TABLE OF CONTENTS

SECTION TS 23. MISCELLANEOUS WORKS

SECTION TS 23. MISCELLANEOUS WORKS

23.1 GENERAL

This section of the Technical Specifications covers the requirements for various works not specified elsewhere including the following :

- PVC Pipe
- Water Supply Pipe Reconstruction
- Telephone Cable Reconstruction
- Staff Gauge

23.2 PVC PIPE

23.2.1 Scope

This item covers the requirements for PVC bridge deck drains and PVC conduits for utility services in bridge decks.

23.2.2 Technical Requirements

Material for weep holes shall be black, Unplasticised Poly-Vinyl-Chloride (uPVC) conforming to the requirements of JIS K 6741of the diameter shown on the Drawings. Pipe material shall be approved in writing by the Engineer before any purchase orders are placed.

23.2.3 Construction Requirements

PVC pipes shall be cut to the required lengths and installed in the locations shown on the Drawings. When PVC pipes are embedded in concrete they shall be held rigidly in place prior to and during placement of concrete. Any concrete or other material accumulated inside PVC pipes shall be removed and the bore of the pipes shall permit free draining of water.

23.3 WATER SUPPLY PIPE RECONSTRUCTION

23.3.1 Scope

Two existing water supply pipelines of approximately 200 mm diameter and their supporting pipe bridges spanning across the Asin River are required to be raised.

The Contractor is required to survey the elevations of the existing bridges and the Engineer shall instruct the amount by which each is to be raised.

The work shall be done in close liaison with the Engineer and the local water authority, Perusahan Daerah Air Minum (PDAM) with specialist work on the pipelines done by PDAM.

23.3.2 Civil Works

All civil work including coffering and dewatering, earthworks, concrete works shall be executed in accordance with the Drawings and the respective technical specifications.

23.3.3 Pipe Connection Works

The Contractor shall not disrupt the water supply in the pipelines.

All work on the pipelines shall be performed by PDAM .

The Contractor shall liaise directly with PDAM and shall schedule civil works according to times set by PDAM for performing the pipeline shut down and reconnection.

The Contractor shall be responsible to pay all costs charged by PDAM for carrying out the pipeline work.

23.4 TELEPHONE CABLE DUCT RECONSTRUCTION

23.4.1 Scope

An existing cable duct bridge supporting telecommunication cables across the Asin River is to be raised. As a consequence of the required raising cables will need to be lengthened or replaced.

The Contractor is required to survey the elevations of the bridge and the Engineer shall instruct the amount by which it is to be raised.

The work shall be done in close liaison with the Engineer and the Indonesian telephone company which owns and operates the cables, Telkom Indonesia, with specialist work on the cables done by PDAM.

23.4.2 Civil Works

All civil work including coffering and dewatering, earthworks, concrete works shall be executed in accordance with the Drawings and the respective technical specifications.

23.4.3 Cable Connection Works

The Contractor shall not disrupt the telecommunication cables.

All work on the cables shall be performed by Telkom Indonesia.

The Contractor shall liaise directly with Telkom Indonesia and shall schedule civil works according to times set by Telkom Indonesia for performing the cable work.

The Contractor shall be responsible to pay all costs charged by Telkom Indonesia for carrying out the cable work.

23.5 STAFF GAUGE

23.5.1 Scope of Work

The work includes the furnishing and installation of a vertical staff gauge for the visual observation of water depth.

23.5.2 Technical Requirements

The staff gauge shall be of painted steel or anodised aluminium and shall be suitably protected against corrosion for permanent use in salt water.

Figures and calibration shall be clear and crisp to enable reading in poor light conditions.

23.5.3 Submittal

The Contractor shall submit shop drawings and technical details of proposed materials, surface protection system, marking pattern etc. for the Engineer's approval.

23.5.4 Construction Requirements

The staff gauge shall be installed firmly and plumb in the location shown in the location shown on the Drawings or as directed by the Engineer.

23.6 MEASUREMENT AND PAYMENT

Payment for the staff gauge shall be made following completion of installation, inspection and approval by the Engineer in accordance with the lump sum price entered in the Priced Bill of Quantities which shall be full compensation for the cost of all materials, labour, equipment and all other associated costs.

The work

23.7 MEASUREMENT AND PAYMENT

Drain Pipe and Utility Pipe

Measurement shall be made of the length of PVC pipe (for drain pipe in bridge decks or utility pipes), complete, in place and approved by the Engineer.

Payment for shall be made at the respective rates entered in the priced Bill of Quantities which shall include the entire cost of completing the work including materials, labour, equipment and all associated costs.

Pipe Connection Works

Payment for Pipe Connection Works shall be made following completion of the work and approval by the Engineer in accordance with the lump sum entered in the priced Bill of Quantities which shall be full compensation for the cost of all expenses incurred by the Contractor in liaising with PDAM, paying PDAM for executing the pipe connection work and any other incidental costs necessary for its completion.

Cable Connection Works

Payment for Cable Connection Works shall be made following completion of work and approval by the Engineer in accordance with the lump sum entered in the priced Bill of Quantities which shall be full compensation for the cost of all expenses incurred by the Contractor in liasing with Telkom Indonesia, paying Telkom Indonesia for executing the cable connection works and any other incidental costs necessary for its completion.

Staff Gauge

Payment for the staff gauge shall be made following of installation, inspection and approval by the Engineer in accordance with the lump sum price entered in the Priced Bill of Quantities which shall be full compensation for the cost of all materials labour, equipment and all other associated costs.

The following pay items shall be measured and paid for under this clause:

Pay Item No.	Description	Unit of Measurement
C.8.9	Drain Pipe, PVC Pipe Dia. 100 mm	M
C.8.10	Utility Pipe, PVC Pipe Dia. 150mm	M
C.10.7	Pipe Connection Works	L.S.
C.11.7	Cable Connection Works	L.S.
H.2	Staff Gauge	L.S

DIVISION C

TECHNICAL SPECIFICATON
MECHANICAL AND ELECTRICAL WORKS

TABLE OF CONTENTS
SECTION TS 24. MECHANICAL WORKS

SECTION TS 24 . MECHANICAL WORKS

24.1 GENERAL REQUIREMENTS

24.1.1 General

This section of the Technical Specification covers the general and particular requirements for that portion of the Works described as, and identified in the Bill of Quantities, as Mechanical Works. It specifies the design parameters, minimum requirements of materials, workmanship, standards, tests and finishes and for all the items of plant to be designed, manufactured, delivered and installed by the Contractor under the Contract.

All plant shall be designed, manufactured, installed and commissioned in accordance with the Drawings and the requirements of these specifications or as directed by the Engineer.

All the items of plant herein described shall be designed to endure long periods of operation without the need for substantial repair or replacement of the parts.

All plant shall be products of reputable manufacturers that have a long history and experience in the production of such plant. In addition, the subcontractor (supplier/manufacturer) for the screw pumps shall have had previous experience in the design, manufacture, installation and commissioning of screw pumps of diameter of at least 3.0 m diameter.

24.1.2 Scope of Mechanical Works

The Contractor shall design, manufacture, install, test, commission and rectify defects for all of the mechanical works comprising the systems, sub-systems and supply warranties components as shown in the Drawings and described in this section of the Specification.

Each item of plant, and each sub-system and system shall be designed, installed and commissioned such that the pumping station and the gate system are complete and function in accordance with the operating philosophy for the pumping station and the specified requirements.

Electrical works associated with the mechanical systems to be provided shall be included in this scope of work unless otherwise stated and included as specific pay items in the Bill of Quantities. Requirements for electrical works are specified in the Section TS 25, Electrical Works, of the Technical Specification.

General descriptions of the main systems and elements of the scope of mechanical works are as follows:

- Main Pump System comprising 3 screw-type main pump units and gear boxes.
- Diesel Engine System for Main Pumps comprising 3 diesel engines, fuel service tank, fuel transfer pump.
- Fuel Tank and Accessories including grounding and cathodic protection.
- Auxiliary Pump System comprising 2 electrically-driven submersible pumps, a control panel and water level detectors
- Overhead Crane System comprising a manually-operated travelling crane complete with girder trolley and chain block

- Piping System comprising fuel transfer piping, overflow piping, fuel service piping, fuel intake piping and air vent piping.
- Inspection and Testing comprising factory testing and site testing
- Provision of Spare Parts for all systems
- Provision of Maintenance Tools for all systems
- Gate comprising a steel sluice gate complete with guide frame, electrical and manual hoist and stop logs
- Provision of stop logs for pump intake channels

24.1.3 Operating Philosophy of Asin Pumping Station

Pump Operation

Water level in the Asin retarding pond / Asin River will be maintained at a satisfactory level as determined by the operator.

The operator will set the water levels at which the auxiliary pump system starts.

When the water level rises to the determined start level, the duty electric, submersible, auxiliary drainage pump will start automatically, powered by mains (PLN) supply.

As the water level lowers the duty auxiliary pump will automatically stop.

When the water level rises to the pre-set level as indicated by the "start pump" on the control panel the operator will perform the following tasks:

- manually start one of the diesel engines for the main pumps in the pump house
- manually start one of the main pumps

When the operator judges that one main pump is not adequate to handle the flood or when "high water" is indicated on the control panel, he will manually start the second main pump, and if necessary, the third main pump.

As the flood passes the operator will progressively shut down the main pumps until he judges that the auxiliary pump has sufficient capacity to maintain a satisfactory pond level.

Stop logs will be used when pump maintenance is required.

Gate Operation

When the water level in the retarding pond is higher than the level outside the gate, the gate may be opened by means of the electric hoist activated at a local panel, or manually.

Stop logs will be used during times of gate maintenance

24.1.4 Data Sheets

The completed data sheets M 1 to M 11 shall form part of, and shall be read in conjunction with, this section of the Technical Specification.

24.1.5 Standards

The following standards shall apply to the works specified in this specified in this section. Alternative standards may be accepted in accordance with clause 1.6 of the General Specification.

Gate:

Refer to clause TS 24.8.2

Gate:

Refer to clause TS 24.8.2

Pumps:

JIS B 8301 – 1976 Testing Method for Screw Pumps

JIS B 8302 – 1976 Measuring Method of Pump Capacity

Diesel Engines:

JIS B 8014 – 1964 Test Code for Constant Speed Diesel Engines

Overhead Cranes:

JIS B 8801, Manual Overhead Crane

Electrical Motors:

JIS C 4004 – 1977 General Rules for Electric Rotary Machinery

JIS C 4201 – 1963 Low Voltage Three Phase Induction Motors (for General Purpose)

Electrical Generators:

JIS C 4004 – 1977 General Rules for Electric Rotary Machinery

JEC 114 – 1964

JEC 146 – 1960

24.1.6 Standard Products

The equipment to be furnished under the Contract shall be standard products which are in regular production by manufacturers regularly engaged in the production of high quality equipment of the types to be furnished. Such equipment shall be essentially duplicate equipment of that which has been in satisfactory and successful operation in flood control and drainage works for a period of at least twenty five (25) years.

24.1.7 Alternative Design or Specification

The details of mechanical works depicted in the Drawings contained in Volume 3 of the Bidding Documents are for reference only and show the anticipated dimensions and general arrangement of equipment and related piping and wiring etc. It is expected that that equipment furnished under the Contract will differ to some degree from that shown because of plant designs offered by the Contractor differing in minor details or because of modifications required for its installation or for its related wiring and piping.

At the sole discretion of the Engineer, the design and this specification may be varied to allow for alternative design details, construction methods and materials provided that the performance and durability characteristics are equal or superior to those shown on the Drawings or specified herein.

Changes to the civil and building construction details and dimensions shall not, however, be varied.

Where alternative designs have been offered they shall comply with the accepted details contained in the data sheets submitted with the bid and forming part of the Contract or as approved by the Engineer.

24.1.8 Shop Drawings and Calculation Sheets

Within three (3) months after the date of receipt of Letter of Acceptance, and prior to the manufacture of mechanical plant and equipment to be incorporated in the permanent works, the Contractor shall furnish four (4)

copies of calculation sheets, shop drawings and a complete list of materials for approval in accordance with the requirements of clauses 1.4 and 1.5 of the General Specification.

24.1.9 Spare Parts

The Contractor shall supply spare parts for maintenance purposes suitable for 5-years operation, in accordance with the approved schedule, based on the accepted recommendations of the Contractor made in completed data sheets appended to his bid for all systems for the Asin Pumping Station Mechanical Works.

24.1.10 Maintenance Tools

The Contractor shall supply maintenance tools which shall include tools required for the installation, overhauling and assembly of the equipment in accordance with the approved schedule, based on the accepted recommendations of the Contractor made in completed data sheets appended to his bid for all systems for the Asin Pumping Station Mechanical Works.

Tools for individual equipment, such as pumps, engines, cranes and gate shall be contained in separate tool boxes.

24.1.11 Installation, Operation and Maintenance Instructions

Operation and Maintenance Manuals

At least three (3) months prior to the date of site testing and commissioning of the plant, the Contractor shall submit three (3) copies of the Operation and Maintenance Manual which shall contain comprehensive data for the operation and maintenance of the entire pumping station / gate system in addition to comprehensive information for the operation and maintenance of each individual item of plant for the Engineer's review and comments. Following approval by the Engineer, ten (10) copies of the final Operation and Maintenance Manual shall be submitted by the Contractor for the Employers reference.

Contractor's Engineers

The Contractor shall assign at least one mechanical engineer and one electrical engineer full-time for the supervision during the period of the installation of the plant furnished under this Contract and for the field operational testing and commissioning plus a 2-week period following the completion of commissioning for the training of operators. In the event that commissioning is completed during the dry season, the engineers shall return for a further 2-week period during the following wet season for training and instruction of operators over all a full range of conditions of operation.

24.1.12 Work Schedule

The schedule for all mechanical and associated electrical work for each of the systems described herein shall be shown in detail in the work programme described in clause 1.5 of the General Specification. The schedule shall include details and durations of all activities including, but not limited to preparation of shop drawings and their approval, procurement of materials, manufacturing, delivery, installation, testing and commissioning.

24.1.13 Name Plates

Each plant (pump, motor, engine, crane, gate, etc.) shall have a standard name plate securely affixed thereto in a conspicuous place, showing the type of plant, serial number, date of manufacture, the name of the manufacturer and all other necessary information to complete the identification, in English characters. Detailed requirements for the name plate of each equipment shall include the following in addition to other standard information provided by the manufacturers:

- Pump: Capacity in m3/sec at rated speed, revolution per minute,
- Diesel engines: Power rating (kW) and revolution per minute.
- Electric Motors: kW, speed and electric current characteristics.
- All other equipment: Manufacturer's standard details as approved by the Engineer.

24.1.14 Inspection, Testing and Commissioning

24.1.14.1 Inspection, Testing and Commissioning Manual

The Contractor shall prepare a manual for inspection testing and commissioning for the mechanical and electrical works. The manual shall include schedules, tests/inspection to be performed, locations, witnesses to attend, comprehensive check sheets for recording and other relevant data.

The manual shall be submitted in accordance with the procedures stated in Clause 1.4 and 1.5 of the General Specifications.

24.1.14.2 Tests and Inspections

Upon completion of the manufacture of the plant and at the time indicated on the work schedule, and where indicated as required in the following table, the Contractor shall conduct operational tests at the factory under actual field operating conditions.

The Auxiliary Pumps shall be operated to cover the full range of the operating condition. Testing method shall be in accordance with the requirements of JIS B 83001 and 8302 or other internationally accepted standards approved by the Engineer.

Diesel engines shall be tested in accordance with the requirements of JIS 8014 or other internationally accepted standards approved by the Engineer. Floodgates shall be inspected and tested in accordance with the Standards of Japan Water Gate Association or other internationally accepted standards approved by the Engineer and the requirements herein described.

The results of all tests shall verify the technical particulars given in the approved documents and drawings. Operational test for screw pumps at the manufacturer's workshop shall not be required.

Mill sheets shall be submitted for materials of torque shaft and blades of the screw pumps of main drainage pumps and all other materials. Mill sheets are also required for SUS 304 material.

The Contractor shall invite one (1) mechanical inspector (the Engineer or his Representative) for two (2) man days for main drainage pumps, two (2) man days for main diesel engine, and two (2) man days for the gate respectively, i.e. a total of six (6) man days for the purpose of witnessing tests in the Contractor's workshops.

All necessary expenses for the said inspector such as round-trip air tickets, per diem living allowance and land transportation charge shall be borne by Contractor.

Factory Inspection and / or Testing Schedule

ITEM	Required Test or Inspection	Presence of Engineer or his Representative	Submission of Test Records
Main Pumps	Fabrication	0	0
	Dimension	0	0
	Material	0	0
Diesel Engines	Performance	0(at least one unit)	0
	Dimension	0 (ditto)	0
Gear Boxes	No-Load operation	X	0
	Material	X	0
	Dimension	X	0
Overhead Crane	Dimension	X	0
	Function	X	0
Tanks	Dimension	0	0
	Pressure	0	0
	Material	0	0
Gate	Material	X	0
	Assembly	X	0
	Fabrication	X	0
Stop Log	Dimension	X	0
Automatic Trash Removal Unit	Dimension	X	0
	Assembly	X	0
Belt Conveyer	Dimension	X	0
	Assembly	X	0
Small Piping, Valves and Appurtenances	Manufacturer's Certificate	X	X

Legend : 0: Required
X: Not Required

24.1.15 Welding

Unless otherwise stipulated in this Specification, only electric arc welding shall be used and shall be performed by a welders qualified for the work required.

Welding symbols conforming to JIS G 3021 or other internationally accepted standards and all necessary dimensions for welding shall be shown on the shop drawings prepared by the manufacturers.

The Contractor shall prepare a welding manual for the fabrication of all plant which involves welding for the approval of the Engineer in accordance with the submittal procedures stated in clauses 1.4 and 1.5 of the General

Specification. The manual shall clearly state the procedures for qualification of welders, welding procedures including welding rods, welding positions, joint preparation, type of welding machine, weld examination by either radiographic, ultrasonic or all other applicable methods and procedures for weld repairs and the formats for recording inspections. The welding manual shall be submitted in a timely manner and shall be subject to the Engineer's approval.

The results of all welding inspections shall be recorded and submitted to the Engineer for approval.

24.1.16 Protective Treatment of Metalwork

24.1.16.1 General

This clause specifies the requirements for the protective treatment of metal surfaces for all metalwork to be furnished by the Contractor. The items covered by this clause shall include, but not be limited to, screw pumps, gates, cranes, handrails, and all other metal components included in the Works.

24.1.16.2 Painting Manual

The Contractor shall prepare a painting manual specifying his proposed protective treatment of metalwork for all steel components. The procedures proposed by the Contractor in the painting manual shall be equal to or superior to those stated in this clause TS 24.1.16.

The painting manual shall be submitted in accordance with the procedures stated in clauses 1.4 and 1.5 of the General Specification.

24.1.16.3 Cleaning and Preparation

Cleaning and preparation of surfaces for painting shall be in accordance with the following and as required according to the painting system described in clause.

Surfaces to be painted shall be cleaned before the application of paint or surface treatment. All oil, grease, dirt, rust, loose mill scale, weld spatter, slag or flux deposit, oil weathered paint, and other foreign substances shall be removed. The removal of oil and grease shall be accomplished before mechanical cleaning is started. Clean cloths and cleaning fluids shall be used to avoid leaving a thin film of greasy residue on the surfaces being cleaned. Cleaning and painting shall be so programmed that dust or spray from the cleaning process will not fall on wet, newly painted surfaces. Where required, imperfections and holes in surfaces and open joints between matching surfaces shall be filled or removed in an approved manner. Any required wash treatment shall be carried out in accordance with the paint manufacturer's instructions.

Extreme care shall be exercised when blast cleaning is applied on structures to prevent blasting materials from entering or damaging machined surfaces and other precision parts.

All cleaning, preparation and paint application shall be carried out after the parts are completely finished and checked in the shop assembly. The parts shall be disassembled to the extent necessary to enable cleaning and painting those surfaces which are inaccessible when assembled. After the finishing coats have been applied and the paint surface hardened, parts shall be reassembled as required for shipment. Those bolts and other

connections which will not be removed in erection shall be coated with the shop primer and finishing.

24.1.16.4 Paint Application

Workmanship

All work shall be done in a workmanlike manner so that the finished surfaces will be free from runs, drops, ridges, waves, laps, pinholes, and unnecessary brush marks. All coats shall be applied in such manner as to produce an even film of uniform thickness completely coating all corners and crevices. All painting shall be done by thoroughly experienced and skilled workmen. Care shall be exercised during spraying to hold the nozzle sufficiently close to the surface being painted to avoid excessive evaporation of the volatile constituents, loss of material into the air, or the bridging of crevices and corners. All surface preparation and paint application in the shop and field shall be supervised by a supervisor, approved by the Engineer, from the paint manufacturer, provided by the Contractor. The supervisor shall certify that all preparations and applications are in accordance with this Specification and the paint manufacturer's recommendations and specifications.

Equipment

All paint shall be applied using airless spray equipment unless otherwise approved. Spray equipment shall be equipped with a mechanical agitator, a pressure gauge, and a pressure regulator. Nozzles shall be of the proper size as recommended by the paint manufacturer.

Paint Properties, Mixing and Thinning

The Contractor shall submit the specification of each type of paint to be used in each system for the Works for the Engineer's approval prior to the executing any painting work.

Test certificates from the paint manufacturer shall be provided for each batch of each type of paint used in the Works.

All paint, when applied, shall provide a satisfactory film and a smooth even surface. Paint shall be thoroughly stirred, strained and kept at a uniform consistency during application. Paints may be thinned in accordance with the paint manufacturer's recommendations. Paint furnished for field touch-up work shall be delivered in containers which shall show the designated name, formula or specification number, colour, special directions, manufacturer, and date of manufacture.

Atmospheric Conditions

Paint shall be applied only to surfaces that are thoroughly dry and only under such combination of humidity and temperature of the atmosphere and surfaces to be painted as will cause evaporation rather that condensation. In no case shall any paint be applied to surfaces upon which there is moisture condensation. The temperature of the surface to be painted shall be at least 3°C above dew point. Painting shall not be carried out when the relative humidity of the surrounding air exceeds 85 percent.

Protection of Paint Surfaces

Where protection is provided for painted surfaces, such protection shall be kept in place until the paint film has properly dried. Items which have been painted shall not be handled, worked on, or otherwise disturbed until the paint coat is completely dry and hard.

Time Between Surface Preparation and Painting

Surfaces which have been cleaned, pre-treated, and/or otherwise prepared for painting shall be primed as soon as practicable after such preparation has been completed prior to deterioration of the prepared surface in accordance with the paint manufacturer's recommendations.

Coating Progress

Where painting on any type of surfaces has been commenced for any portion of the Work, the complete painting operation shall be continuous and completed as soon as practicable and without delays.

24.1.16.5 Colours

The finish colour of all structures shall be as approved by the Engineer but the Contractor shall propose a colour scheme for the work and shall submit colour strips or paint samples. A colour strip shall be included with the approved colour schedule for each type of finish to be applied at the Site shop or site.

24.1.16.6 Paint System

The paint system for use on steelworks shall be in accordance the system for each respective application in the painting manual approved by the Engineer. Painting systems shall be equal or superior to those shown in the tables for Paint System No 1 to 9 hereunder.

Where the paint system is applied to a structure that is partly embedded in concrete, the surface preparation and paint system applied to the exposed material shall extend 100 mm beyond the edge of the concrete surround or embedment.

24.1.16.7 Surfaces Not to be Painted

Wire ropes, gear teeth, interior of hydraulic piping, corrosion-resistant metal seals, the gate skin plate and other machined surfaces shall not be painted.

On completion of cleaning, surfaces not to be painted shall be coated with an approved rust preventative coating material or an adhesive plastic film to protect the surfaces from minor mechanical damage and corrosion during transportation and storage . The coating material shall be stripped off after installation.

Unassembled fitting, pins, keys, bolts, nuts etc shall be oiled and wrapped with moisture-resistant paper or protected by other approved means.

24.1.16.8 Paint Testing

All paint applications shall be tested in accordance with the following:

- The dry film thickness of each shop primer coat and total thickness of all coats shall be measured by the Contractor in the presence of the Engineer or his representative.
- The edges, corner and the areas within 5 mm distance from them, and the surface of castings and steels forgings shall be excluded unless the Engineer has reason to doubt the thickness of the application.
- Two (2) portions shall be selected per 10 m² by the Engineer and more than four (4) arbitrary points shall be measured per portion.
- An electronic thickness measuring gauge shall be used and shall be calibrated in accordance with an approved standard.
- The mean value of each portion shall be more than the average thickness specified and the minimum thickness in all eight (8) or more

points measured per 10 m² shall be more than the minimum thickness specified.

- The details of testing shall be as approved by the Engineer following the submission of the Contractor's proposal.

PAINT SYSTEM

Paint System No.	Location	Site	Process	General Name	No. of Coats	Coating Interval (at 20°C)	Dry Film Thickness (micron/coat)	
							Ave	Min
1	Ferrous Metal Continuous Immersion in Water	Shop	Surface Preparation	Commercial Blast Cleaning Sa 2 1/2				
			Primer Coat	Epoxy Zinc Rich Paint	1	3 days 6 months	20	15
			1st Coat	Coat Tar Epoxy Resin Paint	1	24 hours 7 days	280	200
			2nd Coat	Coat Tar Epoxy Resin Paint	1	-	280	200
		Field	Surface Preparation	Power Tool Cleaning Sa 2 1/2		Note Damaged areas and welded areas only		
			Touch-up Primer Coat	Epoxy Zinc Rich Paint	1	3 days 6 months	20	15
			Touch-up	Coal Tar Epoxy Resin Paint	2		280	200

2	Ferrous Metal Intermittent Immersion and Splash	Shop	Surface Preparation	Commercial Blast Cleaning Sa 2 1/2				
			Primer Coat	Epoxy Zinc Rich Paint	1	3 days 6 months	20	15
			1st Coat	Epoxy Resin Paint	1	24 hours 7 days	110	80
			2nd Coat	Epoxy Micaceous Iron Oxide Paint	1	24 hours 18 months	50	35
		Field	Surface Preparation	Power Tool Cleaning Sa 2 1/2		Note : Damage areas and welded areas only		
			Touch-up Primer Coat	Epoxy Zinc Rich Paint	1	3 days 6 months	20	15
			Touch-up	Epoxy Resin Paint	2	24 hours 7 days	110	80
			3rd Coat	- ditto -	1	- ditto -	40	20
			4th Coat	- ditto -	1	-	40	20
3	Ferrous Metal Atmospheric Exposure		Surface Preparation	Commercial Blast Cleaning Sa 2 1/2				
			1st Coat	Lead Suboxide Anti-Corrosive Paint	1	24 hours 6 months		25
			2nd Coat	- ditto -	1	- ditto -	35	25
			3rd Coat	Phenol Micaceous Iron Oxide Paint	1	24 hours 18 months		35
		Field	Surface Preparation	Commercial Blast Cleaning Sa 2 1/2				
			Touch-up	Lead Suboxide Anti-Corrosive Paint	2	24 hours 6 months	35	25
			Touch-up	Phenol Micaceous Iron Anti-Corrosive Paint	1	24 hours 18 months	50	35
			4th Coat	Long Oil Alkyd Resin	1	24 hours 1 month	25	20
			5th Coat	- ditto -	1	-	25	20

4	Equipment for Temporary use	Shop	Surface Preparation	Commercial Blast Cleaning Sa 2 1/2	-			
			1st Coat	Zinc Chromate Primer	1	8 hours 6 months	35	25
			2nd Coat	- ditto -	1	-	35	25
		Field	Surface Preparation	Power Tool Cleaning (SSPC-SP3)		Note : Damaged areas and welded areas only		
			Touch-up	Zinc Chromate Primer	2	8 hours (Note:- ditto-) 6 months	35	25
5	Small Sized Steel Pipe (except Hydraulic Piping)	Shop	Surface Preparation	Solvent Wash (SSPC-SP1)				
			Coating	Hard-Drying Anti Corrosive Oil	1	Over 4 hours	50	-
6	Ferrous Metal Embedded in Soil	Shop	Surface Preparation	Blast Cleaning (SSPC-SP10)				
			1st Coat	Zinc Chromate Primer	1	8 hours 6 months	35	25
			2nd Coat	- ditto -	1	8 hours 6 months	35	25
			3rd Coat	Alkyd Resin Paint	1	5 hours 6 months	20	15
			4th Coat	- ditto -	1	-		
8	Ferrous Metal Embedded in Concrete			Clean				
9	Ferrous Metal Embedded in Soil	Shop	Surface Preparation	Commercial Blast Cleaning Sa 2 1/2				
			1st Coat	Coal Tar Epoxy Primer	1	24 hours 5 days		
			2nd Coat	Coal Tar Epoxy Enamel		Note: 2nd+33rd Coat Simultaneous Application		3000
			3rd Coat	Glass Cloth				

24.1.16.9 Galvanising

All galvanizing specified on the Drawings shall be by the hot dip galvanizing process in accordance with the requirements of AASHTO M 111 (ASTM A 1230 "Zinc (Hot Galvanized) Coatings", AASHTO M 232 (ASTM A 153) "Zinc Coating (Hot-Dip) on iron and Steel Hardware" and this Clause.

Surface Preparation

Steelwork shall be pre-cleaned in accordance with the requirements of AS 1627 Part 1 or equivalent standard followed by acid pickling in accordance with the requirements of A 1627 Part 5 or equivalent standard.

All weld spatter, slag, burrs, loose rust and mill scale and other foreign substances shall be removed by either sand or shot or grit-blasting to "Near-White metal" under "Sa 2 1/2" of Swedish Standard SIS 055900 or SSPC-SP10 of Steel Structures Painting Council Manual Volume 2.

Surface contaminants and coatings which cannot be removed by the normal chemical cleaning process in the galvanizing operation shall be removed by abrasive blast cleaning or some other suitable method.

Galvanizing

All articles to be galvanized shall be handled in such a manner as to avoid any mechanical damage and to minimise distortion.

Galvanising parameters such as galvanizing temperature, time of immersion and withdrawal speed shall be chosen to suit the requirements of the article being galvanised.

The composition of the zinc in the galvanising bath shall be not less than 98.0% zinc.

Coating Requirements

Thickness:

The thickness of the galvanized coating shall conform with the table below:

Products	Minimum average coating on any individual tests area	
	Coating Mass (Gram/sq.m)	Equivalent Thickness (Micron)
Steel 5 mm thick and over	600	84
Steel under 5 mm thick but not less than 2 mm	450	63
Steel less than 2 mm thick	350	49
Centrifuged work	300	42

The thickness of the galvanized coatings of threaded fasteners shall conform with the table below:

Minimum Average		Minimum Individual	
Coating Mass (Gram/sq. m)	Equivalent Thickness (Micron)	Coating Mass (Gram/sq.m)	Equivalent Thickness (Micron)
375	52	300	42

Actual thicknesses shall be measured by a suitable thickness meter. Should any doubt arise, as to the quality of galvanizing, tests shall be carried out in accordance with AASHTO T 65 'Tests for Weight of Coating on Zinc-Coated (Galvanised) Iron or Steel Articles or ASTM E 376 'Measuring Coating Thickness by Magnetic Field or Eddy Current (Electromagnetic Test Methods).

Surface Finish

The galvanized coating shall be continuous, adherent, as smooth and evenly distributed as possible, and free from any defect that is detrimental to the stated and use of the coated article. On silicon killed steels, the coating may be dull grey, provided that the coating is sound and continuous.

The integrity of the coating shall be determined by visual inspection and coating thickness measurements.

Where slip factors are required to enable high strength friction grip bolting where shown, these shall be obtained after galvanizing by suitable mechanical treatment of the mating surfaces.

Where a paint finish is to be applied to the galvanized coating, all spikes shall be removed and all edges shall be free from lumps and runs.

Adhesion

The galvanized coating shall be sufficiently adherent to withstand normal handling during transport and erection. The Engineer may test the adhesion in accordance with AASHTO M 111 (ASTM A 123).

Passivation

Galvanized reinforcing bars and ferrules shall be passivated in a 2% sodium dichromate solution applied by the galvanizer.

Transport and Storage

Galvanized components shall, wherever possible, be transported and stored under dry, well ventilated conditions to prevent the formation of wet storage staining.

A chromate passivation treatment after galvanizing may be used to minimise the wet storage staining which may occur on articles unable to be stored in dry, well ventilated conditions.

Any wet storage staining shall be removed by the galvanizer if formed prior to leaving the galvanizer's plant. Provided that the coating thickness complies with the requirements of AASHTO M 111 (ASTM A 123), no further remedial action shall be required to the stained areas.

Exposed covers around couplings, v-belts and other moving parts shall be pickled in sulphuric acid then hot-dip galvanised with a thickness of 80 microns.

24.1.16.10 Other Protective Coating Systems

Any other alternative systems proposed by the Contractor which are will result in superior protection to that specified herein shall be subject to the approval of the Engineer.

24.1.17 Defects Liability and Warranties

Pursuant to Clause 35 of the Conditions of Contract the Contractor shall promptly repair and make good any defect or deficiency in any item of mechanical or electrical equipment forming part of the permanent works.

Further to the Contractor's liability for rectification of defects, the Contractor shall supply written warranties guaranteeing the plant supplied under the Contract from all of the subcontractors and / or suppliers of all specialised plant for durations of two (2) years from the date of the issue of the Certificate of Completion of the Works. Such warranties shall be consistent with the warranty details entered in the data sheet for respective items of plant and shall be made out in favour of the Employer.

24.2 MAIN PUMP SYSTEM

24.2.1 General

The Contractor shall supply all labour, materials, equipment and incidentals required for the design, manufacture, installation, testing and commissioning of three Archimedian screw pumps as shown in the Drawings and as specified herein.

The pumps shall be new and of current manufacture and complete with all accessories and controls to provide a complete operational system.

The control system for the pumps shall be in accordance with the operating philosophy for the pumping station as detailed above.

The design and specification may be varied as stated in clause TS 24.1.7, above

24.2.2 General Specification for Screw Pumps

24.2.2.1 Scope

The screw pumps shall comprise the screw pump, supports for the drive unit, profile plates, gear boxes, couplings, guards, upper and lower bearing assemblies, belts, pulleys, lubrication systems, splash plates, all fastenings and any other items necessary for three (3) complete screw pump units. Diesel motors are specified elsewhere.

24.2.2.2 Spiral Screw

The spiral screw pump body shall consist of a centre tube (torque tube) constructed of 12 mm mill-certified SS 400 steel , sealed at each end with rigidly designed steel end plates of the same quality of as the centre tube. The screw shall have a rotational speed of 26.5 rpm.

Tube end plates shall be machined with registers to precisely accept the upper and lower bearing assemblies. The layout of the bolt holes in the end plates for the lower bearing assembly shall be water-tight.

End plates shall be precisely perpendicular to the torque tube centreline.

Screw flights shall be constructed of cold formed, SS 400 steel. The screw flights shall be continuously welded to the centre tube on both sides with full penetration welds. All radial welds between adjacent flight segments shall be full penetration welds. Each flight segment shall be perpendicular to the centre tube.

The outer edges of the flights shall be of the specified diameter of 3,000 mm to a tolerance of + or – 3 mm and shall be parallel to the main axis of the centre tube.

24.2.2.3 Concrete Trough

The concrete trough shall be formed as shown on the approved working drawings. The clearance between the outer edges of the flights and the inner face of the trough shall be within the limits specified in the data sheet for the screw pump. Concrete shall be class C-2 in accordance with the requirements of section 3 of the Technical Specification.

24.2.2.4 Bearings

Lower Bearing Assembly

The lower bearing assembly shall be designed as follows :

It shall allow continuous operation when fully submerged in the saline contaminated water to be pumped.

It shall remain in true axial alignment with the screw pump centreline during all operating conditions

It shall allow for free expansion of the screw pump

The lower bearing shall be an automatically grease–lubricated bearing assembly consisting of a sleeve type bearing bush of phosphor bronze, a high carbon steel shaft stuffing box and a gland plate, cast iron base and cast iron hub flange attached to the screw pump body end plate. The Lower bearing assembly shall carry radial loading only. The bearing shall be completely protected by a stationary cast iron shroud to prevent material in the incoming water to become entangled with moving parts. The shroud shall be in two halves to facilitate its removal from the bearing assembly. The bearing shaft and bush shall be bolted to the cast iron base anchorage casting and screw pump body end plate. The design of the lower bearing shall be such that it can be replaced without requiring the removal of the cast iron base anchorage or the screw pump body.

Each screw pump shall have a grease pump in accordance with the manufacturer's recommendation and in complying with that specified on the relevant data sheet in Appendix 6 of the Contractor's bid.

Upper Bearing

The upper bearing assembly shall incorporate an anti-friction bearing train consisting of a self-aligning, double-spherical roller bearing mounted in a cast iron housing designed to withstand all the thrust and radial loads of the pump under operating conditions. The bearing housing shall be designed with easily removable sections for ease of inspection and service. The design of the upper bearing shall be such that all loads shall be transmitted to the supporting reinforced concrete foundation.

The upper bearing drive shaft shall be a solid steel stub fitted with either a cast iron flange or a machine faced and gusseted steel plate flange to match the register on the screw pump centre tube end plate. The back face of the upper bearing flange shall incorporate a steel splash plate covering the opening to the screw pump.

24.2.2.5 Gear Box

Each screw pump shall be driven by a totally enclosed oil-lubricated, air cooled, foot-mounted, helical/bevel, right-angle-shaft gear box. The gears and bearings shall lubricated to suit the size and mounting orientation of the unit. The gear box shall be designed for 24-hour continuous service with a bearing life of 40,000 hours at rated power, in the angular mounting position corresponding to the inclination angle of the screw pump.

The housings of the gear boxes shall be complete with removable inspection covers, oil filler and drain and oil breather.

24.2.2.6 Flexible Coupling

The output shaft of the gear box shall be connected to the screw pump upper bearing by means of a low-speed flexible coupling.

It shall be designed to compensate for shocks, vibration and shaft misalignment. The coupling shall consist of two cast iron housings separated by flexible, non-metallic rubber or elastomeric bushes. Replacement of the flexible elements shall be possible without disassembly of the screw pump drive train.

24.2.2.7 Diesel Motors

The diesel motors which power the screw pumps are specified below.

24.2.2.8 V-Belt Drive

The diesel engine and gear box shall be connected by means of v-belts and pulleys.

24.2.2.9 Guards

Protective guards shall be provided on all moving elements of the screw pump. (i.e. V-belts and low-speed coupling).The guards shall be easily removable for inspection and maintenance purposes.

24.2.2.10 Anti Rotation Device

Screw pumps shall be fitted with anti-rotation devices to prevent back rotation of the screw pump when the pumps are stopped.

24.2.2.11 Surface Protection

All fabricated steel parts of the screw pumps shall be protected in accordance with the minimum requirements stated in clause TS 23.1.16.

24.2.2.12 Design Criteria and Technical Data

Design criteria and technical data for the screw pumps are summarised in the following table:

Type	Screw pump with concrete trough
Number of Units	Three (3)
Capacity	3,000 litre / sec, head 5.1m
Diameter of Screw	3,000 mm
Flight Pitch	Refer to relevant data sheet
Angle of Inclination	30 degrees
Number of Flights	3
Adsorbed power at motor shaft	Refer to relevant data sheet
Elevation of Filling Point	-2.60
Maximum Pumping Point	2.50

Top of Trough Elevation (Chute Point)	+1.20
Bottom of Trough Elevation (Touch Point)	-5.20
Diesel Engine Output	325 hp, *1800* rpm
Pump Efficiency	Refer relevant data sheet
Driving Method	Diesel Engine through reduction gear box
Lower Bearing	Automatically grease lubricated
Upper Bearing	Grease lubricated
Coating System	System 1 in accordance with clause TS 24.1.16.

Note: Data in the above table is subject to modification in the event of changes proposed by the Contractor in his bid being accepted.

24.2.3 Submittals

The Contractor shall submit the following items for the Engineer's approval in accordance with the requirements of clauses 1.4 and 1.5 of the General Specification:

- Shop drawings and specifications of all components and assemblies comprising the pumping systems.
- Details of all materials and components surface treatment.
- Welding procedures in accordance with clause TS 24.1.15.
- Quality control procedures to be used during fabrication installation and testing.
- A detailed schedule for the fabrication, transportation, installation, testing and commissioning of the pumps.

24.2.4 Quality Control

The Contractor shall comply with the approved quality control procedures during all stages of the works and shall document all data and inspection and test results in accordance with those procedures.

Inspection and testing shall be in accordance with the schedule manual for Inspection Testing and Commissioning referred to in Clause TS 24.1.14..

24.2.5 Fabrication and Manufacture

The screw pump shall be fabricated strictly in accordance with the approved shop drawings and procedures and to the tolerances indicated therein.

Torque tubes shall be mounted in a precision lathe to check that the circularity of the torque tube is within tolerance and accurately faced to ensure that end plates will be perpendicular to the major axis.

After flights have been welded to the torque tube the screw pump body shall be mounted in a precision lathe and the flights accurately machined to the specified diameter within the specified tolerance.

24.2.6 Installation and Testing

Refer to clause TS 24.9 for general installation and testing procedures applicable to the pump system and to the overall installation.

24.2.7 Spare Parts

Spare parts shall be interchangeable with each pump and shall be of the same materials and workmanship. The spare parts to be furnished for each pump shall be in accordance with the approved list of spare parts recommended by the Contractor in the approval data sheet M-10.

24.3 DIESEL ENGINE SYSTEM FOR MAIN PUMPS

24.3.1 General

The work comprises the supply, installation, testing and commissioning of three (3) diesel engines which drive the main pumps as part of the main pump system as specified above.

Diesel engines shall be horizontal, single acting injection, 4 stroke cycle, cold starting, radiator air-cooled diesel engines and shall be base mounted.

Main parts shall posses excellent properties against heat, pressure, corrosion, and wear. All parts shall be manufactured to ensure the highest accuracy and precision by means of limit gauges, special jigs, fixtures, etc., so that they are entirely interchangeable with each other.

The three engines shall be identical to ensure that common spare parts may be used. Materials used, manufacturing and performance shall be in accordance with applicable JIS specifications or equivalent.

Design Conditions for the diesel engines for the main pumps shall be as follows:

ITEM	REQUIREMENT
Continuous rating output	270 hp
1 hour rating output	110 %
Continuous operation speed:	1,800 rpm
Bore of Cylinders: mm	In accordance with approved data sheet
Number of Cylinders:	In accordance with approved data sheet
Specific fuel Consumption:	In accordance with approved data sheet
Starting System:	Battery powered electric starter motor
Location of Operation:	In pump house
Engine cooling system:	Radiator
Engine Lubrications System:	Forced lubrication pump mounted on engine
Fuel Oil Recommended:	Diesel heavy oil

Note: Data in the above table is subject to modification in the event of changes proposed by the Contractor in his bid being accepted.

24.3.2 Accessories

Accessories for the diesel engine to be furnished shall be as follows:

- Gauges

  Tachometer, lubrication oil pressure, cooling water pressure, suction air pressure, fuel oil pressure, etc.

- Thermometers

  Lubrication oil, cooling water, exhaust gas, etc.

- Auxiliary Priming Pumps

  Wing type lubrication oil pumps

- Strainers and Coolers

  Fuel oil strainer, lubrication oil strainer, lubrication oil cooler, suction air cooler, etc.

- Safety Devices

  Lubrication oil pressure relay, cooling water high temperature relay, over speed relay, cooling water flow sight glass, etc.

- Miscellaneous

  Exhaust system has turbo-supercharger, pressure indicator cock for each cylinder, flywheel and dual air reservoir tanks, flexible pipe joints, installation bolts, etc.

24.3.3 Installation and Testing

Refer to Clause TS 24.9, Installation and Testing of Main Pump System.

24.3.4 Spare Parts

Spare parts shall be interchangeable with each engine and shall be of the same material and workmanship. The spare parts to be furnished shall be in accordance with clause TS 24.1.9 of this specification.

24.4 AUXILIARY EQUIPMENT FOR DIESEL ENGINES

24.4.1 General

The Contractor shall design, supply, install, test and commission the following items of auxiliary equipment which are necessary for the complete and correct operation of the diesel engines for the main pumps and the diesel generator in accordance with the Drawings, the Specification and the directions of the Engineer.

24.4.2 Fuel Transfer Pump

The fuel transfer pump shall be installed in the location indicated in the Drawings. Its function shall be to transfer fuel from the fuel storage tank to the fuel service tank, and shall be automatically controlled by a float switch to maintain a regulated fuel level in the fuel service tank.

All necessary piping for the fuel system shall be provided and shall be in accordance with the specification for piping in clause TS 24.5. The piping provided under this item shall include piping up to all diesel engines including the diesel generator.

The type and requirements for the fuel oil transfer pump shall be as follows:

ITEM	TYPE AND REQUIREMENTS
Type:	Horizontal gear type powered by single phase, 220 V, 0.5 kW electric motor
Requirement:	Transfer capacity to be as proposed by the Contractor and entered in the relevant data sheet forming part of this specification.
Number of Units:	1
Accessories:	Gate valve, check valve, couplings, complete piping system, etc.

Note: Data in the above table is subject to modification in the event of changes proposed by the Contractor in his bid being accepted.

24.4.3 Fuel Storage Tank

The fuel service tank shall be an underground, buried tank of welded steel construction complete with an inspection opening and cover and flanged bosses for connecting pipework and other accessories, in accordance with the Drawings, the Specification and the directions of the Engineer.

The type and requirements for the fuel oil storage tank shall be as follows:

ITEM	TYPE AND REQUIREMENTS
Type:	Welded steel construction, steel to be JIS designation rolled steel (SS – 400)
Volume:	10,000 litre
Size:	Refer to approved data sheet
Number of Units:	1
Accessories:	Fuel level gauge, float switch with alarm, flanges for connecting pipework, vent pipe, grounding, cathodic protection.
Surface Protection System	System 1 in accordance with clause TS 24.1.16 or better.

Note: Data in the above table is subject to modification in the event of changes proposed by the Contractor in his bid being accepted.

24.4.4 Fuel Service Tank

The fuel service tank shall be a welded steel tank complete with steel supporting frame, level gauge, inspection opening and flanged bosses for connecting pipework in accordance with the Drawings, the Specification and the directions of the Engineer.

The type and requirements for the fuel oil storage tank shall be as follows:

ITEM	TYPE AND REQUIREMENTS
Type:	Welded steel construction, steel to be JIS designation rolled steel (SS – 400)
Volume: litre	2,000
Minimum thickness of bottom plate: mm	4
Number of Units:	1
Accessories:	Level indicator, inlet, outlet, overflow, vent pipe, drain pipe, inspection opening.

Note: Data in the above table is subject to modification in the event of changes proposed by the Contractor in his bid being accepted.

24.4.5 Installation and Testing

Refer to Clause 23.9, Installation and Testing.

24.5 PIPING SYSTEMS

24.5.1 General

The work includes the supply, fabrication, installation, testing and commissioning of piping systems for the fuel and lubrications for the following systems:

- Fuel systems for the diesel engines powering the main drainage pumps and the diesel generator.
- Discharge piping for the auxiliary pumping system

24.5.2 Requirements

Water and Oil Piping:

Water and oil piping shall be galvanised steel pipe and shall conform to the requirements of JIS G 3442.

Pipe fittings shall be galvanised and shall conform to the requirements of JIS B 2301. Piping and accessories shall be connected either by threaded or flanged connections. Flanges shall be galvanised for water lines and for oil lines. Flanges shall conform to the requirements of JIS B 2201 and B 2212.

Gates valves for water and oil service lines shall conform to the requirements of JIS B 2044. Check valves for water and oil service lines shall conform to the requirements of JIS B 2045.

Accessories such as supporting racks, frames, pipe brackets, maintaining metal bands, bolts, nuts and other attachment shall be provided together with the pump equipment and shall conform to the requirements of the applicable Japanese standard or other standard approved by the Engineer.

Surface treatment of piping shall be in accordance with clause TS 24.1.16, Surface Protection of Metalwork.

24.5.3 Installation

Testing of all pipework associated with the main pump system shall be in accordance with clause TS 24.9, Installation and Testing.

24.6 AUXILIARY DRAINAGE PUMP SYSTEM

24.6.1 General

An auxiliary drainage pump system shall be installed in the location as shown in the Drawings to provide drainage of the retarding basin during non-flood conditions in accordance with the operating philosophy. The work includes the supply, installation, testing and commissioning of the complete auxiliary drainage system.

24.6.2 Requirements

The type and requirements for the drain pump shall be as follows:

ITEM	TYPE AND REQUIREMENTS
Type:	Vertical, submersible, electric motor-driven pump (sliding type on guide rail with self connection to flange of discharge pipe)
Capacity:	100 litre / s, Head 6 m,
Power Supply	3-phase, 380 V AC,
Number of Pumps:	2
Accessories:	Guide rail, mounting platform, raising chain, discharge piping complete with flange to pump, check valves, mounting brackets and local control panel
Control Panel:	Refer to clause TS 25.6, "Local Control Panels"
Trash Screen:	Trash screen shall be in accordance with the manufacturer's recommendation.

24.6.3 Installation and Testing

Installation and testing shall generally be conducted in accordance with clause TS 24.9, Installation and Testing.

Particular care is to be taken to ensure that the pumps readily correctly self-align and seal with the discharge pipe flanges under their own weight when in the operating position.

All electrical equipment shall be installed and tested in accordance with the section TS 25, Electrical Works.

24.7 OVERHEAD CRANE SYSTEM

24.7.1 General

The Contractor shall design, supply, install and test a manually-operated travelling crane unit in the pump control building of the Asin Pumping Station. The safe working load shall be 2000 kg.

24.7.2 Requirements

<u>Crane Structure</u>

The crane shall be of the single girder type. The girder shall be structurally braced to mobile blocks that travel along rails.

The girder shall be fabricated from suitably sized steel flats and stiffened internally to provide a structure of high torsional stiffness and rigidity. All assembly shall be made in jigs to ensure accurate alignment of the members. Welding shall be automatic submerged arc welding in accordance with approved welding procedures by approved welders.

Rails

Crane Rails and are included in the building works.

Supports

Supports for the crane rails and are included in the building works.

Drive Unit

The crane shall be provided with a manually operated drive unit mounted on a gear box which shall be flange mounted and spigotted to the end carriage. The output shaft of the gear box shall have high tensile pinion meshing with the spur teeth on the driven crane wheel.

Hoist Unit

The hoist unit shall comprise a manually operated chain block and a travelling trolley. Both shall be provided by an established, long-standing specialist supplier of lifting equipment and is subject to the Engineer's approval.

Surface protection of metal components shall be in accordance with clause TS 24.1.16.

24.7.3 Installation and Testing

Installation and testing shall be in accordance with the approval manual for Inspection, Testing and Commissioning referred to in Clause TS 24.1.14.

24.8 GATE WORKS

24.8.1 General

This clause 24.8 covers the requirements of the gate and stop logs to be furnished by the Contractor at the Asin Pumping Station.

24.8.1.1 Scope of Work

The work shall include the design, material arrangement, manufacturing, testing, inspecting, painting, packing, insurance, transportation from the shop to the site (including customs clearance), storage, installation, commissioning, in-situ tests and inspections, taxes, completion and rectification of defects, and provision of warranties for a period of 2 years for all mechanical and electrical plant.

General descriptions of the gates and stop logs are as follows:

Asin Pumping Station Gate

Type: Girder Type Sluice Gate with fixed rollers

Quantity: 2 (two) sets

Clear Span: 4.00 m

Gate Height: 3.25

Stop Logs for Asin Pumping Station Gate

Clear Span: 4.00 m

Height: 1.50 m

Quantity: 2 sets x 3 stop logs per set = 6

Stop Logs for Asin Pumping Station

Clear Span: Refer to Drawings

Height: 1.50 m

Quantity: 3 sets x 4 stop logs per set = 12

Further details are set out hereunder and in the Drawings.

24.8.1.2 Standards

The Work shall comply with the latest edition of standards and criteria listed below or such standards and criteria which are equivalent or superior to the listed ones which are accepted broadly throughout the world.

- Japanese Industrial Standards (JIS)
- Technical Standard on Dam and Weir Equipment, Japan Association of
- Dam and Weir Equipment (JADEE)
- Manual for River Works in Japan, River Bureau, Ministry of Construction, Japan

In the event that the Contractor proposes to use other standards which he claims to be equivalent or superior to the above standards he shall make application to the Engineer to use such standards and supply English versions for the Engineer's review.

24.8.1.3 Submittals

The Contractor shall submit the following documents for the Engineer's approval in accordance with the provisions of clause 1.5 of the General Specification. The following documents may be sub-sections of comprehensive manuals for the whole of the mechanical and electrical works where appropriate.

Document List

The document list shall include all documents pertaining to the gates for the Simongan Weir and adjacent off-take structures to be submitted in accordance with the General Specification and the further requirements described in this section of the specification.

Design Computations

The Contractor shall submit comprehensive design computations for the Engineer's approval in accordance with clause TS 24.1.8.

Drawings

The Contractor shall submit shop Drawings in accordance with clause TS 24.1.8.

Materials List

Detailed, tabulated materials lists showing technical details of material shall be prepared and submitted for approval.

Welding Manual

The welding as referred to in clause TS 24.1.15

Painting Manual

A painting manual as referred to in clause TS 24.1.16

Detailed Program

The detailed programme shall show details of fabrication, installation and key dates for inspections etc. The programme shall be integrated with and

consistent with the overall construction programme described in clause 1.5 of the General Specification.

Inspection, Testing and Commissioning Manual

Further to the requirements satiated in clause TS 24.1.14.1 the manual shall include details of all tests and inspections to be performed throughout all stages of procurement, manufacturing, assembly and commissioning of the gates and related systems. It shall also include dates and locations of all inspections to be performed.

Operation and Maintenance Manual

The Contractor shall prepare and submit an operation and maintenance manual for the guidance of operators and maintenance personnel in accordance with the requirements of clause TS 24.1.11.

Reports of Tests and Inspections

Reports of all tests and inspections shall be submitted to the Engineer for approval within 3 days of any test or inspection being carried out.

24.8.1.4 Materials

All materials shall be new and of first class quality conforming to the requirements of JIS or approved equal, and be suitable for the purpose, free from defects and imperfections, and of the classifications and grades listed herein, or their equivalents and shall be subject to the approval of the Engineer.

Material to be used:

(a) Material of gate leaf

Material shall comply with "Technical Standard on Dam and Weir Equipment " or equivalent or better standards.

(b) Welding material

Welding material shall be in accordance with the approved welding manual referred to in clause TS 24.1.15.

(c) Sealing material

Material shall comply with the "Technical Standard on Dam and Weir Equipment " or equivalent.

(d) Bolts, Nuts and Washers

Bolts, nuts and washers used for bolted connections shall be those specified in ISO or equivalent or better standard.

24.8.2 Design Criteria

24.8.2.1 Design Stresses

(1) Allowable Stress of Materials

Allowable stresses shall comply with "Technical Standard on Dam and Weir Equipment (JADEE) Chapter 2", or equivalent standard approved by the Engineer.

(2) Increase in Allowable Stress during earthquake

This item shall comply with "Technical Standard on Dam and Weir Equipment (JADEE) Chapter 2", or equivalent or better standards.

24.8.2.2 Design Data

(1) Design Loads

The basic design loads considered in the structural design of gates are self-weight of gate, static water pressure, dynamic water pressure, muddy soil pressure, seismic inertia force, wind load, wave load, thermal force and operating load. These load shall be calculated in compliance with "Technical Standard on Dam and Weir Equipment (JADEE) Chapter 2" or equivalent or better standard.

(2) Material of Main Structural Members

The quality of the material shall be of SS400, SM400, SUS304, SC450 and S25C under JIS or equivalents as approved by the Engineer.

(3) Minimum Thickness

All gate components : not less than 6 mm (including corrosion allowance)

(4) Corrosion Allowance

Corrosion allowance shall be 3 mm.

24.8.2.3 Summary of Design Criteria for Gates and Stop Logs

The Contractor shall design the gates and stop logs for the conditions summarised in the following table

Asin Pumping Station Gate

Type	Girder-type roller sluice gate
Quantity	2
Clear Span	4.00 m
Gate Height	3.46 m
HWL	EL. + 0.45
Sill Elevation	EL. –2.41
Design Head	2.86 m
Sealing Method	Rubber seal on 3 edges on upstream side
Seismic Coefficient (Kh)	0.11
Seismic Wave	0.1 m
Maximum Deflection of Beam	1/800
Corrosion Allowance	3 mm
Type of Hoist	Electrically driven wire rope wound type stationary hoist (1 motor driving 2 drums)
Operation Speed	0.3 m / minute + or – 10%
Hoisting Height	5.0 m
Operation Method	Local

Stop Logs for Asin Pumping Station Gate

Type	Steel Stop Log
Quantity	2 sets x 3 stop logs per set = 6
Clear Span	4.00 m
Stop Log Height	1.50 m
HWL	EL. + 0.45
Sill Elevation	EL. –2.41
Design Head	4.15 m (Note design head for Asin Pumping Station is to be used for all stop log design)
Sealing Method	Rubber seal on 3 edges on upstream side
Seismic Coefficient	0.11
Seismic Wave	0.1 m
Maximum Deflection of Beam	1/800
Corrosion Allowance	3 mm

Stop Logs for Asin Pumping Station

Type	Steel Stop Log
Quantity	3 sets x 4 stop logs per set = 12
Clear Span	4.00 m
Stop Log Height	1.50 m
HWL	EL. + 0.45
Sill Elevation	EL. –3.70
Design Head	4.15 m
Sealing Method	Rubber seal on 3 edges on upstream side
Seismic Coefficient	0.11
Seismic Wave	0.1 m
Maximum Deflection of Beam	1/800
Corrosion Allowance	3 mm

24.8.2.4 Design Particulars

(1) General

(a) The gate leaves, guide frames and gate hoists shall have necessary strength and rigidity for the conditions indicated in this specification and shall have adequate safety factors against vibration and buckling.

(b) The gate leaves and guide frames shall maintain the necessary water tightness, shall be reliable in operation, and shall have suitable structures for operation and maintenance.

(2) Gate Leaves

(a) Appropriate drain holes shall be provided to prevent rust in the main horizontal girders where entrapment of water is possible.

(b) In providing drain holes, the diameter of holes shall be 50mm or more and the location of holes shall be selected without adversely affecting the strength of structure.

(c) The skin plate shall be fabricated with main horizontal girders and vertical stiffeners, and shall be welded completely all around with fillet welds to the above members.

(d) The connections of main member shall be by welding. Where field welding is carried out it shall be performed in such a manner that welding distortion will be reduced to a minimum and deformation of and residual stress in gate leaves will not occur.

(e) Side rollers shall be provided on each side of gate leaves.

(f) Gate leaves shall be designed to be have sufficient strength for the case of being suspended by one side only.

(3) Roller and Sheave

a) Main rollers shall be positioned to support approximately equal loading and shall be designed and constructed not to allow excess unbalanced load.

b) Two side rollers or more shall be provided on each side of gate.

(4) Seals

(a) In designing seals consideration shall be given to the type of seal, the method of initial fitting and replacement. Particular attention shall be given to the water-tightness at corners. Seal shall be sufficiently strong to be resistant to stream damage when gates are partially open and they should not cause harmful vibration or cavitation.

(b) The seal rubber shall have necessary strength, elasticity, and durability. The seal rubber also shall have necessary compression set and shall not cause excess friction nor turn up during operation

(c) The seals shall be fixed to the gates by means of stainless steel bars and secured with stainless steel bolts and nuts at approximately 100mm centers.

(d) Rubber seals shall be continuous to the extent possible and shall contain as few joints as possible.

(5) Gate Guide Frames

a) The structure of the guide frames shall designed such that they easily accommodate gate leaves and shall have sufficient strength to bear all loads imposed on them by the gates.

b) The roller rail shall be of corrosion resistant steel with shall have a higher hardness than the roller

c) The sealing member of the guide frames shall be provided with stainless steel bar (equivalent to SUS 304) at least 6 mm thick, and shall be flush and smooth.

d) Blockouts in concrete to accommodate guide frames shall be accurately formed so as to avoid the need for chipping or drilling for the purpose of installing guide frames.

e) Steel anchor bars shall be installed during the concrete construction stage of the work.

(6) Gate Hoist

(a) Actuators

The actuators shall be full weatherproof and fitted with anti-condensation treated limit switches and torque switches. Each actuator shall be adequately sized to suit the application with a time rating of 15 minutes or twice the sluice gate operating time whichever is longer.

Alternative hand operation shall be possible, and the hand wheel together with a suitable reduction gearbox for easy operation by one man. The motor drive shall be automatically disengaged during manual operations. Manual hoisting equipment shall be so designed that the maximum required operating force to be applied by an operator is 100 N (10 kgf). A ratchet or similar device shall be fitted to prevent operating handles rotating in the reverse direction should a handle be released during operation.

The actuator shall be equipped with a gate opening indicator on the control panel in pump house.

All operating stems, gears and headstocks shall be provided with adequate points for lubrication.

(b) Gears

Gears shall be made using purpose-built gear cutting machines. The meshing of the gears shall be smooth and shall operate quietly

The gear and drum shall form and integral unit with the two components connected by means of bolts in reamed holes or other suitable method.

(c) Drums

Rope drums shall be of the rope groove type. Grooves shall be smoothly machined.

The drum lengths and the number of grooves shall be such as to accommodate the full length of ropes in one layer without overlapping and have at least one groove spare when gates is in their highest position and at least 3 dead turns of rope remaining on drums when the gates are in their lowest positions.

If rope drums are of fabricated steel construction they shall be stress relieved.

(d) Wire Rope

Wire rope shall be pre-tensioned wire rope of high quality from a long-established, reputable supplier. The diameter of wire rope after pre-tensioning shall not be less than the required diameter based on design loads.

Wire rope shall be galvanized steel or made from stainless steel.

Wire rope ends shall be swaged and fitted with metal alloy sockets.

Adjusting devices shall be provided on both sides of gates at the ends of wire ropes for the adjustment of wire rope lengths.

(e) Stop-Logs

All stop logs shall be identical and interchangeable. The maximum head to which any stop log can be subjected shall be used as the basis of design.

24.8.3 Manufacturing and Materials

a) Skin Plates and Gate Frames

The skin plates shall be made from welded structural steel to form a continuous plate. Drain holes at the bottom plate of main girder and top eyebolt for use during erection shall be provided, if necessary.

b) Roller Rails for Roller Gate

The roller rails shall be smooth and plane, free from twists, warps and kinks, and shall be welded on the welding pads mounted on the pier and abutment wall. The welding pads, studs, bolts, nuts and accessories shall be carefully adjusted so that the roller rails may be installed securely in correct positions.

c) Guide frames and seals Plates

The guide frames and shall be smooth and plane, free from twists, warps and kinks. Guide frames and seal plates may be divided into pieces for easy handling and when divided, they shall be welded in the field to form the specified total length.

d) Seals

The side and bottom seals shall be <P> type and rectangular type rubber seals respectively and shall be fixed on the gates and stop logs with corrosion resistant supporting plates, bolts, nuts and washers. The seals shall be so mounted as to permit easy replacement and adjustment in the field. The seals shall not be attached to the gate assembly during fabrication except when necessary for fitting and matching, and care shall be exercised to protect all sealing parts from damage. All steel edges in contact with or which may be in contact with the seals during operation of gates shall be rounded.

e) Sill Beams

The bottom sill plates made of corrosion resistant steel shall be welded on the sill beams of structural steel and shall be straight within specified tolerances, free from twists and warps.

f) Preparation for Field Connections

Preparatory work such as cutting, sectioning and other shaping of metals to be connected in the field shall be executed in the shop. Adequate and temporarily bolted field connections shall be provided in order to hold the gate assembly rigidly and in proper alignment during installation in the field. Holes for fitted bolts of field connections shall be shop drilled undersize to permit field reaming.

24.8.4 Method of Construction

24.8.4.1 Fabrication

The gates shall be manufactured as completely welded structures. The plates for the upstream shall be cut carefully to size. The side beams and horizontal beams shall be clamped tightly to the face plate, so as to ensure that, immediately before welding, the space between plate and members shall not exceed 1 mm. Wherever members are welded to plates, welding shall be continuous on both sides, to ensure that no water or moisture can penetrate between the two parts.

Surfaces to be welded shall be free from loose rust scales, paint, and other foreign matter. All welding shall be done by the shielded electric arc method to the extent shown on the Drawings. Welding shall be shop- welding wherever possible. Welding in the field shall not be accepted, unless authorised in writing by the Engineer. All welding shall be in accordance with good welding practise, and the approved welding manual. After each pass of weld metal has been deposited, it shall be thoroughly peened to relieve shrinkage stresses and shall be brushed with wire brush to remove all slag, dirt, or flux before the succeeding bead is applied. All welds shall show uniform sections, smoothness of weld metal, feather edges without overlaps and shall be free from porosity and clinkers. Visual inspection at the edges and end of welds shall indicate good fusion with the base metal. In assembling and during welding, the component parts of built-up members shall be held in place by sufficient clamps or other adequate means to hold the parts in proper position and in close contact. All welded components shall be stress - relieved prior to machining. All welds in the gate leaves shall be inspected by radiographic or ultrasonic methods. All defective welds shall be repaired by approved procedures and reinspected. The process shall be repeated until all welds are approved by the Engineer.

Welded rods, welding positions, welding process, joint preparation, type of welding machine, weld examination by either radiographic, ultrasonic or all other applicable methods shall be approved by the Engineer prior to commencements of the work, and the results shall be recorded by the Manufacturer, and shall be submitted to the Engineer, if required.

The gates shall be furnished complete with all rubber seals, wall plates, sills, wheels, bearings, grease facilities and all fastening materials needed. The alignment of all sills, travelling profiles, etc., within the related structural recesses shall be done by the Contractor to the Engineer's approval. All parts shall be made in accordance with the shop drawings approved by the Engineer.

The gates shall be accurately constructed so that, when installed, each pair of roller wheels has a common axis, exactly horizontal and parallel to the bottom sill.

All fabrication shall be such as to ensure that the gates are free from twists, bends and other deformations, to the satisfaction of the Engineer.

All parts shall be made accurately to industrial standards to facilitate assembly, installation and repair. The Contractor shall assume responsibility for co-ordinated and adequate design, conforming to the best engineering practice for the requirements of the work under these Specifications.

All dimensions shown on the Drawings are minimum. The manufacturer shall add such increases and finishing allowances as may be necessary to ensure that no dimension will be less.

24.8.4.2 Installation

The Contractor shall install the gates and related components as shown on the approved shop drawings, including all accessories such as anchor bolts, wall plates, guide rails and sill as far as necessary. All items to be embedded in concrete shall be supported rigidly and accurately before and while concrete is being poured. All aligning, supporting, etc., shall be done by the Contractor in accordance with good practise and to the requirements of the Engineer. Base plates, wall plates, guide rails and sills shall be grouted afterwards if shown on the Drawings or if ordered by the Engineer. Grouting shall be performed by such methods as are approved by the Engineer and shall ensure a solid setting.

Upon completion all parts shall be cleaned, lubricated and otherwise serviced by the Contractor. Grease, to be approved by the Engineer, shall be thoroughly worked into the cables. All pin bearings and roller bearings shall be grease lubricated. Hard grease is to be used in bearings and seals so as to ensure the impermeability to water and moisture.

All closed gear-reducers shall be filled to the correct levels with lubricating oil of type approved by the gear-reducers manufacturer. Open gear - reducers shall have a good quality graphite-grease applied on the teeth. All lubricants and cleaning agents shall be furnished by the Contractor at no extra cost.

All gate seals are to be installed as shown on the Drawings. The side seals shall be placed so that they are in contact with the wall plates or side shields throughout their length, in such a way that they are not deformed by the pressure against the side faces. The bottom seals shall contact the sill throughout their length. The Contractor shall take special care with seal joints at the corners so as to prevent leaking at these places.

The hoists shall be placed in correct alignment with the gates. The cables of each shall be adjusted to the same tension.

All electrical works shall comply with the requirements of Section TS 25, "Electrical Works".

The use of force during assembly shall not be tolerated. Temporary construction may be fixed to the main structures only after the approval of the Engineer. If during assembly, chains or cables must be fixed to the foundations or any other part of the structures, strong and sufficient timber supports shall be used to protect the respective structures from any damage.

After cleaning and lubricating, the Contractor shall prove the proper operation of each unit by running each gate completely up and down for at least 5 times per gate. Should any part of these works fail to operate to the satisfaction of the Engineer, such alterations shall be made by the Contractor as are required by the Engineer, without entailing extra payment thereof.

24.9 INSTALLATION AND TESTING

24.9.1 General

The Contractor shall install all equipment for each of the systems in the Asin Pumping station in accordance with the procedures approved by the Engineer and as specified hereunder.

The systems to which this clause applies are as follows:

- The main pump system
- The diesel engines for the main pumps and all auxiliary equipment
- The diesel generator system (Refer to TS 25, Electrical Works)
- The auxiliary pump system
- All electrical systems associated with the above systems
- All electrical systems shall be installed and tested in accordance with the provisions of the section TS 25, Electrical Works.

24.9.2 Installation

The Contractor shall remove the pumps, diesel engines, generator, trash screen units, conveyor, and other auxiliary equipment from their respective packing and shall inspect for damages. The Contractor shall repair or replace any damaged portion of the various plants, subject to the approval of the Engineer.

Anchor bolts shall be cast in place in accordance with templates supplied by the respective suppliers of the various items of equipment. All anchor bolts shall be of stainless steel 316. S15 to BS 970 unless otherwise approved.

The upper and lower bearings for the screw pumps shall be mounted on their respective concrete plinths and accurately aligned.

The screw pumps shall be mounted on the bearings and further checks and of correct alignment of bearings made.

Particular care shall be taken to ensure the correct alignment of the pump shafts and reduction gear boxes.

After final alignment the bearing mounting assemblies shall be grouted with non-shrink grout.

The troughs for the screw pumps shall be formed as shown in the Drawings, using the method approved by the Engineer, to the accuracy consistent with the recommendations of the pump supplier.

The bases for diesel engines, generator and other auxiliary units shall be installed on their respective concrete plinths or concrete foundations.

After final alignment, the bases shall be grouted with non-shrink grout.

All other equipment including, but not limited to, auxiliary pump system equipment, trash system components, overhead crane system components shall be similarly accurately installed and checked for correct placement, alignment in accordance with the approved drawings and installation procedures.

24.9.3 Testing

24.9.3.1 General

All testing shall be performed in accordance with the Inspection, Testing and Commissioning Manual referred to in clause TS 24.1.14 and the guidelines hereunder.

Prior to delivery to the site equipment shall be tested and inspected according to the respective manufacturers' quality control procedures. The requirements of documentation and inspection by the Engineer or his representative are described in clause TS 24.1.2

The Contractor shall test each item of equipment, each system and the overall operation of the Asin Pumping Station in accordance with the specification and the testing schedule approved by the Engineer.

Before any test is made, the Contractor shall check that every item of equipment complies with the requirement of the specification, is installed correctly, with correct alignment and with the proper connections with associated equipment, and is in satisfactory operating condition.

Each item of equipment and associated equipment shall be tested to prove that the operation is satisfactory and its performance in accordance with the specified requirements and the performance indicated in the data sheets supplied by the Contractor with his bid.

All tests to be carried out in accordance with the approved procedure shall be witnessed by the Engineer or his representative. The Contractor shall give the Engineer at least 24 hours notice of any test he intends to carry out which is required to be witnessed by the Engineer.

24.9.3.2 Tests at Site

Preliminary Tests

During and after the installation of each item of equipment, the Contractor shall perform the following preliminary tests to establish the accuracy of the assembly, to be in sound condition to operate under load and to prove the adequacy of the materials and the workmanship's. All tests and test procedures shall be approved by the Engineer.

All electrical test shall be conducted in accordance with the requirements of section TS 25, Electrical Works.

Operation tests of auxiliary equipment

Pump reduction gear and engine shaft alignment and measurement of pump flight clearances

Operation of the pumps and engines, to check bearing operation, running clearances

Any additional tests required by the Engineer to ensure the safety of the equipment when operated

Tests on Completion

After all components of each system have been installed, tested and found to be satisfactory and each system checked for satisfactory operation and all necessary adjustments made, the Contractor shall conduct operational tests in the Engineer's presence to demonstrate that the entire work has been properly installed, and is correctly adjusted to operate as specified.

The Contractor shall make all final adjustment to the control and detection devices. The Contractor shall be responsible for the operation of the system during the test on completion.

Pump operation tests shall be made when water level in the inlet channel is above levels at which the auxiliary pumps and the main pumps will operate at their respective full capacities. All tests shall be carried out by the Contractor on his responsibility and at his costs including necessary testing equipment and instruments.

Electric power, fuel and other consumables is required for any test it shall be provided by the Contractor at his own expense. The final results of all tests including tests run by the Contractor shall be subject to acceptance by the Engineer.

Unless otherwise specified, the Contractor shall submit to the Engineer five (5) copies of all test or inspection reports.

Extended Testing

For the purposes of verifying proper equipment operating procedures testing shall continue until the end of the wet season following Completion. The Contractor's obligation during this period, in addition to his obligations regarding Defects Liability and Warranties, shall be to provide all consumables for the complete operation of the pumping station and gates. Compliance with this requirement shall not prejudice the rights and entitlements of the Contractor in relation to Completion.

24.10 MEASUREMENT AND PAYMENT

This clause specifies the method of measurement and payment for the mechanical works portion of the Works.

24.10.1 Main Pump System

Main Pumps

This clause covers the main pump system specified in clause TS 24.2.

Payment for main drainage pumps shall be made at the price per set entered in the priced Bill of Quantities.

Payment shall be made in the following manner:

- For the purpose of interim payment, sixty (60) percent of the price per set shall be paid in the form of a monthly progress payment upon arrival of each pump at the Site and upon submission of the following documents:
- Inspection certificate issued by the Engineer.
- The remaining forty (40) percent of the price per set, which is deemed as the cost for installation, supervision, operational test, training of local staff for the pump operation and maintenance, shall be following the completion of testing of the entire system for the Asin Pumping station to the Engineer's approval.
- Payment shall constitute full compensation for designing, manufacturing, delivering, installing, commissioning, supervising, testing and training of local staff for the pumping facilities operation, and all other associated costs.

Gear Boxes

Payment for gear boxes shall be made at the price per set entered in the priced Bill of Quantities.

Payment shall be made in the following manner:

- For the purpose of interim payment, sixty (60) percent of the price per set shall be paid in the form of a monthly progress payment upon arrival of each pump at the Site and upon submission of the following documents:
- Inspection certificate issued by the Engineer.
- The remaining forty (40) percent of the price per set, which is deemed as the cost for installation, supervision, operational test, training of

local staff for the pump operation and maintenance, shall be following the completion of testing of the entire system for the Asin Pumping station to the Engineer's approval.

- Payment shall constitute full compensation for designing, manufacturing, delivering, installing, commissioning, supervising, testing and training of local staff for the pumping facilities operation, and all other associated costs.

The items to be paid under this clause is as follows:

Pay Item No.	Description	Unit of Measurement
D.3.1	Furnishing and Installing Main Pump Units	set
D.3.2	Gear Boxes	set

24.10.2 Diesel Engines for Main Pumps

This clause covers the method of payment for the diesel engines for the main pumps as specified in clause TS 24.3

Payment for diesel engines for the main pumps shall be made at the price per set entered in the priced Bill of Quantities.

Payment shall be made in the following manner:

- For the purpose of interim payment, sixty (60) percent of the price per set shall be paid in the form of a monthly progress payment upon arrival of each pump at the Site and upon submission of the following documents:
- Inspection certificate issued by the Engineer.
- The remaining forty (40) percent of the price per set, which is deemed as the cost for installation, supervision, operational test, training of local staff for the pump operation and maintenance, shall be following the completion of testing of the entire system for the Asin Pumping station to the Engineer's approval.
- Payment shall constitute full compensation for manufacturing, delivering, installing, commissioning, supervising, testing and training of local staff for the pumping facilities operation, and all other associated costs.

The item to be paid under this clause is as follows:

Pay Item No.	Description	Unit of Measurement
D.3.3	Diesel Engine Units	set

24.10.3 Auxiliary Equipment for Diesel Engines

This clause covers the method of payment for auxiliary equipment for diesel engines as specified in clause TS 24.4

Payment for auxiliary equipment for diesel engines comprising Fuel Transfer Pump, Fuel Storage Tank and Fuel Service Tank shall be made at the respective prices per set or lump sum price entered in the priced Bill of Quantities.

Payment shall be made in the following manner:

- For the purpose of interim payment, eighty (80) percent of the price shall be paid in the form of a monthly progress payment upon arrival of each unit at the Site and following the issuance of an inspection certificate by the Engineer.

- The remaining twenty (20) percent of respective prices, which is deemed as the cost for installation, supervision, operational test, training of local staff for the pump operation and maintenance, shall be made following the completion of testing of the entire system for the Asin Pumping station to the Engineer's approval.
- Payment shall constitute full compensation for manufacturing, delivering, installing, commissioning, supervising, testing and training of local staff for the pumping facilities operation, and all other associated costs.

Items to be paid under this clause are as follows:

Pay Item No.	Description	Unit of Measurement
D.3.4	Fuel Service Tank	set
D.3.5	Fuel Transfer Pump	set
D.7.6	Fuel Tank and Accessories	L.S.
D 7.7	Grounding (for fuel tank)	L.S.

24.10.4 Piping Systems

This clause covers the method of payment for auxiliary equipment for diesel engines as specified in clause TS 24.5.

Discharge Piping for Auxiliary Pumping System

No separate payment shall be made for this item and the cost of piping shall be included in the price for the auxiliary drainage pump system.

Fuel Supply Piping System

Payment shall be made at the Lump sum price stated in the Bill of Quantities for the completed fuel supply piping system, in place and approved by the Engineer.

Payment shall constitute full compensation for supplying, installing, commissioning, supervising, testing and commissioning of all piping, valves and other piping system components up to the flanges of the various tanks and equipment served by the piping system. The vent pipe for the fuel tank is also included in this item. The price shall also include allowance for training of local staff for the pumping facilities operation, and all other associated costs.

The item to be paid under this clause is as follows:

Pay Item No.	Description	Unit of Measurement
D.3.8	Piping System	L.S.

24.10.5 Auxiliary Drainage Pump System

This clause covers the method of payment for the auxiliary drainage system specified in clause TS 24.6.

Payment shall be made at the lump sum price entered in the priced Bill of Quantities for the Auxiliary Drainage Pump System, in place and approved by the Engineer.

Payment shall constitute full compensation for manufacturing, delivering, installing, commissioning, supervising, testing of the complete auxiliary drainage pump system, including all associated piping, and for training of local staff for the pumping facilities operation, and all other associated costs.

The item to be paid under this clause is as follows:

Pay Item No.	Description	Unit of Measurement
D.3.6	Auxiliary Drainage Pump System	L.S.

24.10.6 Overhead Crane

This clause covers the method of payment for the overhead crane system specified in clause TS 24.7

Payment shall be made at the price for the complete set as entered in the priced Bill of Quantities for the Overhead Crane, in place and approved by the Engineer.

Payment shall constitute full compensation for designing, manufacturing, delivering, installing, commissioning, supervising, testing of the complete crane system (excluding the rails which are included in payment for building works), and for training of local staff in the use of the crane, and all other associated costs.

The item to be paid under this clause is as follows:

Pay Item No.	Description	Unit of Measurement
D.3.7	Overhead Crane	set

24.10.7 Gate Works

This clause covers the method of payment for the gate works specified in clause TS 24.8

<u>Gate Leaf Guide Frame and Hoist</u>

Payment for gate leaf, guide frame and hoist shall be made at the respective prices per set entered in the priced Bill of Quantities.

Payment shall be made in the following manner:

For Gate Leaf and Hoist:

- For the purpose of interim payment, sixty (60) percent of the price shall be paid in the form of a monthly progress payment upon arrival of each complete set at the Site and following the issuance of an inspection certificate by the Engineer.
- The remaining twenty (40) percent of respective prices, which are deemed as the cost for installation, supervision, operational test, training of local staff for the gate operation and maintenance, shall be made following the completion of testing of the complete gate system to the Engineer's approval.

For Guide Frame:

- Payment shall be made following completion and completion and testing of the gate system to the Engineer's approval.
- Payment shall constitute full compensation for designing, fabricating, delivering, installing, supervising, testing and training of local staff for in gate operation and maintenance and for all other associated costs.

<u>Stop Logs</u>

Payment shall be made at the Lump sum price entered in the priced Bill of Quantities for stop logs.

Payment shall constitute full compensation for designing, supplying, installing, testing, removal and stacking in a nominated place in the pumping station complex of stop logs and the related spreader beam.

Items to be paid under this clause are as follows:

Pay Item No.	Description	Unit of Measurement
E.2.1	Gate Leaf	set
E.2.2	Guide Frame	set
E.2.3	Hoist	set
E.2.4	Stop Log	L.S.

24.10.8 Inspection and Test

This clause covers the method of payment for the inspection and testing of all mechanical works as specified in clause TS 24.1.14.

Payment shall be made at the lump sum price entered in the priced Bill of Quantities following completion of all inspection and testing to the approval of the Engineer.

Payment shall constitute full compensation for supplying the tools, specialised equipment, specialised personnel, the cost of expenses for the Engineer or his Representative to attend specified workshop test, the cost of all consumables for the Extended Testing and any associated costs.

Interim payment shall be made in accordance with inspections completed and shall be based on the Contractor's breakdown of the lump sum price.

The item to be paid under this clause is as follows:

Pay Item No.	Description	Unit of Measurement
D.3.9	Inspection and Test	L.S.

24.10.9 Maintenance Tools and Spares

This clause covers the method of payment for the furnishing of maintenance tools and spare parts specified in clause TS 24.1.9 and TS 24.1.8 respectively.

Payment shall be made at the lump sum prices as entered in the priced Bill of Quantities the following delivery to the Site of complete sets of spares and tools (complete with tool boxes for each set of tools) in accordance with the schedules of spare parts and maintenance tools for each system, as entered in the data sheets appended to the Contractor's bid.

Payment shall constitute full compensation for supplying the tools and spares as specified, and any associated costs.

Items to be paid under this clause are as follows:

Pay Item No.	Description	Unit of Measurement
E.2.5	Spare Parts (for gate)	L.S.
D.3.10	Spare Parts	L.S.
D.3.11	Maintenance Tools	L.S.