SECTION 8200 VALVES

8201 General

(1) General

- All Sub-Sections under Section 8000 General Technical Specification shall be applied to this section.
- This Section covers the technical specification of the following valves and related equipment, which are installed in the El Salaam No. 7 Pumping Station.

(2) Scope of Works

- Four- (4) 1500-mm diameter, cylinder/counterweight operated bi-plane type butterfly valves.
- One - (1) valve operating systems with all controls and appurtenances.
- Four- (4) 1500 mm diameter, motor operated bi-plane type butterfly valves.
- Three - (3) 2400 mm diameter, motor operated bi-plane type butterfly valves.

The Contractor shall execute all works including the design, manufacture, tests, transport to the site, installation and site tests.

The Contractor shall assume full responsibility for coordinated and adequate design of all equipment and shall exchange with Equipment suppliers furnishing associated equipment or the installation contractor, all necessary drawings and other information required to ensure the satisfactory completion of the equipment as a whole.

8202 Welding

All Sub-Sections in Section 8000 for welding shall be applied. The weldment made of carbon steel used to fabricate valves shall be stress relieved.

8203 Equipment Requirements

(1) General

The discharge valve shall be provided in the discharge pipes just after the pumps for the purpose of stopping water, reverse flow prevention and water hammer prevention but are not intend to control the flow rate. The discharge valves are joints operated by pumps operating on unit number control methods.

The isolating valves shall provide to shut off the water flow to isolate the pump during maintenance periods and positioned at downstream side of the discharge valves. The pipeline valves shall provide to shut off the water flow for the maintenance and the inspection of the piping system and positioned in the valve chamber apart from the pumping station.

The Contractor shall confirm the maximum pressure by the transient phenomena of the pumping system, which will occur by water hammer in the pipeline. And based on the analysis the performance of the pump offered by the Contractor and shall reflect to valve design with regard requirement of specified flange rating nominal pressure (PN) described in the Clause (3) of this Section.

(2) Performance

(a) Discharge Valve

The discharge valve shall be bi-plane type butterfly valve and shall be normally open by the hydraulic cylinder and closed by the counterweight in time of approx. 120 second. When the pump is accidentally stopped, such as a power failure, and back flow starts, the discharge valve is first closed to prevent most water from reverse flow then slowly closed by the hydraulic cylinder (acting as a dash pot) while releasing some of the water. The hydraulic cylinder (acting as a dashpot) controls the closing time of the valve after the optimum time has been determined on the analyzing by the transients of the water hammer according to pipeline conditions.

(b) Isolating valve

The isolating valve shall be a motor operated bi-plane type butterfly valve. Spare parts shall be interchangeable with the discharge valve spares.

(c) Pipeline Valve

The pipeline valves shall be a motor operated bi-plane type butterfly valve. The structural design of the pipeline valve shall be the same as for the isolating valve.

(3) Design and Construction

(a) General

The basic materials and construction methods shall be in the Section 8000. The materials chosen for the different parts of the equipment shall be suitable for quality of water as shown in the chemical analysis given by the Engineer. Equivalent materials according to other specifications or better can be accepted if the contractor shows clearly its chemical analysis and it's mechanical properties.

(b) Discharge Valve

(i) Description

The discharge valve shall be used for the shut-off of the water flow as well as to prevent back flow into the main pump in the event that the main pump shuts down for any reason. The upstream side of the valve body will be directly flanged and bolted to the pump casing extension. The downstream side of the valve body will be linked to the short conduit provided a dismantling sleeve coupling.

(ii) Operating Conditions

The control of the Discharge valve will be fully integrated into the automatic operation sequence of the pump units. The valves shall be equipped with an oil hydraulic unit and each valve control panel for independent local control. All operating valves, instruments, gauges and control devices shall be arranged in this unit and panels.

The closing and opening times of the discharge valves shall be independently adjustable. This adjustment capability shall be of a form that cannot readily or inadvertently be altered. The opening and closing times shall be the minimum, consistent with safe operation and with due consideration to the results of the water hammer analysis, to avoid excessive pressure and water column separation.

The valves shall be operated in the opening direction by the hydraulic cylinder. In the closing direction, operation shall be by counterweights and if necessary, by the disc's hydraulic self-closing tendency with the closing cylinders acting as brakes. The oil pressure shall be supplied from an oil hydraulic unit with the interconnection to the neighboring valves through the individual valve control panel. Schematic diagram is shown on the drawing.

In case of power failure the valve shall be closed safely. It shall be possible to open the valve by means of a manual oil pump.

(iii) Technical data

- Number of valves : 4
- Nominal diameter : DN 1500
- Nominal pressure : 14 bars max.
- Type of valve : Bi-plane type
- Flange rating : PN 16
- Flange regulation : ISO 2531, ISO 7005 or equivalent (See Note-2)
- Laying distance : 700 mm
- Accessory of operator

  Number of limit switch : open and close

Note-1: The Contractor shall confirm pressure based on water hammer analysis.

Note-2: The Contractor shall propose the flange regulation.

(iv) Construction

The bi-plane type butterfly valve, with a nominal diameter of 1500 mm, shall be single eccentric type for high head and suitability for an operating system using hydraulic oil. Valve size, maximum unbalanced pressure expected at the discharge valve, and the time for opening or closing the discharge valve shall be suitable to operate under the most severe normal and abnormal operating conditions including emergency shut down for water hammer protection.

1) Valve Body

The valve body shall be designed to withstand the maximum occurring combined

forces of operating the cylinder or counterweight, pump suction head, pump shut off head, and the bulkhead load imposed by the full discharge of the pipe line. The valve body shall be provided with a structurally adequate base and mating sole plate, which will be embedded in a concrete pier.

The valve body shall be of welded plate steel, cast steel, or spheroidal graphite iron casting (ISO 1083 450-10).

The valve body shall be with integrally flanges to conform in dimension and drilling to ISO 2531 PN16 rating flange on the inlet and outlet sides and supporting feet and lifting lugs. The body seat shall be stainless steel : ISO TR 15510 L-No.6 or equivalent and be mechanically attached or welded to the valve body.

The valve body shall be provided with a structurally adequate base and mating sole plate, which will be supported by a concrete pier. Provisions shall be made to allow sufficient movement between base and sole plate to prevent the forces imposed or by full pump shutoff pressure against a closed valve from damaging equipment or the concrete pier.

Casting shall be repaired only if permitted by the applicable material specification. Defects in cast iron parts shall not repaired by welding. No repair of defects by peening or impregnation shall be permitted for any castings of steel or iron.

2) Valve Shaft

The valve shaft shall be made of stainless steel ISO TR 15510 L-No.48, carbon steel forging ISO 9327 or equivalent and be of sufficient size to transmit the forces imposed on the shaft by the disc and the operator without distortion or undue stress. The valve shaft shall be of the stub shaft type, which comprises two separate shafts inserted into the valve disc hubs or with the flange to attach the valve disc by mean of bolts designed to provide a shake-proof connection without impairing shaft strength. If of stub shaft construction each stub shaft shall be inserted into the valve disc hubs for a distance of not less than 1-1/2 shaft diameters and be securely attached to the valve disc by mean of keys, dowel pins, taper pins, or any combination of the three.

3) Valve Disc

The valve disc shall be of welded plate steel, cast steel, or spheroidal graphite iron casting: ISO 1083 450-10 and be designed to sustain full differential pressures across a closed valve disc without exceeding allowable stress of the material used.

4) Valve Seat

The valve seat shall be of a design that permits removal, replacement and adjustment without removing the valve from the discharge line. The valve seat shall provide tight shut off with a full pipeline pressure of 9.1 bar maximum, on the downstream face of the valve, and 0 bar on the upstream face of the valve.

Synthetic rubber sheets shall be clamped to the disc and be mechanically held in place by the metal retainer. Valve seats, which are bonded by the epoxy in place or rubber seats inflated from behind by epoxy, without metal retainer is not acceptable. The mating seat surface shall be 18-8 stainless steel.

All clamps and retaining rings to be used shall be 18-8 stainless steel. All nuts and screws used with clamps and retaining rings shall also be of 18-8 stainless steel.

5) Stuffing Box

The stuffing box shall be of the material as same as the valve body and shall be furnished with stainless steel glands, adjustable stainless steel shims and suitable hydraulic packing. Suitable clearances shall be provided so that the packing can be adjusted or replaced without disturbing any part of the valve or hydraulic operator except gland and gland follower.

6) Bearings

The valve shall be fitted with sleeve type, self-lubricating bearings in the hubs of the valve body. The inside bearing support shall be designed to allow ready access to the stuffing box. Either two thrust bearings or a two-way thrust bearing shall be provided to insure disc centering.

7) Hydraulic Cylinder

The hydraulic cylinder shall act as an oil dashpot when closing, and shall allow opening of the discharge valve with sufficient torque capability to unseat the valve disc at the maximum pressure difference between upstream and downstream side. The throttling device used for controlling the closing time shall be directly connected to the hydraulic cylinder bottom, preventing the discharge valve from rapid closing when the hydraulic pipeline brakes.

8) Lever Arm

The lever arm shall be of welded steel plate or cast steel design, keyed to the valve shaft during assembly. The lever arm shall be provided with a mechanical lock in the closed and open position preventing unintended valve operation during maintenance and/or inspection of the valve. However, alternatively an oil hydraulic locking device might also be provided.

The cast iron or steel plate counterweights for safe closing of the valve under all conditions of operation and emergency shall be securely fixed to the lever arm. The lever arm shall contain a disc showing in large-scale figures the position of the valve (valve completely open = 90 degree). The lever arm shall contain adjustable cams for the limit switches as follows.

- 0 degree = discharge valve in closed position
- 90 degree = discharge valve in open position

(iii) Discharge Valve Control

A schematic diagram of the hydraulic portion of the valve-operating system is shown on the drawing. The oil hydraulic unit shall be provided complete with two motor operated oil pumps, a hand oil pump, an oil reservoir, a single oil-level switch, an armored gauge glass with valves, a pressure relief valve, and all the necessary connecting piping and wiring completely assembled as a unit. The electrical facilities incorporated in the unit shall be designed based on 380 V AC, 3 phase, 50 Hz for motors and 220V AC, 1 Phase for control. The pressure oil supply system shall preferably be accommodated in one oil hydraulic unit adjacent to each valve consisting of

- An oil reservoir
- Two oil pumping units, one of them selectively being the standby unit
- One hand-operated piston oil pump
- One pressure relief valve
- One oil level switch
- Connecting piping between the oil hydraulic unit and the local-control panel
- Internal electrical wiring of the oil hydraulic unit. Including terminal box for all external electrical connections

(iv) Discharge Valve Operating System

The local operation panel shall consist of the following equipment or devices.

- Cabinet: Free standing and semi-enclosed type cabinet, made of steel plate
- Operation switches: Push buttons, selector switch
- Indicating lamps
- Cable terminal blocks
- Three solenoid valves,
- Flow control valve
- Accumulator
- Pressure switch
- Discharge pressure gauge
- All necessary connecting piping and wiring completely assembled.

The electrical facilities incorporated in the unit shall be designed based on 220 V AC 1 phase for control. The control equipment shall preferably be accommodated in individual valve control panel adjacent to each valve consisting of one accumulator. All necessary control instruments such as a pressure switch and three solenoid valves, connecting piping between the valve and the local-control panel and internal electrical wiring of the control panel, including terminal boxes for all external electrical connections.

(c) Isolating Valve

(i) Description

The isolating valve shall be used for the maintenance shutoff service. The downstream side of the valve shall be directly flanged and bolted to the pipeline. The upstream side of the valve shall be linked to a fitting piece provided with a dismantling sleeve coupling.

(ii) Technical Data

- Number of valves	: 4
- Nominal diameter	: DN 1500
- Nominal pressure	: 14 bars max.
-Type of valve	: Bi-plane type
- Operator of valve	: Motor operated type
- Operating time	: Approx. 120 sec.
- Flange rating	: PN 16
- Flange regulation	: ISO 2531, ISO 7005 or equivalent (See Note-2)
- Laying distance	: 700 mm
- Electric source	: For power, 380 VAC, 3-phases, 50 Hz
	: For control, 220 VAC 1-phases, 50 Hz
- Accessory of operator	: Number of limit switch: open and close

Note-1: The Contractor shall confirm pressure based on water hammer analysis.

Note-2: The Contractor shall propose the flange regulation.

(iii) Construction

The motor operated bi-plane type butterfly valve, with a nominal diameter of 1500 mm, shall be single eccentric type for maintenance shut off service and positioned at downstream side of the discharge valve. And spare parts shall be interchangeable with the discharge valve spares. Valve size, maximum unbalanced pressure expected at the isolating valve, and the time for opening or closing the Isolating valve shall be suitable to operate under the most severe normal and abnormal operating conditions.

1) Valve Body

The valve body shall be of welded plate steel, cast steel, or spheroidal graphite iron casting: ISO 1083 450-10 and be designed to withstand the maximum occurring combined forces of pump shut off head, pump suction head, and the maximum head imposed by the discharge header. The valve body shall be with integrally flanges to conform in dimension and drilling to ISO 2531 PN 16 rating flange on the inlet and outlet sides and supporting feet and lifting lugs. The body seat shall be stainless steel : ISO TR 15510 L-No.6 or equivalent and be mechanically attached or welded to the valve body.

The valve body shall be provided with a structurally adequate base and mating sole plate, which will be supported by a concrete pier. Provisions shall be made to allow sufficient movement between base and sole plate to prevent the forces imposed or by full pump shutoff pressure against a closed valve from damaging equipment or the concrete pier. Casting shall be repaired only if permitted by the applicable material specification. Defects in cast iron parts shall not repaired by welding. No repair of defects by peening or impregnation shall be permitted for any castings of steel or iron.

2) Valve Shaft

The valve shaft shall be made of stainless steel ISO TR 15510 L-No.48, carbon steel

forging ISO 9327 or equivalent and be of sufficient size to transmit the forces imposed on the shaft by the disc and the operator without distortion or undue stress. The valve shaft shall be of the stub shaft type, which comprises two separate shafts inserted into the valve disc hubs or with flange to attach the valve disc by mean of bolts designed to provide a shake-proof connection without impairing shaft strength. If of stub shaft construction each stub shaft shall be inserted into the valve disc hubs for a distance of not less than 1-1/2 shaft diameters and be securely attached to the valve disc by mean of keys, dowel pins, taper pins, or any combination of the three.

3) Valve Disc

The valve disc shall be of welded plate steel, cast steel, or spheroidal graphite iron casting (ISO 1083 450-10) and be designed to sustain full differential pressures across a closed valve disc without exceeding allowable stress of the material used.

4) Valve Seat

The valve seat shall be of a design that permits removal, replacement and adjustment without removing the valve from the discharge line. The valve seat shall provide tight shut off with a full pipeline pressure of 9.1 bar maximum, on the downstream face of the valve, and 0 bar on the upstream face of the valve. Synthetic rubber sheets shall be clamped to the disc and be mechanically held in place by metal retainer. Valve seats, which are bonded by the epoxy in place or rubber seats inflated from behind by epoxy, without metal retainer is not acceptable. The mating seat surface shall be 18-8 stainless steel. All clamps and retaining rings to be used shall be 18-8 stainless steel. All nuts and screws used with clamps and retaining rings shall also be of 18-8 stainless steel.

5) Stuffing Box

The stuffing box shall be of the material as same as the valve body and shall be furnished with stainless steel glands, adjustable stainless steel shims and suitable hydraulic packing. Suitable clearances shall be provided so that the packing can be adjusted or replaced without disturbing any part of the valve or the operator except gland and gland follower.

6) Bearings

The valve shall be fitted with sleeve type, self-lubricating bearings in the hubs of the valve body. The inside bearing support shall be designed to allow ready access to the stuffing box. Either two thrust bearings or a two-way thrust bearing shall be provided to insure disc centering. Disc centering mechanism.

7) Operator

The rated torque capability of the operator shall be sufficient to seat, unseat and hold the valve disc rigidly in any intermediate position under any operating condition. The operator shall be compatible with the operation method of the valve itself. The operator shall be designed to hold the valve in any position between fully open and fully closed without movement. The operator shall be provided with the control

station including the lamps and the push bottoms. The operator stand shall be of cast iron or welded plate steel.

(d) Pipeline Valves

(i) Description

The motor operated bi-plane type butterfly valve, with a nominal diameter of 2400 mm, shall be single eccentric type for maintenance shut off service and positioned at the valve chamber apart from the pumping station.

(ii) Technical data

- Number of valves	: 3
- Nominal diameter	: DN 2400
- Nominal pressure	: 14 bars max.
- Type of valve	: Bi-plane type
- Operator of valve	: Motor operated type
- Operating time	: Approx. 120 sec.
- Flange rating	: PN 16
- Flange regulation	: ISO 2531, ISO 7005 or equivalent (See Note-2)
- Laying distance	: 800 mm
- Electric source	: For power, 380 VAC, 3-phases, 50 Hz
	: For control, 220 VAC, 1-phases, 50 Hz
- Accessory of operator	: Number of limit switch: Open and close

Note-1: The Contractor shall confirm pressure based on water hammer analysis.

Note-2: The Contractor shall propose the flange regulation.

(iii) Construction

The construction of the Pipeline valve shall be same as the Isolating valve.

1) Valve Body

The valve body shall be of welded plate steel, cast steel, or spheroidal graphite iron casting (ISO 1083 450-10) and be designed to withstand the bulkhead load 8.4 bar imposed by the full pipeline and 0 bar at upstream side and or the maximum pressure in the discharge header due to water hammer at upstream side and 0 bar at downstream side.

The valve body shall be with integrally flanges to conform in dimension and drilling to ISO 2531 PN16 rating flange on the inlet and outlet sides and supporting feet and lifting lugs. The body seat shall be stainless steel : ISO TR 15510 L-No.6 or equivalent and be mechanically attached or welded to the valve body. The valve body shall be provided with a structurally adequate base and mating sole plate, which will be supported by a concrete pier. Provisions shall be made to allow sufficient movement between base and sole plate to prevent the forces imposed or by full pump shutoff pressure against a closed valve from damaging equipment or the concrete pier. Casting shall be repaired only if permitted by the applicable material specification. Defects in cast iron parts shall not repaired by welding. No repair of defects by

peening or impregnation shall be permitted for any castings of steel or iron.

2) Valve Shaft

The valve shaft shall be made of stainless steel ISO TR 15510 L-No.48 carbon steel forging ISO 9327 or equivalent and be of sufficient size to transmit the forces imposed on the shaft by the disc and the operator without distortion or undue stress. The valve shaft shall be of the stub shaft type, which comprises two separate shafts inserted into the valve disc hubs or with flange to attach the valve disc by mean of bolts designed to provide a shake-proof connection without impairing shaft strength. If of stub shaft construction each stub shaft shall be inserted into the valve disc hubs for a distance of not less than 1-1/2 shaft diameters and be securely attached to the valve disc by mean of keys, dowel pins, taper pins, or any combination of the three.

3) Valve Disc

The valve disc shall be of welded plate steel, cast steel, or spheroidal graphite iron casting, ISO 1083 450-10 and be designed to sustain full differential pressures across a closed valve disc without exceeding allowable stress of the material used. The valve disc shall have enough rigidity to keep minimum leakage not exceed capacity of 400 mm dia. drain/fill pipe when downstream side pipeline has de-watered for maintenance.

4) Valve Seat

The valve seat shall be of a design that permits removal, replacement and adjustment without removing the valve from the pipeline. The valve seat shall provide tight shut off with a full pipeline bulkhead load of 8.4 bar on the downstream face of the valve and 0 bar on the upstream face of the valve. Synthetic rubber sheets shall be clamped to the disc and be mechanically held in place by metal retainer valve seats, which are bonded by the epoxy in place or rubber seats inflated from behind by epoxy, without metal retainer is not acceptable. The mating seat surface shall be 18-8 stainless steel. All clamps and retaining rings to be used shall be 18-8 stainless steel. All nuts and screws used with clamps and retaining rings shall also be of 18-8 stainless steel.

5) Stuffing Box

The stuffing box shall be of the material as same as the valve body and shall be furnished with stainless steel glands, adjustable stainless steel shims and suitable hydraulic packing. Suitable clearances shall be provided so that the packing can be adjusted or replaced without disturbing any part of the valve or the operator except gland and gland follower.

6) Bearings

The valve shall be fitted with sleeve type, self-lubricating bearings in the hubs of the valve body. The inside bearing support shall be designed to allow ready access to the stuffing box. Either two thrust bearings or a two-way thrust bearing shall be provided to insure disc centering.

7) Operator

The rated torque capability of the operator shall be sufficient to seat, unseat and hold the valve disc rigidly in any intermediate position under any operating condition. The operator shall be compatible with the operation method of the valve itself. The operator shall be designed to hold the valve in any position between fully open and fully closed without movement. The operator shall be provided with the control station including the lamps and the push bottoms. The operator stand shall be of cast iron or welded plate steel.

8204 Tests

(1) Factory Tests

The following shop tests shall be executed under the presence of the Engineer.

(a) Shop assembly

All parts within the scope of supply shall generally be assembled at the Contractor's plant to the extent necessary for inspection, testing and otherwise ensuring satisfactory function.

(i) Discharge Valves

- Complete assembly of the valve with the operating mechanism
- Complete assembly of the oil hydraulic unit
- Complete assembly of the local-control panel
- Assembly of the temporary connecting oil-piping between the valve operator, the local-control panel, and the oil hydraulic unit

(ii) Isolating Valves and Pipe line Valves

- Complete assembly of the valve with the operator

(b) Functional test

- Functional test of the valve demonstrating the opening and closing movements as well as sealing application of the disc
- Hydraulic and electrical function test of the oil hydraulic unit and the local-control panels shall be carried out under the rated working pressure.

(c) Shop hydrostatic tests

Following tests shall be required:

- Hydrostatic pressure test of the completely assembled valve. 1.5 times of normal operating pressure shall be applied for at least 30 minutes.
- Seat leakage test on the bi-plane valve under the normal operating pressure shall be held for a period of 15 minutes.
- Pressure test of the oil cylinder with at least 1.5 times the nominal working pressure of the control system

(d) Paint inspection

After completion of coat specified, coated surface appearance and thickness of coated layer shall be inspected.

(2) Site Tests

The Engineer shall keep the power to perform inspections of the assembly during erection, which include a complete verification of all parts with regard to elevations, clearances, pertinent fits, alignments, and quality of workmanship. Unless otherwise specified, any rejection based on the inspection will be reported to the Contractor within ten days. Material that shows injurious defects subsequent to assembly and acceptance will be rejected and the Contractor will be notified.

The Contractor shall supervise and execute the following commissioning tests, as applicable to ensure that the equipment has been correctly installed and all necessary adjustments and settings have been made, and the equipment is in sound condition to operate.

(a) Preliminary Tests

- Pressure test of the control piping at 1.5 times the normal working pressure or as close to this pressure as practicable.
- Electrical checks for correct wiring and cabling of all local-control panels, the oil hydraulic unit, and the operators
- Testing and setting of all relays limit switches, etc.
- Measuring the insulation level of the electrical equipment with a megger
- Functioning test of the bi-plane valve control system, applying all possible closing and opening commands.

(b) Operation and Performance Tests

- Filling the pipeline with the bi-plane valve in the closed position.
- Tightness test of the valve seal with the filled pipeline
- Preliminary adjustment of the opening and closing time of the valve disc.
- Various executions of the opening and closing movements under dead water conditions in order to check for the correct functioning of the control system
- Definite adjustment of the various limit switches and verification of the correct functioning of the various instruments
- Any additional tests required by the Engineer to ensure the completeness and the safety of the equipment when operated.

After completion of the tests listed above, subsequent performance tests shall be carried out with the pump in operation:

- Closing the valve at 100 % of the maximum discharge, in order to prove the vibration-free and safe closings of the valve.

The closing time and the pertinent pressure rise shall be measured and registered. The details of the methods of measurement, the conditions and conduct of the tests at site, shall

be agreed upon between the Engineer and the Contractor. These details will be described in a separate document defining the sequence of the tests, the equipment preparation, and the operation procedure to be followed. After successful completion of all the commissioning tests the valves shall be subject to a trial operation period.

(3) Test Reports

The Contractor shall submit the all reports of the tests and the mill sheets as follows.

Mill Sheets:
- For casting: Valve body, Valve disc
- For steel plate: Valve body, Valve disc
- For stainless steel bar: Valve shaft

8205 Spare Parts

The Contractor shall state the necessary spare parts to be kept in stock valid for two years normal operation. All spare parts shall be interchangeable within all pump systems. The spare parts as described in below shall be included in the spare parts list.

(1) Cylinder/counter weight operated bi-plane type

Butterfly Valve (Diameter 1500 mm)	Quantity
- Valve seat (with set screws or bolts)	1
- Set of hydraulic packing for valve shaft	1
- Set of bearings	1
- Set of seals and gaskets for oil cylinder	1
- Set of flange gaskets (only special one)	1
- Set of limit switch for each type	1
- Oil pump with motor	1
- Set of solenoid valve for each type	1
- Flow control valve	1
- Pressure relieve valve	1
- Pressure switch	1
- Oil level switch	1

(2) Motor operated bi-plane type Butterfly Valve (Diameter 1500 mm)

- Valve seat (with set of screw or bolts)	1
- Set of hydraulic packing for valve shaft	1
- Set of bearings	1
- Set of flange gaskets (only special one)	1
- Set of limit switch for each type	1

(3) Motor operated bi-plane type Butterfly Valve
(Diameter 2400 mm)

- Valve seat (with set of screw or bolts) 1
- Set of hydraulic packing for valve shaft 1
- Set bearing 1
- Set of flange gaskets (only special one) 1
- Set of limit switch for each type 1

8206 Data, Descriptive Documents and Drawings

(1) Drawings and Data Submission

- General arrangement and cross-sectional assembly of the equipment, showing thereon the overall dimensions and limiting space requirements. Materials shall be identified with the corresponding code or serial numbers referring to the ISO standards or the Standards intended to apply.
- General information as to method of assembling, installation and other information as may be needed to show that the materials proposed meet requirements of these specifications.

(2) The Drawings for Manufacture

a. Within 180 days after notice of award, drawings showing overall dimensions of the principal parts such as the suction pipe pump casing, pit liner, and embedded parts.
b. Within 240 days after notice of award, all details of foundation requirements, proposed erection procedure, and details of all embedded parts so that design of second stage concrete can be confirmed.

8207 Instruction Manuals

a. The Contractor shall submit the operating and maintenance manuals for guidance of the erection and operating personnel. These manuals shall describe in detail the construction and recommended procedure for assembling, dismantling, maintaining and operating the equipment.
b. The Contractor shall submit four (4) copies to the Engineer for inspection and approval, at least three months before the first unit is to be commissioned.

8208 Measurement and Payment

Separate measurement or payment shall not be made for the work required under this section. Only when, all equipment or devices related to the valves have been installed, connected and completed it is accepted by the Engineer.

All costs in connection with the work specified herein will be considered to be included with the related item of work in the Bill of Quantities.

SECTION 8300 AUXILIARY EQUIPMENT

8301 General

(1) General

- All Sub-Sections under Section 8000 General Technical Specification shall be applied to this section.
- This Section shall covers the particular specification of the Auxiliary equipment installed in the El Salaam No. 7 Pumping Station.

(2) Scope of Works

The Scope of Works shall be included the designing, manufacturing, testing, transport to the site, erection and tests at the site of the following complete in accordance with this specification. However, the Contractor shall decide required capacity of the pumps, auto-strainer, sand separator, and other equipment required in this system based on the performances of the equipment offered by him.

(a) Water Supply System
- Four (4) complete set of the water supply system including pressure reducing valves, auto-strainers, sand separators, piping, valves, and fittings.

(b) De-Watering System
- Three (3) complete vertical shaft, submersible type, and motor-operated volute pumps with a capacity of 1.3 cubic meter per minute under a total head of 14 meters.
- One (1) compete set of the piping, valves, and fittings.

(c) Lubrication System
- One (1) complete set of the lubrication system

(d) Pipeline Filling System
- Two (2) complete motor driven, horizontal shaft, double suction volute pumps with a capacity of 0.15 cubic meter per second under a total head of 90 meters.
- One (1) complete set of the piping, valves and fittings

8302 Equipment Requirements

(1) General

The Contractor shall provide auxiliary equipment in accordance with the following drawings and requirement specified in hereinafter.

(2) Performance

(a) Sump Pump (Dewatering)

Type: Submersible volute pump
Number: 3 units (including stand-by pump)
Nominal size: 125 mm
Capacity: 1.3 cubic meter / min.
Head: 14 m
Output: 7.5 kW

(b) Pipeline Fill Pump

Type: Horizontal double suction volute pump
Number: 2 units
Nominal size: 250/300 mm
Capacity: 0.15 cubic meter / sec.
Head: 90 m
Output: 240 kW

(3) Design and Construction

(a) General

The basic materials and methods shall be in accordance with Sub-Section 8006. However, the materials chosen for the different parts of the Equipment shall be suitable for quality of water as shown in the chemical analysis given. Equivalent materials according to other specifications or better can be accepted if the contractor shows clearly its chemical analysis and it's mechanical properties.

(b) Water Supply System

(i) General

The water supply system shall be provided equipment such as motor operated intake valves, pressure reducers, auto-strainers, sand separators, pipes, valves, Etc, in the pumping station. The motor operated intake valve shall be used to draw the water from the delivery pressured pipelines and to supply it to the pump and motor for cooling through the pressure reducer, auto-strainer and sand separator. And the cooling water returned from the pump and motor shall be discharged to the suction pipe. The arrangement of the system and water piping diagram shall be as shown on the drawing. The system equipment shall confirm to the following requirements.

(ii) Auto-Strainer

The auto-strainer, which is used to remove obstacles from the raw water, shall be provided in the cooling water supply system between the motor operated intake valve and sand separator. The strainer shall be automatic self-cleaning type and have back-washing device by own internal pressure. The strainer shall be operated in connection with the motor operated intake valve. The capacity of the auto-strainer shall be accorded with the total quantity required for the pump and motor. The strainer casing shall be of cast iron or welded stainless steel with plate steel coated inside with epoxy resin, and be with integrally

flanges to conform ISO 7005 PN 5 rating flange on the inlet and outlet sides. The element shall be of stainless steel. The auto-strainer shall provide manual operating gate valves for drain and back-washed drain, a pressure gage, foundation bolts, and other components necessary as a whole.

(iii) Sand Separators

The sand separators shall be installed at the following of the auto-strainer and be used to separate sand from the raw water. The capacity of the sand separator shall be accorded with the total quantity required for the pump and motor. Automatically operating valve shall be provided to remove settled sand. The auto-strainer casing shall be of stainless steel, and be with integrally flanges to conform ISO 7005 PN 5 rating flange on the inlet and outlet sides. The sand separators shall provide valves, a pressure gage, foundation bolts, and other components necessary as a whole.

(iv) Pressure Reducing Valve

The pressure reducing valves shall be provided at the upstream location of the auto-strainer. The valve shall have high performance, smooth operation, and efficiency that consists of a main valve, a pilot or a group of pilot valves and their connecting small diameter pipelines in functional arrangement. The main valve shall be automatically operated by the pilots with hydraulic pressure available only from flowing water itself. The pressure reducing valve shall be capable to reduce the pressure from the delivery pipeline pressure which depends on the pump head (99.9 to 87.0 m) to 3.9 bar and passthrough the required cooling water for the pump and motor. The valve shall withstand internal water pressure of 14 bar.

The type of ports and seat material shall be as recommended by the manufacturer for the required service. The valve bodies shall be made of cast iron. Internal parts shall be stainless steel or comparable corrosion-resistant materials. The pressure reducing valves shall maintain the required controlled outlet pressure within plus or minus 10 percent of 3.9 bar. The pressure reducing valves shall have flanged connection ISO 7005 PN 16 flange rating. The Contractor shall be provided strainers before the pressure reducing valves to remove major trash flow-in. The strainer element shall be of 18-8 stainless steel wire mesh. Mesh size shall be decided under the Engineer agreement.

(v) Valves

Adequate valves shall be provided for each line. A check valve shall be provided on the return cooling water line to the suction pipe to prevent adverse water flow during the pump stops. The check valve shall withstand internal water pressure of 5 bar. The sealing surface of the valve shall be accurately machined for complete water seal when the valve closes. The motor operating intake valve and its guard valve shall be the gate valve and shall withstand internal water pressure of 14 bar. Hand operating valves shall be provided in each low-pressure line for purpose such as the changeover of the line, shutoff service, and flow control. This valve shall be gate valve or glove valve and shall withstand internal water pressure of 5 bar. The gate valves shall be used for shutoff service and the glove valves shall be used for flow control.

(vi) Pressure Release Valves and Automatic Air Valves

The pressure release valves shall be provided on each lines and release pressure at 5 bar for protection the equipment provided. Automatic air valves shall be provided at top of the pipeline system to permit automatic escape of air during filling, and shall automatically and continuously vent accumulations of air while lines are in service and under pressure. A gate valve shall be provided below the air valve so that repair can be made on the air valve without shutdown of the unit.

(vii) Pipes

Adequate size pipes including branch pipe shall be provided for each line. The exposed pipes less than 50 mm nom. diameter shall be stainless steel and one over and including 65 mm nom. diameter shall be carbon steel coated inside with epoxy resin. Concrete embedded pipes less than 200 mm shall be stainless steel and one over and including 250 mm nom. Diameter shall be carbon steel coated inside with epoxy resin. To prevent galvanic corrosion, electrical insulation shall be provided between stainless steel pipe flange and steel pipe flange.

(viii) Control Facilities

The motor operated intake valve shall be remote controlled from control board provided in control room and be operated with the main pump. Sequentially manual operation shall also be made from the local control panel and motor control center panel by the changeover of selecting switch.

(c) De-watering System

(i) General

Drainage and de-watering system shall be provided with facilities for no watering any leakage of water, flowing into the sump pit from either inside or outside the pump station and suction pipe. The system shall include steel pipes from the suction pipes and delivery pressured pipelines within the pumping station to the suction sump at the outside of the pumping station through the sump pit, valves, sump pumps, control facilities and necessary components. The arrangement of the system and water pipe diagram shall be as shown on drawing.

(ii) Sump Pumps

The sump pumps shall be of submersible, removable construction with bolts fitting, vertical shaft type and shall be provided with effective lubricating system. All sections of the pump and motor casing shall be rigidly connected to maintain correct alignment of all parts. The impeller of the pump shall be made of corrosion resistant material and stainless steel sleeves shall be fitted to the shaft where shaft pass through the gland and bearings. Special attention shall be given to the selecting material with due consideration of severe operating conditions of the pumps.

Adequate provision shall be made in the design of the pump for preventing from the entry of solid materials, which are too large to pass freely through the pump. Continuous output of the motor shall be ample to drive a corresponding pump at the rated voltage $\pm$ 10%

allowance a power supply shall be of AC 380 volts, 50 Hz, 3-Phase.

(iii) Valves

Hand operating valves shall be provided on the piping pumping systems as shown on the drawing. The valves shall be of gate valves and shall withstand internal water pressure 5 bar except one which shall withstand internal water pressure 14 bar and connect directly to the main pump discharge pipes. The valve body shall be made of cast iron and the contact surfaces of seal parts shall be accurately machined for sufficient water seal when the valve closed. The connection of the valve to pipe shall be made by flange coupling for one larger than 50 mm in diameter and by screwed type for one 50 mm or smaller.

(iv) Check Valves

A check valve shall be provided at outlet side of each pump to stop adverse water flow when the pump stopped. The valve shall be of flap type and shall withstand internal water pressure 5 bar. The valve body shall be made of cast iron and the sealing surfaces of the valve shall accurately machined for complete water seal when the valve closed. The diameters of the valve shall be same as the outlet diameter of the pump.

(v) Air-vacuum Valve

Air-vacuum valves shall be provided at the top of the pump casing extensions and discharge header to blow off or flow in air and a gate valve shall be provided below the air valve so that repairs can be made on the air valve without shutdown of the unit. The valve shall withstand internal water pressure 14 bar.

(vi) Pipes

Piping plan shall be as shown on the drawing, and following pipes and fittings are required.

a. A 200 mm diameter drain header including branch pipes to the sump pit, of which be of stainless steel or steel pipe coated inside with epoxy resin considering water quality, shall be provided for leakage from pump stuffing boxes, valve shaft seals, released water from air valves and drain from sand separators or strainers.
b. A 300 mm diameter steel de-watering header including 250 mm diameter branch steel pipes from the suction pipe, of which coated inside with epoxy resin considering water quality shall be provided to a joint terminated with a 400 mm diameter pipeline filling pipe. The pipes shall be designed to withstand the internal water pressure of 5 bar.
c. A 200 mm diameter sump pump discharge pipe including branch pipes from the sump pit to the suction sump at outside of the pumping station, of which be of stainless steel or steel pipe coated inside with epoxy resin considering water quality, shall be provided. The pipes shall be designed to withstand the internal water pressure of 5 bar.

(vii) Control Facilities

Each of the following pump control shall be performed. Automatic starting and stopping of the pumps shall be made by detecting the water level in the sump pit by the level-detecting device provided in the sump pit. Manual starting and stopping of the pumps shall also be

made from the control panel provided on valve room floor by the change over of selecting switch equipped in the control panel. The contractor shall provide the panels, water level detecting devices, wiring materials and other apparatus required for the above pump control.

(d) Lubrication System

(i) General

The lubrication system shall be provided equipment complete with a portable oil pump unit, pipes and valves in the pumping station. The clean oil will be received and stored in 200-liter metal drums. The clean oil shall be taken to the vicinity of the pump or motor and transferred to the oil reservoir of the pump or motor through a hose by gravity or a transfer pump. All oil used to fill the oil reservoir will store to 200-liter metal drums through a hose by gravity or a transfer pump. The arrangement of the system and it piping diagram (oil) shall be shown on the drawing.

(ii) Portable Oil Pump

One oil transfer pump shall be provided and rated to handle the most viscous oil at the lowest average daily ambient temperature. The pump shall have a capacity of about 60 liters per minutes when pumping oil to the top oil level in the bearing of the motor from intermediate shaft bearing floor EL. 7.70. The pump pressure rating shall include an allowance for the hoses, connecting pipes and filter.

The transfer pump shall be provided with a relief valve that is connected to discharge, to the pump suction and set to protect the pump from over-pressures. A pressure gauge shall be attached to the pump discharge and shall be fitted with a filter-pulsation dampener. The transfer pump shall be driven by an electric motor. The available power supply outlets are provided for AC 220V, 50 Hz, and Single Phase.

Suction and a discharge oil resistant hose shall be provided each about 3-meter in length for connection to the transfer pump. All hose connections shall be the swivel coupling type and adapters and coupling halves shall be provided on each pump and motor fill and drain connection. An electrical oil resistant insulated cable of 20-meter length shall be provided with a metal plug suitable for the outlets.

The strainer for flushing pipeline shall be mounted on the mobile cart and shall be rated for the transfer pump discharge at corresponding viscosity. The strainer shall be fitted with a differential pressure gauge and the body shall be rated for the pressure setting of the pump relief valve. The filtering medium shall be of non-corroding metal or synthetic fiber and shall be cleanable. The filter shall effectively remove up to 98 percent of particles of 0.2-mm size in first stage and 0.1 mm size in second stage and shall, when 2/3 blocked, pass the rated flow at a differential of 1 bar. The filter element shall not blowout or fail at this differential and shall not form channels, which will conduct the flow. The strainer body shall have a suitable drain, supports and easy means of access to the filter element. A suitable flexible connection shall be provided between the pump and strainer.

The transfer pump and strainer shall be mounted on a mobile cart. The cart shall be

provided with oil resistant tired casters, lifting lugs and pull bar. Rack shall be provided on the cart for storing hoses and the electrical power cable.

(iii) Piping

Pipe materials and nominal diameters shall confirm to ISO standards. Seamless steel pipe shall be used for all oil lines. Fittings for oil pipe shall be malleable iron standard fittings and valves shall be of the rising stem, steel body, and bronze mounted type. The entire piping system shall be prefabricated insofar as practicable leaving only such joint connections as may be necessary for assembly or possible subsequent dismantling for repair, wherever feasible, long radius pipe bend shall be used in place of pipe fittings. All pipes shall be through cleaned and properly capped or plugged before shipment. Oil pipe shall be oiled to prevent rusting.

(e) Pipeline Filling System

(i) General

The pipeline filling system shall be provided with facilities for filling water into the delivery pressured pipelines or de-water from the pipelines. The system shall include steel pipes from the sump pit in the pumping station to the discharge header, pipelines in the valve chamber apart from the pumping station and by-pass line provided filling pumps, control facilities and necessary components. The arrangement of the system and it water pipe diagram shall be as shown on drawings.

(ii) Filling Pumps

The filling pump shall be of horizontal centrifugal unit of the split casing type with the suction and delivery flanges in the same plan and have double entry impeller. The complete rotating element shall be capable of being removed without neither disturbing the flanged pipe work nor having to remove the motor.

The impeller of the pump shall be made of corrosion resistant material and stainless steel sleeves shall be fitted to the shaft where shaft pass through the gland. Special attention shall be given to the selecting material with due consideration of severe operating conditions of the pumps. Continuous output of the motor shall be ample to drive a corresponding pump at the rated voltage $\pm$ 10% allowance a power supply shall be of AC 380 volt, 50 Hz, 3-Phase.

(iii) Check Valves

Check valve shall be provided at outlet side of each pump to stop adverse water flow when the pump stopped. The valve shall be of flap type and shall withstand internal water pressure 14 bar. The valve body shall be made of cast iron or ductile iron and the sealing surfaces of the valve shall accurately machined for complete water seal when the valve closed. The diameters of the valve shall be same as the outlet diameter of the pump.

(iv) Valves

Hand operating valves shall be provided on the piping as shown on drawing (piping diagram). The valve shall be of gate valves and shall withstand internal water pressure of 14 bars. The valve body shall be made of cast iron or spheroidal graphite iron casting and

the contact surfaces of seal parts shall be accurately machined for sufficient water seal when the valve closes.

(v) Pipes

According to the drawing and following pipes and fittings shall be required.

a. 400-mm diameter steel pipes, of which coated inside with epoxy resin considering water quality, from the pipelines in the valve chamber to the sump pit shall be provided for filling or de-watering.
b. A 200 mm diameter branch pipe, of which be of stainless steel or steel pipe coated inside epoxy resin considering water quality, shall be provided from the discharge header to a joint terminated with a 400 mm diameter pipeline filling pipe. And adequate sized diameter steel branch pipes, of which be of stainless steel or steel pipe coated inside epoxy resin considering water quality, shall be provided for the filling pumps.

The above pipes shall be designed to withstand the internal water pressure of 14 bar.

(vi) Control Facilities

Each of the following pump control shall be performed.

a. Automatic starting and stopping of the pumps shall be made from the control room.
b. Manual starting and stopping of the pumps shall also be made from the control panel provided on valve room floor by the change over of selecting switch equipped in the control panel.

The contractor shall provide the panels, wiring materials and other apparatus required for the above pump control.

8303 Tests

(1) Factory Tests

All equipment and valves shall be pressure tested in accordance with the standards/codes approved. The pump shall be completely assembled at the manufacture's shop and tested to prove the capacity of them before shipment.

(2) Site Tests

After installation at the site, the operation test for the system shall be carried out and the test results shall confirm to the contract requirements.

(3) Test Reports

The contractor shall submit to the Engineer for approval of four certified copies of all reports of the tests. The reports shall include any analyses of these tests.

8304 Spare Parts

The Contractor shall submit the necessary spare parts to be kept in stock valid for two years

normal operation. The spare parts as described in below shall be included in the spare parts list.

(1) For Sump pump (Submersible volute type)	Quantity
- Complete impeller	1
- Set of liner rings for impeller	1
- Set of bearings	1
- Liner ring for impeller	1
- Set of seals and gaskets (only special one)	1

(2) For Horizontal centrifugal split casing type pump	
- Set of seals and gaskets (only special one)	1

8305 Appliances and Tools

The contractor shall furnish one complete set of any special wrenches, tolls, jigs or gauges, which are required for the adjustment or replacement of parts of items of the overhead traveling crane. Such tolls shall be suitably labeled or identified.

8306 Data, Descriptive Documents and Drawings

(1) Drawing and Data Submission

The Contractor shall submit the drawings and data, which will explain the technical recommendations as required.

- General drawings and descriptive data of their proposals together with complete detailed specifications, technical data, catalogues, etc.
- General information as to method of assembling, installation and other information as may be needed to show that the materials proposed satisfy the requirements of these specifications.

(2) The Drawings for Manufacture

- Within 180 days after notice of award, drawings show overall dimensions of the principal parts.
- Within 240 days after notice of award, all details of foundation requirements, proposed erection procedure, and details of all embedded parts so that design of second stage concrete can be confirmed.

8307 Instruction Manuals

a. The Contractor shall submit the operating and maintenance manuals for guidance of the erection and operating personnel. These manuals shall describe in detail the construction and recommended procedure for assembling, dismantling, maintaining and operating the equipment.
b. The Contractor shall submit four (4) copies to the Engineer for inspection and approval, at

least three months before the first unit is to be commissioned.

8308 Measurement and Payment

Separate measurement or payment shall not be made for the work required under this section. Only when, all equipment or devices related to the Water supply, De-watering, Lubrication and Pipeline filling systems, have been installed, connected and completed it is accepted by the Engineer. All costs in connection with the work specified herein will be considered to be included with the related item of work in the Bill of Quantities.

SECTION 8400 TRASH REMOVAL EQUIPMENT

8401 General

(1) General

- All Sub-Sections under Section 8000 General Technical Specification shall be applied to this section.
- This Section shall covers the technical specification of the trash removal screen system, which are installed into the El Salaam No. 7 Pumping Station.

(2) Scope of Works

- Four (4) complete sets of the weed screen with supports and anchors
- Four (4) complete sets of the guard screen with supports and anchors
- One (1) complete set of the trash rake

The Contractor shall execute all works including the design, manufacture, tests, transport to the site, erection and site tests. The Contractor shall assume full responsibility for coordinated and adequate design of all equipment and shall exchange with other suppliers furnishing associated equipment or the installation contractor, all necessary drawings and other information required to ensure the satisfactory completion of the equipment as a whole.

8402 Equipment Requirements

(1) General

The trash removal equipment shall be constructed at the entry of the suction sump to prevent weeds and debris from being drawn into the suction pipes as shown on drawing. The trash removal equipment shall be complete with the weed screens, guard screens and a trash rake.

(2) Performance

The trash removal equipment shall be designed as follows:

(a) Hydraulic Condition
High water surface: EL. 11.94 m
Low water surface: EL. 8.80 m
Gate deck elevation: EL. 13.40 m
Bottom elevation of waterway: EL. 4.40 m
Lintel elevation of waterway: EL. 9.40 m
Width of waterway: 5.50 m

(b) Design Condition
(i) The Weed Screen (Upstream side)
Height of screen: 9.00 m

Installation angle: 75 degree
Clear span: 5.50 m
Water load: Differential head of 1.0 m
Screen bar opening: 50 mm

(ii) The Guard Screen (Downstream side)
Clear span: 5.50 m
Height of screen: 9.00 m
Installation angle: 60 degree
Screen bar opening: 100 mm
Water load: Difference head of 0.5 m

(iii) Trash Rake
Type of rake: Mobile weed screen cleaning machine
Rake length: 2000 mm
Hoisting speed: 10.0 m / min
Raking capacity per unit: 0.5 m^3
Power source: AC 220V, 50 Hz, 3-Phase

(3) Design and Construction

(a) General

The basic materials and methods shall be in accordance with Section 8006. However, the materials chosen for the different parts of the Equipment shall be suitable for quality of water as shown in the chemical analysis given by Engineer. Equivalent materials according to other specifications or better can be accepted if the contractor shows clearly its chemical analysis and it's mechanical properties.

(b) Weed Screen

The weed screen shall be designed to prevent matters, injurious to the pump from entering to the suction pipe and to adequately withstand the impact forces, static load and vibration phenomena which are likely to occur due to the flow of water passing through the screen. The screen shall consist of bar elements, supporting beams, and all other necessary components. The Contractor shall decide details of the screen manufacturing unless otherwise specified herein, upon approval of the Engineer. The screen shall be fixed on the supporting beams by using the corrosion-resisting bolts, nuts and/or washers.

The bar elements of the screen shall be of rectangular section, and minimum thickness of the bars shall not be less than 9 millimeters. The clear opening of the bar elements (pitch) shall be 50 millimeters plus or minus 1 millimeters. All of the bars shall be transversely connected to prevent vibration. The supporting beams shall be of H-Beam, built-up and/or Angle type steel construction, and all or both ends of beams shall be embedded in the concrete. The maximum deflection of the supporting beams shall be less than 1/500 of the clear span.

(c) Guard Screen

The guard screen shall be installed at downstream of the weed screen. Construction shall be

on the same as the weed screen except screen bar opening of 100 millimeter.

(d) Mobile Weed Screen Cleaning Machine

One mobile cleaning machine for weed screen rake shall be installed on the gate deck EL. 13.40m.

(e) Machine operation mode

(i) Fully Automatic Cleaning

Predetermined program operation shall be operated by time switch.

(ii) Semi Automatic Cleaning

One whole cleaning cycle shall operated by simple push button switch.

(iii) Manual Cleaning

Manual operation switch shall be provided for emergency cases.

(f) Rake

The machine shall be fitted with a high carrying capacity rake with enough area of shelf to accumulate screenings. The rake teeth shall be accurately fitted between the screen bars to clean stones, branches, leaves and other debris etc. which jammed between the screen. For the cleaning of weeds, or plastic bags, which may be winded around the bars, the rake must have the possibility for easy fixation of an additional fine comb, which will be supplied with the machine.

The rake shall be equipped with easy mountable side screens, which will be specially mounded to extract fine debris. The rake trolley shall maintain proper contact with the bars without friction and shall not jump over accumulations of screenings and debris. The rake trolley has to be guided on wheels for exact positioning of the trolley along the top of the screen bars. The rake has to run smoothly without jerks or sudden stops or starts. The rake shall be cleaned on the entire length form the bottom to the top. The rake shall have a down force of at least 500 kg to ensure that floating debris, trunks etc. will not hinder the rake head during its travel to the bottom of the rack.

The exact positioning of the rake on the bars shall be achieved with proximately limit switches. The rake shall also be able to handle oversized trash (tree trunks). Therefore the rake shall be open on both sides. To avoid unnecessary water transportation, the rake shall have slots so that the water can flow out quickly. Safety Devices for Maximum and Minimum Load: The rake ropes shall run over deflection pulleys, which are fixed, to the steel structure, combined with load safety devices.

Every wire rope shall have its independent safety device. The safety device is of great importance for the protection of the operation safety, ropes, rake, and winch and in general for the whole rack-cleaning machine. The safety device shall stop the machine and its operation if the rake is overloaded. The machine operation shall also be stopped if the rake rope slacks. An alarm shall be triggered off as soon as the machine is stopped through its safety devices.

(i) Rake Winch

The winch shall be a strong steel construction designed for heavy loads. The rope drum has grooves for the rope windings. The motor shall be tropical insulated. For the rake stop and for the rake hold in any position the winch shall be equipped with a built in spring-loaded disc brake.

(ii) Traveling Gears

The machine shall run on sufficient number of traveling gears, which shall require minimum of maintenance. The motor shall be a squirrel cage type with built-in brakes. The machine travel and position stops shall be achieved with proximity limit switches.

(g) Electrical Equipment

The control switchboard shall be lockable and located on the machine. The cabinet shall be water tight, with doors in front and guarantee easy access to the electric components, like switches, circuit breaker, relays, timers program control etc. The front doors are lockable. The switchboard contains a main switch. The motor switches shall be equipped with thermal overload, magnetic short circuit and under voltage relays. The control circuit shall be fed from 220 V AC. The selector switches for automatic, semi automatic or manual operation are inside the control switch board. Control lamps are signaling the respective operation.

The cabinet shall have a time meter to indicate total of operating hours. The program control unit shall be built into this cabinet. The electric power supply cable shall be winded-up on an electrically driven motor cable drum. The end of the cable shall lead to a ground-fixed cable box.

(h) Lighting

For nighttime operation, the system shall be equipped with flood light fixtures.

8403 Tests

(1) Factory Tests

The screens shall be shop-assembled and checked for dimensions, tolerances and accuracy of alignment in accordance with the final approved drawings. Any error or misalignment discovered shall be promptly corrected. The rake shall be assembled in the contractor's shop as possible as complete and operated to ensure performances. If any defect or improper operation is discovered, it shall be corrected and the entire test shall be repeated.

(2) Site Tests

The screens shall be installed in accordance with the details shown on the final approved drawing, and confirmed that elevations, clearances, tolerances pertinent fits, alignments, and quality of workmanship are suitable. The rake shall be operated to demonstrate that it conforms to the design and these specifications under the presence of the Engineer.

(3) Test Reports

The contractor shall submit the Engineer with four certified copies of all reports including any analyses of the tests.

8404 Spare Parts

The Contractor shall state the necessary spare parts to be kept in stock valid for two years normal operation.

8405 Data, Descriptive Documents and Drawings

(1) Drawings and Data Submission

The Contractor shall submit with his tender the drawings and data as following.

- General drawings and descriptive data of their proposals together with complete specifications, technical schedules, catalogues, etc.
- General information as to method of assembling, installation and other information as may be needed to show that the materials proposed satisfied the requirements of the Specifications.

(2) The Drawings for Manufacture

a. Within 180 days after notice of award, drawings showing overall dimensions of the principal parts such as the suction pipe pump casing, pit liner, and embedded parts.
b. Within 240 days after notice of award, all details of foundation requirements, proposed erection procedure, and details of all embedded parts so that design of second stage concrete can be confirmed.

8406 Instruction Manuals

a. The Contractor shall submit the operating and maintenance manuals for guidance of the erection and operating personnel. These manuals shall describe in detail the construction and recommended procedure for assembling, dismantling, maintaining and operating the equipment.
b. The Contractor shall submit four (4) copies to the Engineer for inspection and approval, at least three months before the first unit is to be commissioned.

8407 Measurement and Payment

Separate measurement or payment shall not be made for the work required under this section. Only when, all equipment or devices related to the main pump have been installed, connected and completed it is accepted by the Engineer.

All costs in connection with the work specified herein will be considered to be included with the related item of work in the Bill of Quantities.