(i) The vertical gate shall be sealed at the bottom with a flat synthetic rubber strip attached to the gate so that the bottom edge of the strip seals tightly against the seating face of the bottom seal seat. The side and top seals shall be continuous and shall be materials as shown on the Drawing.

(ii) All seals shall be made of high-grade synthetic or natural rubber and shall be moulded. The upper seal corners shall be moulded pieces.

(iii) The seals shall be fastened by stainless steel clamp strips to machined faces on the downstream side of the skin plate and shall be effective over their full length. Fixing screws for the clamps shall be of stainless steel.

(7) Embedded Frames and Anchors

The embedded frames shall consist of vertical member forming the seal on the side of the gate groove and horizontal members forming the top and bottom seal seats. The Frames shall be capable of being assembled in blockouts on anchor bolts embedded in first stage concrete, accurately located and aligned and then embedded in second stage concrete. All working surfaces shall be machined and free of twists and warps.

(8) Tolerances

As recommended by the manufacturer.

S12.09 GATE VALVE

(1) General

The work covered the assembly, erection, installation, testing and commissioning of gate valve supplied by the Contractor. The gate valve shall conform to TIS 256 or AWWA C500. The gate valve shall be cast-iron bodies with non-rising stems and solid wedge. The minimum design working pressure shall be not less than 10 bars.

(2) Installation and Operation

A gate valve and associated work shall be installed at the penstock at near surge tank. The gate valve for aboveground service shall be furnished with hand wheel. The direction of opening for gate valve shall be counterclockwise as viewed from the top.

(3) Markings

Markings shall be cast on the bonnet or body of valve and shall show the following:

- Manufacturer's name
- Year of manufacture
- Nominal diameter
- Designation of working pressure
- Lot number
- Number of turn to open
- Owner

The letter or markings specified above shall be at least 15 mm. in height and shall be 3 mm. raised from the surface.

On the wrench nut or hand wheel, the arrows showing the direction of opening or closing shall be cast on.

(4) Accessories for gate valve

- (a) Rubber gaskets for flanged joint shall be furnished for gate valve delivered. The rubber gasket shall be full face and their dimensions as shown on the Drawing. The rubber gaskets shall conform to BS 2494, Hardness range 56-65 or JIS K 6353, class III, Hardness Hs 55-65
- (b) Bolts and nuts for flanges joint shall also be furnished for gate valve delivered. Bolts and nuts shall be made of steel conforming to ASTM A 307, grade B, or TIS 171, class 4.6 and shall be hot-dipped galvanized. The dimension of bolts and nuts shall be as shown on the Drawing.

S12.10 JOINT FOR STEEL PIPE

Joints for steel pipe shall be mechanical coupling, dismantling joint, and restrained joint or as shown on the Drawing and as specified in the Section 13.

S12.11 MISCELLANEOUS METAL WORKS

(1) General

The work covered by this Clause shall include, but shall not be limited to, the supply of material, fabrication, installation and painting or hot-dip galvanizing of items of miscellaneous metal work such as:

- Galvanized steel pipe, steel plate
- Steel grating cover, ladder rung, Handrail,
- Miscellaneous metal work for the other works as shown on the Drawings

(2) Materials

Materials shall conform to the following Specifications

Material and Products	ASTM Designation or Equivalent
Steel shapes	A 283, A 306 and A 36 or TIS 107-2533 and 1227-2539
Steel plate and section	A 36
Steel tube and pipe	A 53
Cast iron pipe	A377
Metal steel black bolts and nuts	A 36, A307
Galvanized bolt and nuts	A153
High strength bolts and nuts	A 325
Steel pipes, black or galvanized	A 120 or TIS-277-2532
Hot-rolled steel bars	A 575 and A 576 or TIS-55-2516

Material and Products	ASTM Designation or Equivalent
Cold finished steel bars	A 108
Galvanizing	A 123 or A 153
Anchor bolts	A 307
Welding	D1.1
Welding rod for carbon steel	A5.17

(3) Fabrication

(a) General

Fabrication of metal work shall be in accordance with the best modern practice in the manufacture and fabrication of materials of the type covered by these Specifications, and in accordance with the Drawings. Built-up metal work shall be completely assembled in the shop and matched for correct field erection. All frames shall be suitably braced as required, to maintain alignment during shipment and erection. All joints shall be filed, milled or machined as necessary to secure close and perfect connection.

All exposed bolts, projecting beyond the nut, shall be preened.

(b) Welding of Steel

Welded work shall be in accordance with the requirements of "Welding in Building Construction" as formulated by AWS.

(4) Painting

Miscellaneous metal work to be painted shall be treated as indicated in Section 10 hereafter.

(5) Hot-dip Galvanizing

Metal work to be galvanized shall receive an adherent, smooth and continuous zinc coating, free from bubbles, porosities or other irregularities that may affect the soundness of the protective layer. The thickness of the zinc layer shall be such that the rate of deposited metal corresponds to a minimum of 600 gm/m².

(6) Installation and Erection

(a) General

The work shall include all cutting, fitting and drilling required for proper installation, and to make all the required connection with adjoining work. All anchors, sockets, pipe sleeves and expansion bolts required for securing the metal work to the construction shall be furnished by the Contractor, except where specifically stated otherwise.

(b) Embedded Metal

- (i) All embedded metal shall be accurately set in place before the concrete is poured or, subject to the approval of the Engineer, recesses may be left in the concrete and the metal work placed, anchored and blocked in place after the concrete of the structure has set.
- (ii) Where it is impracticable to place anchors or anchor bolts required for the installation of ladders or other miscellaneous metal work before concrete is built, holes shall be drilled in the structures and expansion bolts shall be installed.

(c) Ladder Rungs

Ladders shall be fabricated, painted and installed in accordance with the Drawings and the provisions of these specifications. The components shall be cut, punched, drilled and welded as required for installation, which shall follow the completion of concrete work as closely as possible.

(d) Galvanized Steel Pipe Handrail

The Contractor shall furnish and install all pipe handrail and posts as shown on the Drawings in accordance with these Specifications. The Contractor shall furnish and install all brackets, nuts, bolts and expansion anchors required for installation. Handrail sections shall be installed to true line and level to the satisfaction of the Engineer.

The galvanized pipe for handrail and posts shall be standard 37.5 millimeter (1 1/2 inch) nominal size steel pipe, intermediate grade.

(e) Anchor Bolts

Anchor bolts to be embedded in concrete shall be positioned with a template before concrete is placed and the Contractor shall ensure that the anchor bolts are maintained in the correct position as shown on the Drawings, during the placing of concrete.

(f) Galvanized Steel Pipe

- (i) The dimension and/or size of galvanized steel pipe shall be fabricated to the dimensions and size as shown on the drawings.
- (ii) The galvanized steel pipe for the blow-off valve pits shall be set to the correct alignment and profile and anchored in concrete as shown on the Drawings.

(g) Skin Plates

The skin plates shall be as shown on the Drawing and as approved by the Engineer and shall be delivered match marked for assembly and installed strictly in accordance the manufacturer's instructions.

(h) Miscellaneous Metal Works

The Contractor shall furnish and install miscellaneous metal works, including metal works listed in this subclause and miscellaneous metal works elsewhere as shown on the Drawings or directed.

- Embedded metal works
- Non-embedded metal works
- Embedded steel plate with bar anchorage
- Steel roof frame
- Galvanized steel
- Stiffener ring
- Steel strap
- Steel plate pipe collar

S12.12 MEASUREMENT AND PAYMENT

(1) Permanent Equipment

- (a) The Contractor shall supply and install the following permanent equipment as shown on the Drawings. The scope of work shall include the design manufacture, supply, delivery, erection, commissioning, production of operation and maintenance manuals and defect liability as described hereunder.
- (b) The design, manufacture, supply, delivery to the Site, erection and commissioning, production of operation and maintenance manuals and defect liability shall be in accordance with Section 12 to the Specification. Section 12 covers the design, manufacture, supply and delivery to the Site, erection and commissioning and defect liability.

- (c) The bidder shall submit drawings showing the general arrangement and important details of each item, a description of the construction, operation and materials to be used.
- (d) Within ninety (90) days of the Acceptance of Bid, the Contractor shall submit detailed information including a complete set of design calculations and drawings as required in Clause 4.04 of Volume I, necessary for the manufacture, erection, commissioning, operation and maintenance of each item to the Engineer for approval. The Contractor shall be fully responsible for the correctness of these drawings. The Contractor may be required by the Engineer to supply such additional drawings, data and design calculations and to make such changes in the design as may be necessary to ensure that the plant conforms to the requirements of the Contract. When the Engineer has approved the drawings they shall become the Drawings and shall not be modified or departed from without the approval of the Engineer.
- (e) The Engineer may inspect and/or test during design, manufacture, installation and commissioning, the various portions of the plant at all reasonable times and shall have the power to reject all components and/or assemblies that are not in accordance with the Drawings or that otherwise do not meet the requirements of this Specification.
- (f) The Contractor shall be responsible for liaison with the permanent equipment manufacturer to determine final dimensions, blockout locations and sizes, other details such as embedded metalwork and compliance with the requirements of the Specification.

Payment for the installation of permanent equipment will be made at the rate bid, which shall be included all cost, for the completion of the work as specified in this Section and the Drawings, except second stage concrete in blockouts, which will be paid and included in payment for concrete for different classes provided in Section 9.

Payment for the Spare Parts will be made at the Lump Sum rate stated in the Schedule. The Lump Sum payment will cover all material and labor for the preparation of the spare parts as well as the transport to locations to be indicated by the Engineer.

Should all or part of the Permanent Equipment supplied by the Contractor be imported into Thailand, the Contractor shall be responsible for all the necessary arrangements for Custom clearance, and shall pay all applicable Custom duties and taxes. The duties and taxes shall be included in the local currency portion of the Schedule.

For Installation and grouting pipe in intake, the Contractor shall propose method of construction for the Engineer approval before proceeding.

(2) Traveling Crane

Traveling crane will be measured and paid at the rate per set therefor in the Schedule, and shall include accessories and incidental necessary to complete the work.

(3) Staff Gauge

Staff gauge will be measured by number of pieces installed and the payment will be made at the rate per set bid therefor in the Schedule.

(4) Trashracks

Trashracks will be measured by number of pieces installed and the payment will be made at the rate per set bid therefor in the Schedule.

(5) Bulkhead gates

Bulkhead gates will be measured by number of pieces installed and the payment will be made at the rate per set bid therefor in the Schedule.

(6) Lifting Beams

Lifting beams will be measured by number of pieces installed and the payment will be made at the rate per set bid therefor in the Schedule.

(7) Gantry Crane and Associated Works (Not Applicable)

Gantry Crane and associated works will be measured by set and the payment will be made at the rate per set bid therefor in the Schedule.

(8) Vertical Gates

Vertical gate will be measured by set and the payment will be made at the rate per set bid therefor in the Schedule, which shall include all costs of material, labor, welding, painting, installing, gate lift with gear motor and including all necessary works required to complete the Works as specified.

(9) Miscellaneous Metalwork

- (a) Measurement for payment for the miscellaneous metalwork will be of the weight of finished material installed.

Measurement will be based on the calculated weight of the metalwork before installation. The Contractor shall supply the calculated weight of metalwork.

- (b) Payment will be made at the rate per kilogram bid therefor in the Schedule, and shall include the complete costs for painting or galvanizing.
- (c) Payment for furnishing and installing galvanized steel pipe handrail will be made at the rate per linear meter, which shall include all costs of material, labor, installing and, where required, excavation, backfilling, concreting for footing and including all necessary works required to complete the Works as specified.
- (d) Payment for furnishing and installing ladder rungs will be made at the rate per kilogram bid therefor in the Schedule.
- (e) The cost of anchor bolts shall be included in the rate bid in the Schedule for the various item of the metal works for which anchor bolts are used, except for the anchor bolts.
- (f) The cost of galvanized steel pipe shall be made at the rate per linear meter. The cost will include full compensation for furnishing all labor, materials, test, construction equipment and incidentals for supply fabrication and any cost necessary for execution of the Works.
- (g) Payment for furnishing and installing skin plates and frames will be made at the rate per kilogram.
- (h) Payment for furnishing and installing miscellaneous metal work of the other works will be made at the rate bid therefor in the Schedule.

The price will include full compensation, for furnishing all labor, materials, tools, construction equipment and incidentals for supply, fabrication and any other costs necessary for execution of the Works.

- (i) Payment for furnishing, erecting and installing of structural steelwork will be made at the rate per bid therefor in the Schedule. These rates shall include all required structural steelwork.

(i) Furnishing and installing roof members.

(ii) Furnishing and installing miscellaneous structural steelwork.

The price shall include the entire cost of furnishing all labor, materials, tools, construction equipment and incidentals for supply, transport, cutting, bending and welding of structural steelwork, and any other cost necessary for doing the work as indicated in this Section, shown on the Drawings and/or directed by the Engineer.

- (j) The cost of miscellaneous metals works shall be made at the rate per kilogram for various item of metal work which metal works are used.

(10) Spare Parts (Not Applicable)

Spare parts of each type of stem used for permanent equipments will be measured by set and the payment will be made at the lump sum bid therefor in the Schedule.

The Lump Sum payment will cover all material and labor for the preparation of the spare parts as well as the transport to locations to be indicated by the Engineer.