

SECTION 40200 VENTILATION AND AIR CONDITIONING

40201 Work included under this Section about the air conditioning and mechanical
Scope of Work ventilation requirements for this project are the following:

- a) Supply, installation, starting, balancing of water chillers, pumps, air handling units, fan coil units, ductwork, accessories, temperature controls, valves, pipes, drains and all system accessories that are required for the optimal functionality of the system.
- b) Furnishing all labor, tools and equipment necessary for complete installation of the water chillers, pumps, air handling units, fan coil units, ductwork, accessories, temperature controls, valves, pipes, drains and all system accessories
- c) A complete warranty of at least one (1) year of the air conditioning and ventilation systems.
- d) Furnishing all labor, tools and equipment necessary for the testing and operation of all Air Conditioning and Ventilation System.

40202
Equipment

A chilled water system, balanced with air handling units and fan coil units.

40202.1 Chiller

Two (2) air cooled chillers with reciprocating or screw Compressors with a cooling capacity of 60 tons of refrigeration @ 35°C ambient temperature and leaving water temperature of 5.5° C, and Step capacity modulation of 25%, 50%, 75% and 100% Refrigerant R-22.

Electrical Data : 208 V, 3 phase, 60 Hz.

Water : Flow rate 0.68 m³/min each

40202.2 Chiller Arrangement

The two chillers should be arranged in a series connection. This will reduce the operating costs during low cooling load period. One of the two chillers will be the lead chiller. This chiller will be working most of the time at a 100% of its capacity. If cooling demand increases, the lag chiller will start and respond to met the increased cooling demand. When the cooling demand decreases the lagchiller will reduce its capacity until it shuts down. The system should be arranged so that, during low cooling load periods, the lead chiller may be shut down for maintenance, and that the lag chiller responds to the demand of cooling load.

40202.3 Air Handlers

One (1) 8-refrigeration ton Air handler

One (1) 10-refrigeration ton Air handler

Two (2) 14-refrigeration ton Air handlers

Each with the following characteristics:

The entire unit should be insulated with 25 mm rubber-in-shear. The filter should be 50 mm throw away type with a pressure drop of 4.32 mm of water gauge (mm. w.g.). The pressure drop across the coil should be equal or less than 13.72 (mm. w.g.) The fan should be forward curved with an outdoor drip proof (ODP) motor direct drive, with 208 V/2 phase/60 Hz.

Airflow 10 ton unit	115 m ³ /min
Airflow 12 ton unit	125 m ³ /min
Airflow 14 ton unit	145 m ³ /min
Airflow 20 ton unit	205 m ³ /min

Air and water temperatures for Air Handling Units

Entering dry bulb air temperature	29.4°C
Entering wet bulb air temperature	20°.0C
Leaving dry bulb temperature	12.8°C
Entering water temperature	6.7°C
Leaving water temperature	12.2°C

40202.4 Fan Coil Units

The Fan Coil Units (FCU), should be made out of galvanized steel. It should be provisioned with hanging slots on top of the housing.

The housing has to be thermally and acoustically insulated with 13 mm fiber glass. The coil has to be 13 mm outside diameter (O.D.). Copper tubing with aluminum fins mechanically bonded to the tubes. The coils should be leak tested for at least working pressures of 17.5 Kg/cm².

The air discharge side, should be provided with a 25 mm duct collar.

The unit should be provided with 1" thick disposable filters.

The Fan should be centrifugal, forward curved, double width wheels, the blower housing should be galvanized steel.

The motor should be a three-speed PSC type, with thermal overload protection. Motor bearings should be sleeve type.

The condensated water drain pan should be lined with closed cell fire retardant foam insulation. The water should never be in contact with the metal pan to avoid corrosion problems. The motor blower assembly should be easy to reach and remove.

Air and water temperatures for Fan Coil Units

Entering dry bulb air temperature	29.4°C
Entering wet bulb air temperature	20.0°C
Leaving dry bulb temperature	15.1°C
Entering water temperature	7.2°C
Leaving water temperature	12.3°C

40202.5 Mini-Split System (Condensing Unit)

The Mini-Split systems, ranging from 2,625 kW to 7 kW, should be rotary compressors with horizontal condenser air discharge.

The Mini-Split systems, ranging from 8.75 kW and greater, should be rotary compressors with vertical condenser air discharge.

The condensing unit should be provided with high and low pressure sensors, that will cut off the power supply to the compressor when the pressure is to high or too low

The control voltage has to be 24 VAC.

40202.6 Mini-Split System (Evaporating Unit)

The Mini-Split systems, ranging from 2,625 kW to 3.5 kW, should be wall mounted fan coil units, with a wired wireless thermostat.

The Mini-Split systems, ranging from 5.25 kW and greater, ceiling mounted fan coil units, with a wired wireless thermostat.

All the units should be provided with automatic louvers for air distribution.

The unit should be provided with washable filters.

The Fan should be centrifugal, forward curved, double width wheels, the blower housing should be plastic.

The motor should be a three-speed PSC type, with thermal overload protection. Motor bearings should be sleeve type.

40202.7 Mechanical Ventilation

1 st . floor cafeteria kitchen	One (1) Roof exhaust centrifugal fan 30 m ³ /min
1 st , 2 nd , 3 rd . and 4 th floor kitchen	One (1) Roof exhaust centrifugal fan 30 m ³ /min besides Machine Room
1 st , 2 nd . and 3 rd . floor bathrooms	Six (6) Ceiling exhaust fan 18 m ³ /min
4 th . floor bathroom	One (1) Ceiling exhaust fan 18 m ³ /min
5 th . floor bathroom	One (1) Sidewall exhaust fan 5 m ³ /min
6 th . Floor bathroom	One (1) Ceiling exhaust fan 18 m ³ /min

For the kitchen in the 1st, 2nd, 3rd. and 4th floor, a duct will pick the air in each kitchen shall be installed. The roof exhaust centrifugal fan will be located on the roof of 3rd floor.

All the bathroom exhaust fans will be installed above the ceiling, and will discharge the air to the outside through the wall.

40203 Pipes

40203.1 Chilled Water Pipes

All the pipes should be Black Steel. They should be insulated with 13 mm wall Rubatex or similar insulation. All fittings like elbows and tees, that are not near any system component, should be welded, all other fittings like valves should be flanged to the pipes. The diameters of the pipes are specified on the drawings.

The water speed should not be faster than 2.44 m/s Friction losses shall not be greater than 20 mm/m of pipe.

The pipes have to be insulated with a 13 mm Rubatex or similar material. The pipes that are outside of the building should be also covered up with aluminum sheet. All the accessories like valves and strainers should be also be insulated.

Removable thermometers should be installed in the water entrance and the water exit of the chiller.

Pressure gages should be installed on the suction and discharge side of the pump. They should be removable, because pressure gages due to vibration will deteriorate and will not be reliable when needed. A 13 mm or 19 mm ball valve should be installed so that the gage could easily be removed.

Flexible connectors should be installed at pumps and air handling units, to reduce

vibration and prevent damage caused by misalignment.

All low points of the system, should be equipped with drains. Separate shutoff and drain of individual equipment and circuits should be installed, so that the entire system does not have to be drained for service of a particular item.

Strainers should be used to protect elements of the system. A strainer should be installed on the suction side of the pump and on the entrance of every Air Handling Unit.

Butterfly valves, should be installed on the suction and discharge side of the pumps and at the entrance and exit of the chiller.

40203.2 Condensate Water

All air handling units (AHU) and fan coil units (FCU) will accumulate condensate water due to dehumidification of air. The condensate water should be removed from the units through PVC pipes. The drain connection on each unit should have a drain trap for easy access for cleaning. The pipes always a downstream pitch of at least 3%.

40204 Ducts and Grilles

40204.1 Ductworks

The main branch of each duct circuit, should be made out of galvanized sheet metal. The gage of the sheet metal is to be determined in accordance to the Sheet Metal and Air Conditioning Contractor's National Association (SMACNA) manual.

The sizing of the ducts is shown on the drawings.

The friction loss should not be greater than 20 mm/m

The velocity in every outlet should be between 2.5 m/s – 5 m/s

Every outlet should be a 4 way diffuser, with dimensions as indicated on the drawing.

The return inlets, should be return grilles of the dimensions indicated on the drawing.

A return grille should be located on every door, to allow air flow to the return grilles.

40204.2 Diffusers and Grilles

a) Supply Directional Diffusers

All air diffusers must be 4-way directional, drop face diffusers, that fit into standard 610 mm x 610 mm, drop ceiling T-style grids. The sizes of the diffuser is shown on the drawings.

b) Return Grilles

All return grilles must have 45° angle fixed deflecting vanes. They should be flush mounted. The size of the return grilles should 460 mm x 150 mm.

c) Fresh Air Inlet Grilles

The fresh air inlet grilles will be mounted on the wall connected directly to every AHU. They must have 45° angle fixed deflecting vanes. They should be flush mounted. The size of the fresh air inlet grilles should be 610 mm x 610 mm. The duct between the inlet grille and the AHU, should be provided with a damper to manage air flow.

40205 Control

The thermostat for each unit will be located near the return grille. The thermostats should control electric motorized valves that will shut off the water flow to the unit if the desired temperature is reached.

The electric motorized valve should be three-way valves with an operating voltage of 24 volts.

**40206
Water Pumps**

There should be two water pumps, to allow maintenance without sacrificing water circulation.

Each pump should have a flow-rate of 1,360 lt/min with a head of 55 m.

Motor:	Totally Enclosed Fan Cooled (TEFC)
NEMA frame:	256 T
Motor power:	25 HP
Full Load Amps (208 V):	74.8
Suction size:	76 mm
Discharge size:	62 mm
Impeller dia:	178 mm
Suction velocity:	4.75 m/s
Discharge velocity:	7.35 m/s

**40207
Expansion Tank**

The expansion tank shall be open type, it should be located at least 1 meter above the highest point of the piping system and it should be connected to the suction side of the pump to prevent sub-atmospheric system pressures caused by pump operation. The system should have an internal overflow drain. The minimum tank volume should be at least 10% of the total water volume in the system. The material of the expansion tank should be galvanized steel.

The filling of the system will be through the expansion tank, this means that a pressurized water supply connection should be available at least 2 meters away from the tank.

**40208
Refrigerant**

40208.1 Equipment

The equipment to be used, for the Container gate, Cargo Gate and Container Freight Station, will be Mini-Split systems, running with R-22 refrigerant

**40209
Testing,
Adjusting, and
Balancing**

The Contractor shall notify the Engineer at least 30 days before the testing, adjusting and balancing work to be started. Testing, adjusting and balancing methods shall be approved before commencement of testing, adjusting and balancing. Testing, adjusting and balancing shall be carried out in accordance with ASHRAE, ARI or International Acceptable Standards.

SECTION 40300 PLUMBING AND SANITARY APPLIANCES

40301
Scope of Works This Section shall cover the works of supply and installation of all sanitary appliances, taps, faucets, fittings, and plumbing and toilet accessories in toilets, kitchens, pantries and janitor rooms as shown on the Drawings in the following Buildings:

- a) Port Administration Building
- b) Container Freight Station
- c) Maintenance and Repair Shop
- d) Power Station

40302
General Requirements This works shall comply the following to meet the requirements designated in the drawings and as specified herein.

- a) Respective units of equipment as shown or specified shall be manufacturer's first quality lines of essentially standard series, and they shall be factory fabricated ready for field erection and installation.
- b) Comparable assemblies of manufacturers other than specified may be proposed if they differ in minor details only and otherwise comply with requirements shown or specified, subject to prior approval by the Engineer.
- c) Materials and equipment shown or specified shall be essentially standard catalogue products of manufacturers approved by the Engineer; variations therefore shall be only as specified.
- d) Where two or more units of the same class, type or kind are required, the units shall be products of a single manufacturer. However, various component parts of a system do not need to be products of the same manufacturer.
- e) The Engineer prior to ordering for installation should approve all plumbing fixtures and fittings.
- f) All fixtures shall be complete with fittings in accordance with the manufacturer's supply or recommendation and shall be guaranteed against defective design, material and workmanship for period of one (1) year from the date of final acceptance.

40303
Reference Specifications

40303.1 Pipe and Fittings Materials

SECTION 40107.3 shall apply for Polyvinyl Chloride (PVC) pipes and fittings

40303.2 Installation

SECTION 40105 shall apply.

40303.3 Tests

SECTION 40108 shall apply in addition to what is specified herein.

40303.4 Disinfections and Flushing

SECTION 40109 shall apply

40304
Sanitary

40304.1 Water Closets

Water Closets shall be white vitreous china, American Standard model Hydra code

Appliances and Fittings 2116551 or equivalent, provided with seat and cover and a low level white vitreous 6 liters flushing cistern and a bronze service control valve.

40304.2 Wash Basins

The wash basins shall be white vitreous china, American Standard model Saturno code 0210411 or equivalent, fixed on to metal brackets, complete with plug and chain, with chromium plated bronze pillar cold water tap and wastewater outlet with stainless steel or chromium plated bronze bottle trap. The water supply for Wash Basins shall be provided with a bronze service control valve.

40304.3 Sink Type 1

Sinks type 1 shall be stainless steel with one drainboard and one bowl, fixed on walls with metal brackets and provided with plug and chain, chromium plated bronze water tap with swan neck and wastewater outlet and stainless steel or chromium plated bronze bottle trap. A supply service control valve shall be provided.

40304.4 Sink Type 2

Sinks type 2 shall be stainless steel with two drainboards and double bowl, fixed on walls with metal brackets and provided with plug and chain, chromium plated bronze water tap with swan neck and wastewater outlet and stainless steel or chromium plated bronze bottle trap. Water supply inlet shall be provided with a bronze service control valve.

40304.5 Concrete Sinks

These sinks shall be cast in place or precast reinforced concrete according to dimensions and arrangement shown in the Drawings. The Reinforced concrete shall be in accordance to related specifications consigned in SECTION 30400. The Concrete sinks shall be finished with plaster and smoothed with cement grout, as specified in SECTION 31200.

40304.6 Service Floor Sinks

These sinks shall be concrete block walls according to dimensions and arrangement shown in the Drawings and in fulfillment of the requirements specified in SECTION 30600. The Service Floor Sinks shall be provided with a floor drain as specified in SECTION 40305.3. The Service Floor Sinks shall be finished with plaster and smoothed with cement grout, as specified in SECTION 31200.

40304.7 Urinals

The urinals shall be white vitreous china, American Standard model Artico code 6558607 or equivalent, with concealed trap, hanged on wall with metal brackets, press-button valve water release, 45mm wastewater outlet. Urinals' water supply shall be provided with a bronze service control valve.

**40305
Plumbing and
Toilet
Accessories**

40305.1 Shower Heads

The showers shall be provided with adjustable chromium plated bronze shower rose and riser tube and chromium plated bronze gate valve with screwed tail for couplings. Valves shall be secured with necessary back plate, nuts and washers.

40305.2 Control Valves

Chromium plated bronze angle valves shall be provided to each water closet, washbasin, sink and urinal.

40305.3 Floor Drains

Cast iron drain and flushing collar with adjustable nickel bronze grating cover shall

be installed to receive wastewater at floor level at the places defined in the Drawings

40305.4 Sanitary Cleanouts

Cast iron adjustable floor level cleanout assembly with round nickel bronze top shall be installed where indicated in Drawings. The cleanout cover adjustment shall be watertight and gas tight. Clean outs shall be of the same size as the pipe.

40305.5 Shower Drains

Cast iron drain and flushing collar with adjustable nickel bronze grating cover shall be installed to receive wastewater at floor level at the as defined in the Drawings

40305.6 Grab Bars

The grab bars to be installed in accessible toilets shall be type-304 stainless steel with satin finish. Grab bar shall have 18-gauge (1.2 mm) wall thickness and 30 mm outside diameter. Clearance between the grab bar and wall shall be 40 mm. Concealed mounting flanges shall be 3mm thick stainless steel plate, 50 mm x 80 mm and equipped with two screw holes for attachment to wall. Flange covers shall be 22-gauge (0.8 mm) stainless steel, 85 mm diameter, and shall snap over mounting flanges to conceal mounting screws. Ends of grab bar shall pass through concealed mounting flanges and be heliarc welded to form one structural unit.

40305.7 Hand Dryer:

Hand dryers shall be surface-mounted of one-piece cast-aluminum cover pretreated with chromate before high-gloss, baked white enamel finish is applied. Cover shall be equipped with a two-position, self-returning, chrome plated air-outlet nozzle that adjusts for hand and face drying and automatically returns to hand-drying position after face-drying. Electronic sensor shall automatically turn dryer on when hands are held under air-outlet opening or the nozzle is lift to the face-drying position. Dryer shall turn off automatically when hands are removed or self-returning nozzle is released. Motor shall be 1/10 HP, universal type and equipped with automatic thermal-overload switch. Unit shall be UL listed.

40305.8 Toilet Tissue Dispensers

Toilet Tissue dispenser's door shall be 0.8mm stainless steel with satin finish and shall be equipped with a lock not keyed. Spindle shall accommodate one toilet tissue roll up to 255mm diameter with 55mm diameter core. Spindle shall be convertible in the field to dispense a 40 mm diameter core roll by removing outer O-rings furnished.

40305.9 Shower Curtain Holder

Shower Curtain rod shall be type-304, 20-gauge (1.0 mm) stainless steel tubing with satin finish and 25 mm outside diameter. Flanges shall be type-304, 20-gauge (1.0 mm) stainless steel with satin finish and drawn, one-piece, seamless construction. Length of the rod shall be as specified in the drawings.

40305.10 Gaskets:

- a) Rubber: Durable and suitable for pressure, temperature and Water characteristics of works as required.
- b) Liquid: Synthetic rubber compound specifically formulated for service intended.
- c) Sealing Tape: For threaded connections, Teflon tape suitable for

Temperatures ranging from -50° to +180°C.

40306
Test and
Inspection

40306.1 Inspection

- a) The Engineer will inspect materials, equipment and the completed installation.
- b) All equipment, materials or work rejected because of defects or non-conformance with the Drawings and Specification shall be replaced or corrected by the Contractor as directed at no additional cost.

40306.2 Tests

- a) All tests shall be performed and the Contractor shall furnish all materials, labor and equipment required for test. The Contractor at no addition cost shall correct defects disclosed by the test. Equipment and material certified as having been successfully tested by the manufacturer in accordance with referenced specifications and standards will not require re-testing before installation.
- b) Equipment and materials not tested at the place of manufacture will be tested before or after installation, as applicable, where necessary to determine compliance with referenced specifications and standards.

SECTION 40400 FIREFIGHTING SYSTEM

40401 Scope of Works

This work shall consist of the furnishing of all the equipment, materials, labor and supervision required to complete the following works in compliance with the Drawings and as specified herein.

- a) Pipes for water supply, from the Stationary Fire Pump, for indoor hydrants in the Port Administration Building, including all necessary accessories and fittings. Pipes for water supply for outdoor hydrants and monitors are excluded in this Section but included in Section 40500.
- b) Outdoor standing hydrants around the buildings.
- c) Underground hydrants in Container Yard, Multi-Purpose Yard, Passenger Berth and Open Storage Areas, including all necessary accessories and fittings.
- d) Underground valves for vessel service with attached meter.
- e) Fire Monitors with attached valve.
- f) Indoor hydrants in the administration Building including all necessary accessories and fittings and the fire fighting support equipment.
- g) Fire Hydrants support equipment contained in the Fire Station Cabinets.
- h) Stationary Fire Pump in the administration Building
- i) Mobile Fire Pump including all accessories and fittings for its operation.
- j) Portable fire extinguishers inside the buildings and wheeled extinguishers in the outdoors.

40402 General Requirements

The Contractor shall be responsible for the coordination of all further design work, and installation work for the whole fire fighting system.

40403 Piping

40403.1 General

Pipes and fittings for water supply for internal fire fighting system shall be heavy galvanized iron types and shall comply with ANSI/ASTM A 120-79 together with additional clauses and conditions specified in SECTION 40107.4 and herein.

40403.2 Joints

Galvanized iron pipes of all diameters shall be joined by threaded galvanized iron sockets of suitable strength. The screw threads in all pipes and fittings shall comply with ISO Metric Screw Threads.

40403.3 Installation

The Provisions of SECTION 40105 *Pipe Installation* shall apply.

40403.4 Hydraulic Test

The Provisions of SECTION 40108.2 *Hydrostatic Test for Pressure Pipelines* shall apply.

40403.5 Painting

Pipes and fittings shall be prepared for painting with solvent cleaning in accordance

with Steel Structures Painting Council (SSPC-SP1) prior to painting with one coat of epoxy paint "safety red" color.

**40404
Outdoor
Standing Fire
Hydrants**

40404.1 General

Outdoors standing fire hydrants shall comply AWWA C502 requirements and shall be 17.23 bar rated working pressure and test pressure shall be 34.5 bar.

40404.2 Features and Materials

Gray iron upper barrel shall be designed for 360° rotation of nozzle section for correct direction of face of hydrant. Main valve closure shall be of the compression type. Hydrant shall be provided with two 62 mm bronze nozzles and one 114mm bronze pumper nozzle, and ductile iron traffic flange, 100 mm flanged inlet. Lower barrel and hydrant base shall be ductile iron. Hydrant shall be painted with two coats of polyurethane enamel paint "safety red" color. The hydrant shall be provided with cast iron nozzle cap, chain and gasket for each outlet. Bolts and nuts shall be rustproofed steel in accordance with ASTM A307. All gray iron parts shall be ASTM A126 class B.

40404.3 Installation

Hydrants shall be installed vertical and its face shall be in direction as directed by the Engineer. Hydrant shall be firmly supported and braced before installing the thrust block. Thread compound shall be used on all threaded and coupled joints.

**40405
Underground
Fire Hydrants**

40405.1 General

Underground Fire Hydrants shall be a 62 mm gate valve.

40405.2 Features and Materials

Valve shall be cast brass with solid wedge disc and tapered seats. The inlet shall be 62 mm female. The outlet shall be 62 mm hose thread provided with cap and chain. Red iron wheel handle.

40405.3 Installation

Valve shall be installed vertically inside a pit with the minimal dimensions as shown in the Drawings. Valve shall be firmly supported and braced before installing the thrust block.

**40406
Underground
Valves for
Vessel Service**

40406.1 General

Underground Valve for Vessel Service to be a 62 mm gate type provided with a 62 mm Flow Meter.

40406.2 Valve's Features and Materials

Valve shall be cast brass with solid wedge disc and tapered seats. The inlet shall be 62 mm threaded female. The outlet shall be 62 mm hose thread provided with cap and chain. Red iron wheel handle.

40406.3 Meter's Features and Materials

Meter shall be turbine magnetic transmission type, ductile cast iron body painted with epoxy paint, flanged connections, cubic meter reading.

40406.4 Installation

Valve shall be installed vertically inside a pit together with the meter in accordance with the dimensions specified in the Drawings. Meter and valve shall be connected

by a ϕ 62 mm with a minimum length of 300 mm. Valve and meter shall be firmly supported and braced before installing the thrust blocks.

**40407
Fire Monitors**

40407.1 General

Fire Monitor shall be ϕ 75 mm waterway and rated for 4700 l/min. Fire Monitor to be provided with a ϕ 75 mm gate valve.

40407.2 Fire Monitor's Features and Materials:

Safety red painted brass ϕ 75 mm waterway, gear operated for vertical movement, 360° horizontal rotation, flanged inlet connection, as Castek's Protek Style 611 or equivalent. Fire Monitor shall be provided with a brass construction combination fog and straight stream nozzle as Castek's Protek Style 845B or equivalent.

40407.3 Valve's Features and Materials

The ϕ 75 mm gate valve shall be cast iron body in accordance with ASTM A 126 Class B, cast bronze parts in accordance with ASTM B62, flanged connection.

40407.4 Installation

Monitor and valve shall be installed inside pit in berth area in accordance with the Drawings. Fire Monitor and valve shall be firmly supported and braced before installing the thrust blocks.

**40408
Indoor
Hydrants**

40408.1 General

Indoor hydrant shall consist of the following:

- a) Cabinet
- b) Hose Rack
- c) Angle Valve and fittings
- d) Fire Nozzle
- e) Fire Hose

40408.2 Features and Materials

832 mm x 883 mm x 203 mm trim less stainless steel cabinet with full glass cover, painted with security red enamel paint. Hose rack shall be steel safety red enameled. Angle valve shall be brass NPT x NST thread, and shall be provided with an aluminum handwheel, a 62 mm x 38 mm reducer and a brass 38 mm NPT x NST thread nipple. Fire nozzle shall be ϕ 38 mm twist shut-off straight stream-fog, for class A and B fires. Fire hose shall be ϕ 38 mm polyester single jacket, rubber lined, NST thread; length shall be as required in the Drawings.

40408.3 Installation

The indoor hydrant cabinet shall be placed where is indicated in the Drawings and shall be fixed and secured to the wall opening as specified by the manufacturer.

**40409
Fire Hydrants
Support
Equipment**

40409.1 General

Fire Station Cabinets shall be installed in order to store the hydrants supporting equipment as specified herein. The quantity and locations of these Fire Stations shall be as specified in the BOQ and the Drawings.

40409.2 Features and Materials:

Fire Station cabinets shall be constructed of heavy 16 gauge galvanized steel sheet including shelves, red zinc chromate prime coating.

40409.3 Equipment

The following equipment shall be provided inside each cabinet:

- a) One brass ball valve wye, red painted, 62 mm inlet and two 38 mm outlets.
- b) One handline nozzle, combination fog and straight stream, anodized aluminum construction, 38 mm inlet, 115-230-360-475 l/min selectable flows.
- c) Two handline nozzles, combination fog and straight stream, anodized aluminum construction, 62 mm inlet, 360-475-550-750-950 l/min selectable flows.
- d) Four Fire Hoses Synthetic Nitrile rubber covered, ϕ 62 mm x 15 m (50'), aluminum coupling, red color.
- e) Two Fire Hoses Synthetic Nitrile rubber covered, ϕ 38 mm x 15 m (50'), aluminum coupling, red color.
- f) Four ϕ 62 mm hose coupling gaskets
- g) Two ϕ 38 mm hose coupling gaskets
- h) Two adjustable hydrant wrenches, malleable iron head and 22 mm steel handle for pentagon hydrant nuts, notched to fit 32 mm square hydrant nut.
- i) Four Universal Spanners, for pin lug or rocker lug couplings 25 mm thru 115 mm, malleable iron.
- j) One Pin Lug Adapter 62 mm x 38 mm
- k) Two Play Pipes provided with swivel handle, base end of play pipe threaded 62 mm NST, discharge end threaded 56 mm ODM x 12 threads, standard tip discharge 29 mm, red marlin wrap.

40409.4 International Shore Connections:

To be provided in the Fire Station Cabinets in the Container Yard, in the Multi-Purpose Yard and in the Passenger Berth. The International Shore Connection shall consist of the following two parts:

- a) Shore side: shall be a 178 mm brass flange with 14 mm minimum thickness drilled with four 19 mm holes, equally spaced on 140 mm bolt circle, other side of flange tapped with 62 mm NST or any other 62 mm shore thread. The following appurtenances shall be provided: eight 16 mm flat brass washers, four 16 mm hexagon brass nuts, 16 mm x 50 mm hexagon head brass bolts, one 62 mm rubber washer for hose coupling connection and one fiber gasket for flange seal.
- b) Ship Side: shall be a 178 mm brass flange with 14 mm minimum thickness

with four 19 mm wide slots equally spaced for matching with a flange drilled with four 19 mm holes on a 140 mm bolt circle, other side of flange tapped with 62 mm NST or any other 62 mm shore thread. The following appurtenances shall be provided: eight 16 mm flat brass washers, four 16 mm hexagon brass nuts, 16 mm x 50 mm hexagon head brass bolts, one 62 mm rubber washer for hose coupling connection and one fiber gasket for flange seal.

**40410
Stationary Fire
Pump**

40410.1 General

The Stationary Fire Pump to be provided in the administration Building shall be electrical centrifugal type and shall comply all NFPA 20 standards and what is stipulated herein. Close-coupled to motor and total assembly removable without disturbing piping.

40410.2 Performance

Pump shall be 425 liters per minute minimum at 6.9 bar pressure. Pump shall furnish minimum efficiency of 150 percent of rated capacity at not less than 65 percent of total rated head. Pump shall be electricity powered, 208 V 3 phase, and 7.46 kW motor power. Pump shall be automatically controlled; it shall turn on when a hydrant's valve is opened and water pressure is lost.

40410.3 Materials

Pump case shall be close grain cast iron fitted with renewable bronze wear rings, pump shaft shall be stainless steel, seals shall be mechanical packing gland with stainless steel wear shaft, impeller shall be dynamically balanced bronze.

40410.4 Fittings

The following fittings shall be provided for the pump: automatic air release valve, circulation relief valve and pressure gauges.

40410.5 Installation:

Pump shall be installed according to manufacturer's recommendations. The base plate shall be securely attached to and set level on a solid foundation.

**40411
Mobile Fire
Pump**

40411.1 General

The Mobile Fire Pump to be provided in the berth area shall be a skid mounted diesel pump and shall be suitable for use with either fresh or salt water.

40411.2 Pump

Pump shall be rated for a minimum of 11,355 liters per minute at 10.3 bar pressure. Pump shall be horizontal split case, cast iron construction, bronze fitted, ASA Class 125 FF flanged suction x 200 mm ASA Class 250 FF flanged discharge.

40411.3 Driver

Pump's driver shall be a turbocharged diesel engine; power at flywheel shall be 285 kW at 1900 RPM. Exhaust shall be 150 mm with industrial grade silencers. Fuel consumption shall be 69 liters per hour at run out (17000 liters at 6.2 bar at 1900 RPM).

40411.4 Skid Base

The pump and engine shall be directly mounted to a steel skid base, which also shall serve as a fuel tank. The fuel tank shall have a capacity of 690 liters for a 10 hour minimum supply at rated flow and shall be furnished with fuel fill connections at each end. A steel tubing lifting and rigging spreader frame shall be provided to facilitate removal of the skid from the trailer. Top of frame shall have hose troughs

with securing handles for storage of the three hard suction hoses.

40411.5 Trailer

The pumping skid is furnished with a custom designed Trailer from which it shall be easily removed for non-mobile or permanent installations. Trailer shall have dual axles with single wheels and 12 V DC electric brakes front and rear, a hinge shall be provided in the front, 62 mm bolted adjustable draw bar coupler. Trailer shall include front jack with 7000 pounds rating and top-wind-drop-leg and shall have storage compartments for storage of wheel chocks. The trailer shall be prepared, primed and painted with white polyurethane enamel with a blue polyurethane enamel top. The trailer shall be provided with a single 24 V DC work lights each side, two rear combination brake/turn lights, one license plate light, two back-up lights and markers.

40411.6 Electrical System

The pump shall be provided with an electrical priming system. The electrical priming system shall be a 24 V DC main primer with two manual back up primers. The electrical system shall include a 55 AMP alternator and two type 8D minimum 900 CCA batteries.

40411.7 Operator's Panel

The Operator's Panel shall be located on the skid readily accessible from ground level but clear of any suction or discharge. The Operator's Panel shall contain all controls for starting and stopping the engine, monitoring engine functions, priming the pump, and monitoring pump suction and discharge pressures. Controls shall include off-on-start switch, tachometer, engine oil pressure gauge, engine coolant temperature gauge, voltmeter, suction gauge, discharge gauge, left and right side work lights with switches, vernier engine throttle control, and priming pump valve/switch control.

40411.8 Connections

The pump shall be furnished a suction manifold and a discharge manifold. Both suction and discharge connections shall be angled down 15 degrees from horizontal and shall be provided with a 18 mm valve for draining. All valves 75 mm and smaller shall be equipped with male National Hose threads with caps and operate with quarter-turn handles. All valves larger than 75 mm shall be furnished with gear operated butterfly valve shut-offs.

- a) Suction Manifold: Suction Manifold shall be constructed from 250 mm, schedule 10, and stainless steel pipe and shall be complete with three 150 mm National Hose thread Male brass suction connection adapters with inlet screens and brass 150 mm National Hose thread caps.
- b) Discharge Manifold: Discharge Manifold shall be constructed from 200 mm schedule 10 stainless steel pipe and shall be complete with one 62 mm male National Hose thread discharge with valve and three 125 mm Storz discharges with butterfly valves.

40411.9 Accessories

The Mobile Pump shall be furnished with the following appurtenances:

- a) Three PVC 3 meter long, lightweight, black color, ridged helix with smoothed bore, for unrestricted flow, suction hose with lightweight M x F National Hose couplings. Each hose shall include a 150 mm basket type, lightweight strainers.

- b) Two wheel chocks.

**40412
Fire
Extinguishers**

40412.1 General

All Portable Fire Extinguishers shall comply with the standards of NFPA 10 *Standards for Portable Fire Extinguishers*.

40412.2 Type of Extinguishers

In accordance with NFPA 10 standards the type of extinguisher shall be depending on the type of fire as follows:

- a) Class AB fire: AFFF Foam Extinguisher
- b) Class BC fire: Carbon Dioxide Extinguisher
- c) Class ABC fire: Dry chemical (Ammonium phosphate) Multi Purpose extinguisher.
- d) Class K fire: Wet Chemical (Potassium Acetate mixed with water) Extinguisher.

40412.3 Features and Materials

- a) AFFF Foam Extinguishers:
shall be 6-liter capacity and shall be provided with hose and spray nozzle.
- b) Carbon Dioxide Extinguisher:
shall be 4.5, 6.8 and 9 kg capacity as specified in the Drawings, aluminum cylinder and brass valve, provided with hose and horn.
- c) Dry chemical Multi Purpose extinguisher:
shall be 4.5, 6.8, 9 and 56.7 kg capacity as specified in the drawings. 56.7 kg capacity extinguisher shall be wheeled and provided with hose and nozzle.

40412.4 Installation

Extinguishers shall be fixed to walls as shown in the drawings fixed with steel brackets as specified by the extinguisher's manufacturer. Brackets shall be primed and polyester powder paint finish. The height of placement of the extinguisher shall be as shown in the drawings, in accordance with NFPA 10 standards.

**40413
Pits**

Pits for Fire Fighting Equipment shall be constructed as shown in the drawings and as defined in TABLE 40413-1. Concrete shall be Class S3 in conformance to the applicable requirements of the SECTION 30400 *CONCRETE* of these Specifications. Covers shall be cast iron and shall be capable of bearing a failure stress as defined in Table 40413-1.

Table 40413-1: Pits for Fire Fighting System

Type	Contents	Location	Cast Iron Cover Failure Stress
1A	Fire Monitor and Valve	Container and Multi-purpose Berths	30 ton
	Hydrant and Meter (Valve for Vessel Service)	Container and Multi-purpose Berths	30 ton
1B	Fire Monitor and Valve	Passenger Berth	30 ton

	Hydrant and Meter (Valve for Vessel Service)	Passenger Berth	30 ton
2A	Underground Hydrant	Yards (Heavy traffic areas)	30 ton
2B	Underground Hydrant	Yards (light traffic areas)	15 ton

**40414
Commissioning**

Prior to taking over of works, all work scope of this SECTION shall be subjected of the processes described herein.

40414.1 Flushing

- a) Underground mains and lead in connections to equipment or buildings shall be flushed thoroughly before connections are made in order to remove foreign materials, which may have entered the mains during the course of the installation.
- b) The minimum rate of flow for flushing underground mains shall not be less than the water demand rate of the system.
- c) The flushing operation shall be continued for a time sufficient to ensure thorough cleaning. When planning the flushing operations, the Contractor shall perform all works necessary to dispose of the water issuing from the test outlets.

40414.1 Testing

- a) After completion of the entire fire fighting system, field operating performance and acceptance tests shall be performed as required by NFPA 20 and 24.
- b) Testing shall be conducted in presence of and to satisfaction of the Engineer.
- c) Seven days notification to the Engineer is required before testing.
- d) Hydrostatic Test
 - Testing procedure of the piping and appurtenances shall be as described in SECTION 40108.2
 - The entire outside system shall be tested at a hydrostatic pressure of not less than 15 bar for 2 hours. All building connection lines shall be isolated during the test.
 - The amount of leakage at joints shall not exceed 2 liters per hour per 100 joints irrespective of pipe diameter. The leakage shall be distributed over all joints. If such leakage occurs at a few points the installation shall be disapproved and all necessary repairs shall be made.
 - The amount of allowable leakage may be increased by 5 liters / cm valve diameter per hour for each metal seated valve in the test section.
- e) Operating Test
 - Each hydrant shall be opened and closed under water pressure; this shall be done with pump (s) running. All control valves shall be fully closed and opened under water pressure to ensure proper operation.

- Equipment and material certified as having been successfully tested by the manufacturer in accordance with referenced specifications and standards will not require retesting before installation. Extinguishers shall be certified by the manufacturer in compliance of NFPA 10 requirements.
- Equipment and materials not tested at the place of manufacture will be tested before or after installation, as applicable, where necessary to determine compliance with referenced specifications and standards.
- All Pipelines shall be pressure tested to 1.50 times the working pressure after the installation of all pipefittings prior to concealing or backfilling.
- The fire water supply system shall be started up and initially operated under the supervision of the Contractor's representative.
- Upon completion of start-up, final leak testing and proper adjustment of controls, the systems shall be tested to demonstrate the performance, which complies with the reference and capacity requirements of the Specification and standards.
- The system shall be tested for not less than 8 hours, during which time hourly readings shall be recorded. At the end of the test period, the readings shall be averaged and the average shall be considered to be the system performance.

SECTION 40500 WATER SUPPLY SYSTEM

40501 Scope of Work

- a) The Works specified under this Section include the furnishing of all the equipment, materials, labor, testing and supervision required to complete in compliance with the Drawings and the relevant sections of these Specifications the entire potable/fire fighting Water Supply System.
- b) Water Supply System includes the following:
 - Water Supply Pipelines and Appurtenances.
 - Water Storage and Purification Facilities.
- c) Water Storage and Purification Facilities includes the following:
 - Water Storage Tanks
 - Water Purification System
 - Service House for Valves
 - Exterior Works
- d) Fire Fighting pipelines and appurtenances from the Stationary Pump to the indoor hydrants in the Administration Building are excluded in this Section but are included in SECTION 40400.

40502 Contractor's Design Responsibility

The Contractor shall have the responsibility of the design, construction and commissioning of the following systems:

- a) Water Storage Tanks
- b) Water Purification System
- c) Service House (for Tanks' Valves)

40503 Reference Specifications

40503.1 Pipe and Fittings Materials

- a) Section 40107.3 shall apply for Polyvinyl Chloride (PVC) pipes and fittings;
- b) Section 40107.2 shall apply for Ductile Iron pipes and fittings.

40503.2 Installation

Section 40105 shall apply.

40503.3 Tests

Section 40108 shall apply.

40503.4 Disinfections and Flushing

Section 40109 shall apply.

40504 Pipes and Fittings

- a) Water Supply pipe types shall be as specified in Table 40504-1.

Table 40504-1: Pipes for Water Supply System

Location of Pipeline		Type of Pipe
Interiors	Buildings	Polyvinyl Chloride (PVC)
	Service House for Valves of Tanks	Ductile Iron
Outdoors	From Water Tanks to Valve in entrance of Port area (300 mm pipeline) and berth front (150 mm).	Ductile Iron
	From Valve in entrance of Port Area to within Port Area	Polyvinyl Chloride (PVC)
	From Deep well to Water Purification System	Galvanized Iron
	Tanks Drainage	Polyvinyl Chloride (PVC)

- b) PVC pipes and fittings shall be in accordance with the requirements of Section 40107.3
- c) Ductile Iron shall be in compliance of Section 40107.2
- d) Galvanized Iron shall be in accordance with Section 40107.4

**40505
 Joints**

40505.1 PVC Pipes

- a) For PVC pipes under 50 mm joints shall be solvent welded
- b) For pipes 50 mm and over joints shall be rubber ring gasket type unless otherwise specified in the Drawings and other sections of the Specifications.

40505.2 Ductile Iron Pipes

- a) For Ductile Iron pipes to be installed below ground joints shall be flexible rubber gasket push-on type.
- b) For Ductile Iron pipes to be installed above ground joints shall be rigid flanged type with gasket between flanges.

40505.3 Galvanized Iron Pipes

Joints shall be threaded socket type.

**40506
 Valves**

40506.1 General

- a) Valves shall be rated for 10.0 kg / cm² working pressure, minimum, unless otherwise specified.
- b) All valves shall be operated by hand wheel or key operation, clockwise closing unless specified otherwise by the Engineer. For valves greater than 300 mm diameter gear operators shall be used. The direction of closing clearly indicated on the handwheel or body as appropriate.

- c) Operation of valves shall be so that the torque effort required to operate the handwheel, lever or chain shall not exceed 20 kgm applied by an operator.
- d) Valves shall be provided with operating handwheels, caps, extension spindles and valve boxes as required. Extended valve spindles shall have spindle guides and operating caps.
- e) For valves not easily accessible, the Contractor shall furnish and install chain operated valve, extension handles, extension oil cups or such similar fittings or appliances as may required to permit easy access for proper operation, lubrication etc.
- f) Unless detailed otherwise all hand wheels shall have the words "open" and "close" cast in English with arrows indicating the direction of rotation. All hand wheels shall be of a solid cast type. Handwheels and hand stops shall be fitted with a padlock and chain to prevent unauthorized operation.
- g) Tee keys shall be provided at a rate of one (1) per ten (10) valves.
- h) Valves which are fixed at dead ends of pipelines shall be provided with blind flanges.
- i) Marking shall be either cast on the bonnet or the body and shall show the following:
 - Year of valve casting
 - Size of the valve
 - Designation of working pressure
 - Number of turns to open

40506.2 Gate Valves

- a) Standards: Bronze valves shall be in accordance with ASTM B62, cast iron valves shall be in accordance with AWWA C509 and ASTM A 126, Class B
- b) Material, Connections and Features shall be as shown in Table 40506-1.

Table 40506-1: Material for Gate Valves

Valve's Size	Material	Connection	Features
75 mm and under	Bronze	Threaded	Rising Stem, 68 kg solid wedge disc, handwheel
Over 75 mm	Iron body, bronze core	Flanged	Non-rising stem, 90 kg double disk, handwheel

40506.3 Swing Check Valves

- a) Standards: Bronze valves shall be in accordance with ASTM B62, cast iron valves shall be in accordance with ASTM A 126, Class B.
- b) Check valves shall be of free acting type specially designed for use in pumping systems, giving rapid non-slam closure and with low head loss characteristics when the valve is in open position.

- c) Material, Connections and Features shall be as shown in Table 40506-2.

Table 40506-2: Material and Features for Swing Check Valves

Valve's Size	Material	Connection	Features
75 mm and under	Bronze	Threaded	Metallic disk, bronze seat
Over 75 mm	Iron body, bronze mounted	Flanged	Renewable bronze disk and seat disk

40506.4 Air Release Valves

- a) Standard single orifice air valves shall be flanged type up to 50 mm in diameter and shall be manufactured of ductile iron.
- b) Double orifice air valves shall be manufactured of cast iron and shall have a minimum nominal diameter of the inlet of 80 mm.
- c) Working pressure for air valves shall be not less than 16 kg/cm². For pipelines having working pressures higher than 16 kg/cm² the air valves shall have an operating pressure of not less than 25 kg/cm².
- d) Valves with air intake or exhaust facilities shall have approved screening arrangements or other device to prevent the ingress of airborne sand. Each valve shall be provided with its own isolating valve.

40506.5 Float Operated Valves

- a) Float actuated inlet valves shall be double seat globe valves. The float lever arm and hinge point shall be selected to close the valve at a high reservoir level. The float position shall be adjustable to set it at the required maximum reservoir level. To avoid oscillating of the float induced by the water inflow the float shall be placed in a PVC pipe of suitable diameter and length (stilling pipe).
- b) Materials: Valve shall be bronze. Ball shall be bronze, sheet copper or polyethylene.

**40507
Meters**

- a) Meters shall be located at the water supply inlet to each building and at the stations for water service to vessels as specified in Section 40406.
- b) Meter shall be turbine magnetic transmission type, ductile cast iron body painted with epoxy paint, flanged connections, cubic meter reading.

**40508
Pits**

- a) Every valve to be located in the underground pipeline shall be installed in a pit.
- b) Pits shall be constructed as shown on the Drawings.
- c) Walls of the pits shall be reinforced concrete and cast iron cover. Except where otherwise shown, concrete used in manholes shall be Class S3, and shall conform to the applicable requirements of the SECTION 30400 and cast iron covers shall be capable of bearing a punctual load of 5, 15 or 30 Ton in accordance with what is specified in the Drawings and in Table 40508-1.

TABLE 40508-1: Pits for Water Supply System

Type	Contents	Location	Cast Iron Covers Failure Stress
3	Gate Valve and Meter	Inlets for Buildings	5 ton
4	Underground Faucet	Green areas around Buildings	5 ton
5A	Gate Valve	Heavy traffic areas	30 ton
5B	Gate Valve	Light Traffic areas	15 ton

**40509
Water Storage
Tanks**

40509.1 Scope of Work

- a) The Contractor shall be responsible of designing and construding of the Water Storage Tanks as specified herein and in the Drawings.
- b) The Contractor Design shall include all Civil, structural, mechanical and all incidental works. Pipes and valves are not included under this item.
- c) The Contractor Design Responsibility shall comply with the general requirements for the Design and build Method specified in Section 10400
- d) The drawings shall be considered as an indicative base and as minimum requirements to be considered for the Design. Though the Contractor is required to submit Detailed Design and Shop Drawings and all other documents as specified in Section 10405 and Section 10800.
- e) In order to design the foundation of the tanks and of the Service House the Contractor shall conduct a Soil Bearing Test and any other additional engineering test in the site where the tanks are going to be located as shown in the Drawings.

40509.2 General Design Conditions

- a) All components used in contact with drinking water shall comply with ANSI/NSF 61.
- b) Two 500 cubic meters nominal capacity storage tanks shall be provided.
- c) Tanks shall be cylindrical body with cone deck and flat bottom.
- d) Tanks shall be bolted steel staves type and shall be in conformance with ANSI/AWWA D103. Structural steel shall conform to ASTM A570, Grade 40 and ASTM A 36 requirements.
- e) Dimensions of the tanks shall be as shown in the Drawings:
 - Maximum Height of water: 5,000 mm
 - Maximum internal diameter: 11,300 mm
 - Minimum Capacity Filled to overflow: 511 cubic meters

40509.3 Contractor's Submittals

In addition to what is specified in Section 10400 the Contractor shall comply the following:

- a) Prior to the beginning of construction, submit detailed shop drawings of the tank, foundation, accessories, and exterior color samples for approval.
- b) Certify that the foundation is appropriate for the site conditions and the tank being provided. Also certify that the tank is suitable for potable water storage.
- c) Include with submittal information the tank manufacturer's erection instructions

40509.4 Features and Materials

- a) Tanks:
 - Walls shall be bolted steel staves.
 - Floor shall be bolted steel staves.
 - Roof shall be radially sectioned bolted steel staves, minimum pitch 1:12, clear span, self supporting, overhang 100 mm or less. Roof interior and exterior coating shall be the same as the tanks' walls.
 - Exterior coating shall be solvent-free polyester powder-coating. Interior shall be solvent free epoxy powder-coating and FDA approved for potable water.
- b) Roof Vent:
 - Vent shall be galvanized iron and shall be designed and constructed to prevent entry by birds, animals, and insects.
 - Roof vent screen shall be #20 mesh stainless steel insect screen backed up with 6.3 mm hardware cloth. Arrangement shall be such that allows easy maintenance, cleaning and replacement.
- c) Drain and Overflow Pipe Screen:
 - Overflow level shall be at 511.47 cubic meters.
 - Pipe Screen to be bronze or stainless steel # 18 mesh.
- d) Ladders and Railings:
 - Ladders and railings shall be constructed of galvanized steel or aluminum.
 - Safety Cage shall be mounted on exterior ladder in accordance with OSHA Standards. Provide hinged access hatch with protected padlock hasp near bottom of cage. Begin safety cage 1850 mm above finish ground.
 - Ladders: Both inside and outside ladders shall be provided. The outside tank ladder shall begin at the same level as the tank bottom. The inside ladder shall extend from 305 mm above the tank bottom to the roof access hatch. All ladder rungs shall be skid resistant.
- e) Water Level Indicator
 - Water Level Indicator shall show depth of water in cubic meters with

minimum 100 mm numerals. The board shall be painted white; numerals and level indicator black.

- Indicator Board shall be heavy-duty industrial aluminum.
- Indicator and Pulleys Cast iron.
- Cable and Connectors shall be Stainless steel.
- Float shall be Manufacturer's standard of non-corrosive material.

f) Filters.

- Stainless steel filters shall be provided at the tanks' outlets for water supply and for drainage pipes.

g) Access Hatches.

- Roof Opening shall be 600 mm diameter round waterproof hatch.
- Side Access shall be 600 mm diameter round bolted waterproof access hatch.

h) Nozzles.

A double nozzle shall be installed at every pipe connecting point as specified in the Drawings. Nozzle shall be the suitable diameter for the connecting pipe.

40509.5 Installation

- a) The Contractor shall construct the concrete foundation as shown on the Drawings of his Design. Provide and install the steel attachment ring in the foundation as required by the manufacturer.
- b) Bolt staves shall be installed in accordance with the manufacturer's requirements. Provide sealant at all joints. Construction shall be watertight.
- c) Particular care shall be taken in handling and bolting of tank components to avoid damage to tank coating. Field coating is limited to repair of damaged factory-applied coating. Repair shall be in strict accordance with manufacturer's instructions.

40509.6 Testing and Disinfections

- a) The Contractor shall perform an electrical leak test on panels during a non working day during erection using a 9-volt holiday detection device. Panels containing more than 5 electrical leak points on the inside surface shall be replaced or repaired (in accordance with manufacturer's procedure) as directed by the Engineer.
- b) Test the completed tank in accordance with ANSI/AWWA D103, Section 9. After erection and cleaning of the tank, test for liquid tightness by filling the tank to overflow level. Do not add additional water for a minimum of 24 hours. The Contractor, in accordance with manufacturer's instructions, shall repair all leaks. Drain tank after disinfections is complete.
- c) The tank may be disinfected at the time of testing by filling the tank with a 25 mg/l chlorine solution and leaving for 24 hours. Disinfections shall not occur

until tank sealant is fully cured. Acceptable forms of chlorine for disinfections are liquid chlorine and sodium hypochlorite. Calcium hypochlorite is not acceptable. After disinfections, the chlorine solution shall be drained and flush from the tank.

40509.7 Quality Assurance

- a) The tank shall be supplied by a manufacturer who specializes in powder coated, bolted steel tank design, fabrication, erection, and coating.
- b) Upon completion of the tank, the Contractor shall provide the Engineer with a written certification that the tank has been designed, fabricated, erected, and tested in accordance with the manufacturer's recommendations and with the requirements of ANSI/AWWA D103, and is suitable for potable water storage.
- c) The Contractor shall also provide the Engineer a certification from the manufacturer of the protective coating material, that the material is non-toxic, and will not impart any taste or odor to the water.
- d) Warranties shall be as specified in ANSI/AWWA D103 Section 1.3 or the manufacturer's standard warranty, whichever is more stringent.

40510 Service House for Valves

40510.1 General

- a) The Service House for Valves shall be designed and constructed by the Contractor in the location shown in the drawings.
- b) The Service House shall be in conformance with applicable requirements of related Civil Works, Building Works, and Electrical Works Specifications.
- c) The Contractor shall design the Service House considering that it shall house the following:
 - Control Panel
 - Pipes and valves of the tanks (as shown in the Drawings)

40510.2 Electrical Requirements

- a) The Contractor shall design the electrical system of the Service House in accordance with the requirements specified herein and in the drawings.
- b) Lamps shall be fluorescent 32WT8 type, high power factor, and electronic ballast, enclosed fiberglass-housing, ceiling or suspended mounting, listed for wet locations. Outlets shall be 120 V/15 A, weatherproof type.
- c) Electrical feasibility: there is a 13.2 kV primary three-phase line along the road to Playitas, approximately 50 meters away from the location of the Service House.

40511 Exterior Works of Water Storage and Purification Facilities Site

- a) All exterior works such as pavement, sidewalks, ramps, curbs, storm water and tanks drainage, manholes, outdoor illumination, gate and fence, shall be furnished as shown in the drawings and in conformance with related Specifications.
- b) The Contractor shall be responsible to construct all terrain protection works as required in accordance with the topography of the location in a manner such

to ensure the stability of the structures.

- c) All unpaved areas shall be covered with grass.

**40512
Water
Purification
Facilities**

40512.1 Scope Of Works

- a) The Contractor shall be responsible of the Detailed Design, Construction, installation and commissioning of the complete Water Purification Facility as specified herein.
- b) The Water Purification Facility shall consist of:
-Water Purification System
-Service House
- c) The Contractor Design shall include all civil, mechanical, structural, electrical and any other incidental works.
- d) The Contractor Design Responsibility shall comply with the general requirements for the Design and building Method specified in Section 10400
- e) The Contractor is required to submit Detailed Design and Shop Drawings as specified in SECTION 10800 and herein.
- f) The Contractor shall design the treatment equipment based upon the quality of the well water and the requirement of treatment capacity.

40512.2 General Design Conditions

- a) Flow rate (maximum): 1000 m³/day (62.50 m³/hr)
(minimum): 948.32 m³/day (39.5 m³/hr)
- b) The treated water shall be completely disinfected and comply with the WHO/NSO 13.07.01:97 Standards for drinking water, free of color, turbidity, taste or smell.
- c) Type of raw water: Sample test results from wells in the vicinity are as given in Tables 40512-1 and 40512-2, but the Contractor shall re-test the water from the project's deep well to ascertain exact water quality before starting design.
- d) Electrical feasibility: there is a 13.2 kV primary three-phase line along the road to Playitas, approximately 50 meters away from the location of the Service House.
- e) Ambiance Temperature: 26 °C ~35 °C
- f) Water Temperature: 30 °C
- g) Altitude of the location: 49 m above mean sea level

TABLE 40512-1 Chemical-Physical Quality of Water of Wells in the Vicinity of the Project

Analysis	Result	Un-Certainly	Expresed as	Standards Admissible Maximun	Fulfillment of Standards
Potassium	7	±0.0	ppm K	10	Yes

pH	7.2	±0.0	Units	6.0-8.5	Yes
Total Diluted Solids	776.9	±0.0	ppm	600	No
Total Hardness	460.9	±0.0	ppm CaCO3	400	No
Total Iron	0.03	±0.0	ppm Fe	0.30	Yes
Total Manganese	0.022	±0.0	ppm Mn	0.05	Yes
Chlorides	272.1	±5.3	ppm Cl	250	No
Sulphates	19.1	±0.08	ppm SO4	250	Yes
Lead	ND	±0.0	ppm Pb	0.01	Yes
Arsenic	ND	±0.0	ppm As	0.01	Yes
Chromium	ND	±0.0	ppm Cr6	0.05	Yes
Nitrates	9	±0.0	ppm NO3	45	Yes
Fluorine	0.18	±0.0	ppm F-	1.5	Yes
True Color	ND	±0.0	Units Pt-Co	15	Yes
Turbidity	0.2	±0.0	Units NT	5	Yes
Total Alkalinity	130	±0.0	ppm CaCO3	250	Yes
Sodium	44.4	±0.0	ppm Na	150	Yes
Silica	67.1	±0.0	ppm SiO2	125	Yes

TABLE 40512-2 Bacteriological Quality of Water of Wells in the Vicinity of the Project

Analysis	Result	Expresed as	Standards Admissible Maximun	Fulfillment of Standards
Total Coliform Bacteria	Less than 2	NMP/100 ml	Less than 1.1	(Not possible to establish)
Faecal Coliform Bacteria	Less than 2	NMP/100 ml	Negative	No
Escherichia Coli	Less than 2	NMP/100 ml	Negative	No
Total Count of Mesophilic Aerobical Bacteria	700,000	UFC/ml	100	No

Notes: ND: Non Detectable
ppm: parts per million (mg/liter)
NMP: Most probable number
UFC: Colony forming units

40512.3 Design Criteria

The Contractor shall design the Water Purification System considering the following criteria:

- a) Minimum chemical goods requirement for the process
- b) Minimum consumption of electrical energy
- c) Flexibility of the system
- d) Safely operation
- e) Minimum supervision and maintenance
- f) Equipment shall be from sources from where spares, materials and emergency back up facilities are adequately available locally.

40512.4 Contractor's Submittals

- a) The Contractor shall prepare and submit to the Engineer all necessary detailed design information such that the Engineer can review and approve the same. This information shall include:
 - Design report
 - Analysis data
 - System calculations
 - Structural calculations
 - Engineering flow scheme
 - Electrical power and control system diagram
 - Detailed design drawings
- b) In addition to the above, the Contractor shall submit to the Engineer a performance test record for similar packaged water treatment equipment that the Manufacturer has provided for other projects to demonstrate the effectiveness of the design proposed.

40512.5 Service Life

- a) The overall service life of the water treatment equipment shall not be shorter than 20 years during which replacement of major parts or components of the plant shall not occur. There shall be no interruption of operation lasting continuously for longer than 12 hours for repair services.
- b) The Contractor shall submit a list of major components of the plant stating the service life span of each to the Engineer for approval. The list shall be accompanied with a written guarantee of the manufacturer of the plant to the effect that any damage during the said service life period will be remedied at the manufacturer's costs.
- c) The Contractor shall provide spare parts for the water treatment equipment sufficient to allow five (5) years operation.
- d) In addition, the Contractor shall provide all required chemicals and consumables sufficient for two (2) years operation.

40512.6 Water Quality Testing Facilities

Water quality testing facilities shall be incorporated in the Service House for Valves and Water Purification System. The Contractor shall be responsible for furnishing all the required equipment, utensils, and consumables to perform water quality analysis to the treated water in accordance with the requirements established in NSO 13.07.01:97 Standards and to the approval by the Engineer.

40512.7 Service House

- a) The Service House shall be designed considering that it shall house the following:
 - Water Purification Equipment
 - Control Panel.
 - Emergency Electrical Generator Set.
 - Water Quality Testing Facilities
- b) This building shall be of permanent substantial construction. Structural, Architectural and Electrical design shall provide safe and efficient operation by the Employer's personnel. Appropriate natural ventilation shall be provided. Adequate electrical illumination and power shall be provided.

40512.8 Electrical Requirements

- a) Complete Electric Transformer Substation shall be supplied with suitable capacity for the equipment to be installed.
- b) The Electric Transformer Station shall be pole mounted and shall include grounding, fuse cut-outs and lightning arrester.
- c) Control Panel to be installed in the Service House shall be autotransformer type, with industrial circuit breaker, overload protection, phase/voltage unbalance protection, underload protection, energy consumption dial, pre-start ground check test, overall voltage dial, with hand-held dial control; low voltage surge arrester. This control panel and the Generator Set controller shall be suitable for Local area Network (LAN) connection for remote control

and monitoring.

- d) The Contractor shall furnish at the Service House an Automatic Emergency Electrical Generator Set with suitable characteristics to provide energy to the Water Purification System in a manner to ensure full functioning of the system.

- e) Lamps shall be fluorescent 32WT8 type, high power factor, and electronic ballast, enclosed fiberglass-housing, ceiling or suspended mounting, listed for wet locations. Outlets shall be 120V/15Amp, weatherproof type.

SECTION 40600 WASTEWATER SYSTEM

- 40601**
Scope of Work
- The Works include the furnishing of all the equipment, materials, labor, testing and supervision required to complete the following works in compliance with the Drawings and the relevant sections of these Specifications:
- a) Buildings' Wastewater System, which shall consist of two separated pipelines as follows:
 - Sanitary Drainage: to dispose effluents containing bodily waste from water closets and urinals to the connecting manhole.
 - Waste Drainage: to dispose clear water waste effluents from sinks, showers, floor drains and wash basins to the connecting manhole.
 - b) Main Wastewater System to conduct the joint waste and sanitary disposals from buildings to the Wastewater Treatment Facilities.
 - c) Oil/water Separation systems.
 - d) The Works also includes the Contractor's Design of the Wastewater Treatment Facilities.
- 40602**
Reference Specifications
- a) Pipe and Fittings Materials: SECTION 40107.3 shall apply for Polyvinyl Chloride (PVC) pipes and fittings.
 - b) Installation: SECTION 40105 shall apply.
 - c) Tests: SECTION 40108 shall apply.
 - d) Disinfections and Flushing: SECTION 40109 shall apply
 - e) Reinforced Concrete: SECTION 30400 shall apply.
- 40603**
Pipes and Fittings
- a) Pipes and fittings for Wastewater System shall be Polyvinyl Chloride (PVC), as specified in Section 40107.3
 - b) All fittings shall be the socket type for rubber ring joints or for solvent welded joints and shall be compatible with the pipe where installed.
 - c) Unless noted otherwise, materials and strength of fittings shall be the same as those of the connecting pipe.
- 40604**
Joints
- a) Unless noted otherwise, all exposed joints shall be welded using solvent cement.
 - b) Underground piping 100 mm and larger shall use push-on joints. Joints shall have caulked elastomeric gasket.
 - c) All joints shall be designed to have the same characteristics and strength as the connecting pipe.
- 40605**
Installation
- In addition to Specifications noted in Section 40105 the Contractor shall comply the following:
- a) The installation of PVC pipes and fittings shall be strictly in accordance with the requirements of ASTM D2321, the Manufacturer's technical data, and any

recommendation emitted by the Engineer.

- b) Joints for PVC pipe shall be solvent welded or coupling type. In making solvent welded connections, clean dirt and moisture from pipe and fittings and follow procedure in ASTM D2564, "Solvent Cements for Poly Vinyl Chloride (PVC) Plastic Pipe and Fittings". Care shall be taken in order that the solvent cement will not be spilled on valves or allowed to run from joints.
 - c) PVC pipe and fittings shall be carefully handled and stored to preclude direct exposure to sunlight or contact to sharp objects.
 - d) The installation of buried PVC pipe and fittings shall be strictly in accordance with the Drawings.
 - e) Piping shall be installed to the required lines and grades. All offsets and fittings required to accomplish this must be furnished. All dimensioned pipes and fittings shall be installed before fitting make up pieces, and the whole shall be joined so that no stress or strain is created in the lines and associated equipment due to forcing parts into position.
 - f) Changes in direction shall be made using proper fittings. Piping shall run parallel and at right angles to right-of-way lines unless noted otherwise.
 - g) Temporary bracing and supports shall be provided to adequately support the pipe during its installation and care shall be taken in placing piping to prevent damage to the pipe or pipe coating or to adjacent structures or equipment. All supporting piers and blocking shall be in place before temporary supports and bracing are removed.
 - h) The Contractor shall furnish and place all inserts for the support of piping installed under this Section in masonry and in concrete forms before concrete is placed, unless otherwise specified.
- 40606**
- Manholes and Grease Traps**
- a) Manholes and Grease Traps shall be constructed as shown on the Drawings.
 - b) Walls of the manholes and grease traps shall be reinforced concrete. Concrete shall be Class S3. Manholes' covers shall be cast iron and shall be capable of bearing a punctual load of 30 ton. Covers of Grease Traps shall be reinforced concrete and its exterior surface shall be finished as the floor where it is located.
 - c) The invert channels in manholes shall be smooth and semicircular in shape conforming to the inside of the adjacent sewer section.
 - d) Changes in direction of flow shall be made with a smooth curve of as long a radius as the size of the manhole will permit. The invert channels shall be formed directly in the concrete base, or shall be constructed by laying full-section sewer pipe through the manhole and breaking out the top half after the surrounding concrete has hardened.
 - e) The floor of the manhole outside the channels shall be smooth and shall slope toward the channels not less than 15 mm per 30 cm.
 - f) When the depth of manhole from top to cover to invert of sewer exceeds 0.6 meters, manholes shall have 16 mm diameter steel rungs of approved design

accurately anchored to the walls. Rungs shall be not less than 30 cm in width, spaced approximately 30 cm apart, and installed with at least 15 cm of toe space from inside face of rung to manhole wall.

**40607
Catch Basins**

- a) Catch Basins shall be constructed as shown on the Drawings.
- b) Walls of catch basins shall be reinforced concrete.
- c) Covers of catch basins shall be cast iron grate type, as specified in the drawings.
- d) Walls and bottom floor of catch basins shall be smoothed with cement grout.

**40608
Oil/Water
Separators**

- a) Oil/water Separators shall be constructed in complete accordance with the Drawings.
- b) Oil/water Separator tanks shall be reinforced concrete. Concrete shall be Class S3 as specified in SECTION 30400.
- c) Pipes and Fittings shall be Polyvinyl Chloride in compliance with the applicable requirements of SECTION 40107.3. Joints shall be solvent cement welded.
- d) Manholes' covers shall be cast iron, and shall be capable of bearing punctual loads of 15 or 30 ton, as specified in Table 40608-1.
- e) Vent pipes' screen shall be 20-mesh stainless steel insect screen backed up with 6.3 mm hardware cloth.
- f) Manholes shall have 16 mm diameter steel rungs of approved design accurately anchored to the walls. Rungs shall be not less than 25 cm width, spaced approximately 30 cm apart, and installed with at least 20 cm of toe space from inside face of rung to manhole wall as shown in the Drawings.
- g) Interior walls of tanks shall be smoothed with cement grout.
- h) Mesh to be installed in the opening between Sedimentation Chamber and the oil/water separation Chamber shall be covered with a non-corrosive metal mesh.

Table 40608-1: Oil/water Separators

Identification	Description	Cast Iron Cover Failure Stress
Oil/Water Separator-1	For Maintenance and Repair Shop, RTG Repair Yard, Fuel Station and Transformer of Power Supply Station	15 ton
Oil/Water Separator-2	For Storm Water Route-A	30 ton
Oil/Water Separator-3	For Storm Water Route-B	30 ton
Oil/Water Separator-4	For Storm Water Route-C	30 ton
Oil/Water Separator-5	For Storm Water Route-D	30 ton

**40609
Wastewater
Treatment
Facilities**

40609.1 Scope of Works

- a) The Contractor shall be responsible of designing and constructing of the Wastewater Treatment Facility N° 1 (for Port Administration Building, Power Station and Maintenance and Repair Shop) and of the Wastewater Treatment Facility N° 2 (for Container Freight Station) as specified herein.
- b) The Contractor Design shall include all Civil, structural, mechanical and electrical works.
- c) The Design shall include a Wastewater Pump Station complete with pumps, pipes, valves and all appurtenances required to lift the wastewater from the outlet level of pipeline to the required inlet level of the plants.
- d) The works shall include the design and construction of a Service House.
- e) In order to design the foundations of the tanks for the Wastewater Treatment Facilities and of the Service House the Contractor shall conduct a Soil Bearing Test at the site where these structures are going to be located as shown in the Drawings.

40609.2 Reference Specifications

The Contractor's Design shall comply with the applicable requirements defined in the following Sections of the Specifications:

- a) Contractor Design General Requirements: SECTION 10400
- b) Reinforced Concrete: SECTION 30400.
- c) Pipes and appurtenances: SECTION 40100
- d) Valves: SECTION 40505
- e) Electrical works: SECTION 45000

40609.3 Design Submittals

- a) Detailed Design:

The Contractor shall prepare and submit to the Engineer all necessary detailed design information in support of his proposed plant such that the Engineer can review it. This information shall include:

- Site plans
- Plot layout plans
- Plant layout and profile sheets
- Flow schematics
- Hydraulic profile
- Piping and instrumentation diagrams
- Control building including laboratory and chemical store house
- Structural and civil works calculation and drawings
- Foundation design drawings

- Material and equipment list
- Piping and valve schedules
- Electrical power and control systems
- Instrumentation diagrams

b) Execution Program:

The Contractor shall submit an execution program covering the entire period from survey to handing over the plant to the Employer.

It shall start from a topographic and geo-technical survey of the plant site, design and calculation, and proceed to manufacture, shipment, field erection and construction, testing and commissioning in a sequential and inter-related way showing any salient events such as approval by the Engineer on design and shop drawings, delivery to the site, substantial completion and testing.

In addition to the above, a statement of erection and construction methods shall be submitted to the Engineer indicating construction and erection methods, man-power scheme, temporary facility, safety precaution, specialist instructors from the manufacturer, testing and commissioning procedure.

40609.4 Design Criteria

- a) The plants shall have a daily treatment capacity on a continuous 24 hours operation basis as shown in Table 40609-1.

Table 40609-1: Daily Treatment Capacity for Wastewater Treatment Plants.

Facility	Daily Treatment Capacity
Nº 1	40 cubic meters/day
Nº 2	6 cubic meters/day

- b) The influent quality for both plants shall be considered to be domestic type wastewater, 240 mg/l BOD5
- c) The effluent quality obtained shall be in compliance with the Salvadoran environmental protection norms.
- d) The location of each plant is as shown in the Drawings.
- e) The overall service life of the wastewater treatment plants shall not be less than 20 years during which replacement of major parts or components of the plant shall not occur. There shall be no interruption of operation lasting continuously for longer than 12 hours for repair services. The Contractor shall submit a list of major components of the plant stating the service life span of each to the Engineer for approval. The list shall be accompanied with a written guarantee of the manufacturer of the plant to the effect that any damage during the said service life period will be remedied at the manufacturer's costs.

40609.5 Treatment System

The treatment shall be "Activated Sludge" system, in the modality of "Expanded Aeration".

The Process shall consist of the following four Phases:

- a) Preliminary Treatment, which shall consist in the removal of coarse material.
- b) Biological Treatment for the removal of diluted organic pollutants and fine particles (Activated Sludge).
- c) Disinfections
- d) Biological treatment for the stabilization and adequate disposal of sludge (Sludge Digestion).

40609.6 Treatment Process

- a) Preliminary Treatment: raw wastewater from buildings runs through a filtering screen contained in a tank in order to retain coarse materials.
- b) Biological Treatment (Activated Sludge): shall consist in two processes: aeration process and settlement process.
 - The Aeration Process: the wastewater coming from the preliminary treatment is conducted into the Aeration Tank. In this tank the wastewater is injected with air through fine bubble diffusers in order to create the suitable environment for bacteria to degrade the organic pollutant matter.
 - Settlement Process: After the aeration process the treated sludge-water mixture is conducted to a Settlement or Clarification Tank. In this tank the water and the activated sludge are separated. This separation is achieved by the sludge settlement by gravity to the bottom of the tank. In order to maintain an adequate balance of sludge in the system a portion of the sludge must be recycled into the aeration tank. The surplus sludge, which does not reenter into the system, must be withdrawn periodically to avoid an excessive accumulation. The surplus sludge is conducted into a digester tank where its stabilization is reassumed to reduce its volume and to facilitate its later disposal.
- c) Disinfections:

The clarified and treated water coming from a decanter is conducted into a Chlorination Tank. In this tank pathological bacteria are destroyed.
- d) Sludge Digestion:

The surplus sludge from the aeration tank are conducted into a sludge digestion tank or Sludge Digester. In this tank the sludge is injected with air by coarse bubble diffusers. Through this aeration process the sludge becomes thicker and continues to degrade. Every certain time the degraded or stabilized sludge must be removed from the digester based on a sludge dwelling time calculus. The stabilized sludge is odorless and is suitable for disposing into sun drying beds.

40609.7 Design Requirements for Tanks

- a) Preliminary Treatment Tank:
Shall be reinforced concrete made. Screen shall be steel and shall be installed at a 60° angle.
- b) Aeration Tank: shall be Reinforced Concrete.
Dimensions of tank shall be designed based on the influent daily volume, the hydraulic retention time and the required sludge dwelling time. Diffusers shall be fine bubble.
- c) Clarification or Settlement Tank:
Shall be hopper shape and reinforced concrete made.
- d) Sludge Digester:
Shall be reinforced concrete and shall be sized based on the excess sludge volume. For both plants a 4.5 kg per day of excess sludge volume is estimated. Diffusers shall be coarse bubble.
- e) Chlorination Tank:
Shall be reinforced concrete. Installation of chlorine dosing shall consist of a chlorine make-up tank and feeding facilities in addition of the chlorine solution retention tank.
- f) Sun Drying Beds: shall be reinforced concrete.
The drying beds shall be designed to enable treatment of maximum daily generation of sludge, which is estimated to be 0.6 cubic meters, into a reasonable de-hydrated film over the surface of gravel in the bed. It shall be partitioned into several bays to enable alternate use.

40609.8 Equipment

- a) Aeration Equipment
The aeration equipment or blower shall be designed to infuse air (oxygen) into the liquid and concurrently give an impetus to circulate it around the ditch in a proper velocity.
The blower shall be capable of mixing the liquid in upward direction and simultaneously diffusing the stirred liquid outwardly to dispense air into the liquid, accomplishing liquid mixing, air dispensing into the liquid and circulation of waste liquid through the oxidation ditch all simultaneously.
The blower shall be rated for a sudden overload of 3 times the design influent volume.
Operation of the blower shall be of both automatic and manual operation, former being performed by a timer or on dissolved oxygen gauge.
- b) Movable Outlet Gate from Aeration Tank
The movable gate shall be designed to control the liquid level in the Aeration Tank as required to maintain suitable digestion of organic substance in the ditch.

The gate shall be constituted of gate leaf, spindle and moving gear, manually operated and shall move along guide tracks.

The gate leaf shall be designed to withstand a hydraulic pressure occurring at the highest liquid level on the tank side and no liquid on the outlet side within a deflection of 1/1,500 at its center, made of cast iron in a thickness of not less than 20 mm. A corrosion factor of 5 mm shall be added to the thickness of the leaf on both faces. It shall be equipped with a triangular weir made of stainless steel to measure flow rate.

c) Change-over Gate

The change-over gate shall be designed to divert the effluent liquid from the Aeration Tank to other places than the settling tank for such occasion as maintenance of the latter. It shall be installed in the liquid transfer pit connecting both tanks.

d) Movable Scum Disposal Gate

The movable scum disposal gate shall be designed to evacuate accumulated scum over the liquid surface to be installed near the air diffusers. The gate shall be consisted of gate leaf, spindle and moving gear.

e) Sludge Return Pump

The sludge return pump shall be designed to return sludge from the settling tank to the Aeration Tank as required when sludge concentration there gets insufficient.

The pump shall be of sewage pump equipped with a suction screw and driven by V-belt and pulley. It shall be capable of handling sewage having a sludge concentration of as high as 99 % without causing clogging or overload to its motor. It shall also have characteristics of stable delivery against fluctuation of liquid head.

f) Surplus Sludge Pump

The surplus sludge pump shall be designed to transfer settled sludge on the settling tank bottom to the sludge Digester Tank.

The pump shall be of single shaft screw sewage pump driven by V-belt and pulley. It shall be capable of handling sewage having a sludge concentration of as high as 99 % without causing clogging or overload to its motor.

g) Sump Pump

The sump pump shall be designed to evacuate soil water from sump pits.

The pump shall be of submersible sewage pump, which is capable of handling solid substance in the sewage as large as 70 % of nominal pump size. It shall be capable of shut-off operation.

The pump shall be fitted with a thermal switch to detect thermal overload.

h) Chemical Pump

Recommended type of chemical pump is a manual stroke control diaphragm pump with pressure relief mechanism. The Contractor shall select anti-corrosive materials against attacks by the chemicals used and provide necessary piping system such as a back pressure valve.

40609.9 Wastewater Pump Pit

a) General:

Wastewater Pump Pit shall be reinforced concrete and shall be sized based in the pumps to be installed in it and in the hydraulic profile required for the system to perform adequately.

The Wastewater Pump Pit shall be furnished complete with pumps, pipes, valves and all appurtenances required to lift the wastewater from the pipeline outlet level to the plants' required inlet level. The pipeline outlet level for each plant is shown in Table 40609-2.

b) Submersible Sewage Pumps:

Two submersible pumps shall be provided. One pump shall works at a time; the other one shall stand by. In the event of failure of the duty pump, or level of sewage goes above the high water level, provision shall be made for the standby pump to be put in operation immediately.

Float control unit with cables and accessories of bulb type of which casing is made of polypropylene and cables of sheathed PVC shall be provided for automatic start and stop depending on the waste water levels.

The pumps shall be suitable for wet well installation with guides and discharge connection to facilitate easy connection of the pumps to the discharge lines in the sump. This connection shall be designed in such a way that it permits the removal of the pump by means of a chain. The lifting chain or lifting belt shall be of galvanized steel.

**Table 40609-2: Level of Outlet of Wastewater Pipelines into
Wastewater Pump Pits**

Pit	Location	Pipeline Outlet (Pit Inlet) Level
P1	Wastewater Treatment Facility Nº 1	2.612 m
P2	Wastewater Treatment Facility Nº 2	4.607 m

40609.10 Service House

a) The Service House shall be designed considering that it shall house the following:

- Blowers and appurtenances.
- Control Panel.
- Chemical Storage
- Safety facility: an emergency shower and eyewash.

b) This building shall be of permanent substantial construction. Structural, Architectural and Electrical design shall provide safe and efficient operation by the Employer's personnel. Appropriate natural ventilation shall be

provided. Adequate electrical illumination and power shall be provided.

40609.11 Exterior Works

The Contractor shall design and construct all exterior works necessary for the correct functioning of the plant:

- a) Access works: sidewalks, driveways, stairs or ramps.
- b) Protection works: retention walls, slopes or any other terrain's protection works needed for the stability of the tanks and building.
- c) Fence and gate: each facility shall be provided with a perimeter fence and gate as shown in the drawings.
- d) Exterior Lighting: the plants sites shall be furnished exterior lighting to provide safe working luminance for night operation of the plant. It shall be designed as a part of the electrical power and control system for the plants.
- e) Landscaping: non-paved areas shall be covered with lawn.

40609.12 Control System and Electrical Requirements

- a) A logical programmer shall control the functioning of the System, including the Wastewater Pump Station. This control logical programmer shall be monitored in the Motor Control Center. The Motor Control Center shall display the following:
 - Accumulated operation time for each blower and pump
 - Equipment alternation.
 - Maintenance time
 - Failure signals for each motor and pump
 - General alarm (Sound and visual)
 - Emergency surge
 - Parameters of the timing devices and meters
 - Dry-running protection indicator for pumps
 - Manual-auto switch and start/stop buttons for each equipment
 - Pressure gauges for Pumps
- b) The Control Logical Programmer shall control the operation of the blowers considering the variations of flow during the day. During the periods of high flow both blowers might operate simultaneously, most of the time only one blower shall operate and the other one shall be in stand-by.
- c) All motors shall have manual/off/auto selectors, in the auto mode the Control Logical Programmer shall take over their operation.
- d) The Control system shall be full protected with low tension lightning arrestor, and shall be provided with voltage sensor for lows and highs, and meters for amperage and voltage.
- e) The Control System shall be installed in the Service House of each plant and shall include exterior and indoor illumination.

- f) Signal converters, signal boosters, amplifiers, special power supply, cables, grounding and isolation requirements shall be furnished and installed as necessary for proper performance of the equipment.

40609.13 Commissioning and Maintenance

- a) The Contractor shall design and submit to the Employer an Operation Manual and a Maintenance and Repair Manual for each Wastewater Treatment Plant.
- b) Spare Parts: The Contractor shall provide required spare parts for each wastewater treatment plant as specified in Section 11000.
- c) Maintenance and Repair Services: the contractor shall execute regular and routine maintenance and repair services on the wastewater treatment plants throughout the Defects Liability Period in accordance with the requirements of the Contract and in accordance with the recommendations consigned in the Maintenance and Repair Manual.
- d) The Contractor after compliance of the works will be required to train the Employer's personnel in the operation and maintenance of each wastewater treatment plant.

SECTION 40700 FUEL STATION

40701 Scope of General

This work shall consist of furnishing of all the design, equipment, material, labor and supervising, and testing and commissioning complying with the following works as specified herein.

- a) Above ground type diesel fuel storage tank
- b) Fuel pump
- c) Canopy
- d) Lighting system
- e) Concrete foundation
- f) Barrier to protect damage of fuel station
- g) Accessories as required to complete fuel station

40702 Contractor Design

40702.1 General

The Fuel Station described on this specification is guide line and indicate the minimum requirements for achieving the desired performance.

In order to develop these requirements into comprehensive systems the Contractor shall provide the followings and approved by the Engineer:

- a) Development the design and submit fully detailed shop drawings all aspects of the system
- b) Submit full details of all materials and equipment to be used.
- c) Provide all other necessary information

The submission shall supplement the information contained in the Specification and subject to the Engineer's approval ensure that overall design criteria, intent and cost parameters are being adhered to.

In all aspect of this work the responsibility will rest with the Contractor whether or not the details are provided by his subcontractor.

In addition, the Contractor in the execution of the Works, shall supply and install all auxiliary materials and equipment incidental to the work to ensure complete, functioning installations and systems.

40703 Diesel Oil Fuel Storage Tank

40703.1 Aboveground Tank

Tank shall be of horizontal type of approximately 1,630 mm diameter length, and approximately 5,490 mm long. Tank capacity shall be of 11,355 liters constructed with double wall stainless steel iron of 4.8 mm of thickness in according with normal ASTM A-36.

Manhole of 600 mm diameter shall be provided on the upper part of fuel tank for inspection. For proper operation of fuel storage tank shall be provided with accessories, such as ventilation, inspection, drainage and supply and suction outlets.

Prepared of the metallic surfaces for sandblasting tank shall be painted as follows:

- a) Bases Painting shall be covered with dull finish of two (2) times of

anticorrosive urethane coating at 200°C by hands.

- b) Finish Painting shall be covered with dull finish of one (1) time urethane resistant at 200°C of 1 hand.
- c) The painting shall be resistant to the abrasion and climatic conditions of Cutuco site.

Foundation for fuel tank and pump system shall be designed by the Contractor and approved by the Engineer.

Area lighting System shall be included in this works.

**40704
Fuel Pump
System**

40704.1 Fuel Pump General

Fuel pump shall be of self-contained of single product use for diesel oil fuel.

Standard high capacity self-contained dispensers shall be equipped with heavy duty pumping unit and continuous duty motor with 25 mm hose. Each outlet shall be able to deliver an average of 75-84 liters per minute.

40704.2 Construction

Fuel pump construction shall be of heavy gauge steel with rust resistant bonderized undercoat and acrylic finish.

40704.3 Housing

Upper side panels shall be of textured stainless steel. Lower side panels, doors and dial face cover shall have a stainless steel.

40704.4 Lighted Panels

Illuminated upper panels at top of door assembly shall be of approximately 85 mm x 650 mm, and equipped with two 20 watt-600 mm fluorescent tubes. Ballast shall be of 115 V AC., 60 Hz, in accordance with USA standard.

40704.5 Register

Four wheels with tantalizer, interlock and automatic reset records shall be of individual deliveries to 999.9 liters. Tantalizer records shall be of 999,999.9 liters.

40704.6 Motor

Motor shall be operated with 60 Cycle, 115/230 V, single phase. Motors shall be of heavy duty type, and acceptable for hazardous locations, Class 1, Group D.

40704.7 Meter

The SB100 Meter design features positive displacement, patented rotary valves which greatly reduce pressure drop and allows higher flow rates. The "cup seal" pistons are composed of materials with long-life, long-wear characteristics. Accuracy flow rate is $\pm 3\%$ from 1.3 to 27 GPM (5-100LPM). Cylinder cover adjustment device provides easy field calibration.

40704.8 Strainer

100 mesh nylon strainer with easily removed for cleaning shall be provided.

40704.9 Pumping Unit

Rotary vane pump shall be provided with by-pass valve, control/pressure relief valve and Teflon lip seal on the rotor shaft.

40704.10 Hose Outlet

25 mm hose outlet with nozzle of 16 mm or 19 mm hose shall be equipped.

40704.11 Hose Retractor

Automatic spring tension reel type shall be provided with nylon cable and rotating type hose clamp.