CONTENTS OF DIVISION 7

DIVISION 7 GATES, VALVES AND METAL WORKS ---------- 7000-1

SECTION 7000 GATES ---------- 7000-1
7001 General ---------- 7000-1
7002 Safety Factors and Working Stresses ---------- 7000-1
7003 Material ---------- 7000-3
7004 Equipment Requirements ---------- 7000-4
7005 Tests ---------- 7000-15
7006 Spare Parts ---------- 7000-17
7007 Data, Descriptive Documents and Drawings ---------- 7000-18
7008 Instruction Manuals ---------- 7000-18
7009 Measurement and Payment ---------- 7000-18

SECTION 7100 VALVES ---------- 7100-1
7101 General ---------- 7100-1
7102 Equipment ---------- 7100-1
7103 Tests ---------- 7100-6
7104 Spare Parts ---------- 7100-6
7105 Data, Descriptive Documents and Drawings ---------- 7100-7
7106 Instruction Manuals ---------- 7100-7
7107 Measurement and Payment ---------- 7100-8

SECTION 7200 METAL WORKS ---------- 7200-1
7201 General ---------- 7200-1
7202 Applicable Codes and Standards ---------- 7200-1
7203 Materials and Workmanship ---------- 7200-2
7204 Welding ---------- 7200-3
7205 Field Assembly ---------- 7200-3
7206 Painting ---------- 7200-3
7207 Handrails ---------- 7200-4
7208 Steel Ladder and Ladder Rung ---------- 7200-5
7209 Checkered Plate Cover, Steel Plate Cover and Grating Cover ---------- 7200-5
7210 Steel Pipe and Duct ---------- 7200-5
7211 Steel Door ---------- 7200-6
7212 Measurement and Payment ---------- 7200-6

DIVISION 7 GATES, VALVES AND METAL WORKS

SECTION 7000 GATES

7001 General

(1) General

- All Sub-Sections under Section 8000 General Technical Specification shall be applied to this Section 7000.
- This Section shall covers the gates, gate frames and stoplog, which will be installed in the El Salaam No. 7 Pumping Station.

(2) Scope of Works

The works shall include the designing, manufacturing, testing, transport to the site, erection and site tests of the gate completes.

One (1) complete set of the fixed wheel type bulkhead gate with a lifting beam.
- Four (4) complete sets of embedded guide frames for the fixed wheel type bulkhead gate
- One (1) complete set of the stoplog with a lifting beam
- Four (4) complete sets of the embedded guide frames for the stoplog
- Two (2) complete sets of the fixed wheel type roller gates with the embedded guide frames and hoisting equipment

(3) Co-operation with other suppliers

The Contractor shall assume full responsibility for co-ordinated 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.

7002 Safety Factors and Working Stresses

Liberal factors of safety shall be used throughout the design and especially in the design of parts subject to alternating stresses or shock. Upon request from the Engineer, the Contractor shall furnish complete information as to the maximum unit stresses used in the design.

The allowable stresses for normal loading of structural steel members as to the gate and guide frame shall be as shown in the following table:

Steel material	Materials having the yield point of 2400 kgf /cm^2 min.	
	Thickness $\leqq$ 40mm	$>$40mm
Axial compressive stress(per gross sectional area)	1,200 kgf /cm^2	The stress should be multiplied by 0.92
Axial compressive stress (per gross sectional area) Compressive members L: buckling length of member (cm) r : radios of gyration of gross sectional area of members(cm) ②splice plates	$\frac{L}{r} \leqq 20$: 1,200 kgf /cm^2 $20 \leqq \frac{L}{r} < 93$: $1{,}200\text{-}7.5 \times \left(\frac{L}{r} - 20\right)$ (kgf /cm^2) $93 < \frac{L}{r}$: $\frac{10 \times 10^6}{6{,}700 + \left(\frac{L}{r}\right)^2}$ 1,100 kgf /cm^2	
Bending stress Bending tensile stress (per gross sectional area) Bending compressive stress (per gross sectional area) L : flange supporting length (cm) b : flange width (cm) Aw: gross area of web (cm^2) Ac : gross area of flange (cm^2) $k = (3 + Aw/2Ac)^{0.5}$ ③ When compressive flanges are directly welded as in skin plates	1,200 kgf /cm^2 $\frac{L}{b} \leqq \frac{9}{k}$: 1,200 kgf /cm^2 $\frac{9}{k} < \frac{L}{b} \leqq 30$: $1{,}200\text{-}11 \times \left(k\frac{L}{b} - 9\right)$ (kgf /cm^2) In case of $\frac{Aw}{Ac} < 2$: $k = 2$ 1,200 kgf /cm^2	
Shearing stress (per gross sectional area)	700 kgf /cm^2	

The allowable stresses for overloading condition such as earthquake may be 50 percent higher than that of normal loading. All mechanical machine parts of the gate and hoist subjected to normal loading condition or rated capacity loading condition shall be designed and based as shown on the following table.

Material	Factor of safety based on ultimate strength		
	For tensile force	For compressive force	For shearing force
Rolled steel plate	5	5	8.7
Forged steel	5	5	8.7
Rolled steel bar	5	5	8.7
Stainless steel bar	5	5	8.7
Cast steel	5	5	8.7
Cast iron	10	3.5	17
Ductile iron	7	2.5	12
Bronze casting	8	8	10
Wire rope	8 (For static load under lowering or raising gate)		

The allowable concrete bearing and shearing stresses shall not exceed 50 and 7 bar respectively.

7003 Material

Materials used in the manufacture of the specified equipment shall be new and have physical properties best adapted to their various uses in accordance with best engineering practices. Furnished materials and manufacturing procedures shall be in accordance with pertinent provisions of the applicable standards of the following table unless otherwise specified.

Material	Applicable Standards	Equivalent
Structural steel for General use : Buried part in concrete	ISO 630 E 235A, E275A	JIS G 3101 SS400 ASTM A36
Steel plate for principal stress carrying member of welded structure : Skin plate, Girder,	ISO 630 E-275A to C	JIS G 3106 SM400 or JIS G 3101 SS400 ASTM A 516 Gr.60
Steel casting : General purpose, wheel, side roller	ISO 3755 200 – 400 min.	JIS G 5101 SC410 min. ASTM A 27 U-60-30 min.
Iron casting : General purpose	ISO 185	JIS G 5501 FC250 ASTM A 48 No. 25
Steel piping for ordinary piping	ISO 559 ST 320	JIS G 3452 SGP ASTM A53 Type F
Stainless steel (martensitic) Side roller, wheel shaft	ISO TR 15510 L-No.6	JIS G4303~4305 SUS403, 410 AISI 403, 410
Stainless steel (austenitic) : Bearing plate, exposed guide frame, and side and front shoe,	ISO TR 15510 L-No.6	JIS G 4303~4305 SUS304. AISI 304

7004 Equipment Requirements

(1) General

The arrangement of the gates shall be as shown on the drawings.

(2) Performance

The gates shall be designed for the following water load and condition.

(a) Bulkhead gate

Max. Water level: At elevation 11.94 m
Sill beam: At elevation 4.40 m
Gate deck: At elevation 13.40 m
Height of gate: Approx. 4.10 m
Clear span of gate: 5.50 m
Hoist: Gantry crane

The gate will be operated to up under non-pressure difference between up and downstream sides of the gate, after the suction pipe has been refilled by using de-watering valves in the pumping station. And the gate will be down under balanced head condition.

(b) Stoplog

Max. Water level: At elevation 11.94 m
Sill beam: At elevation 4.40 m
Gate deck: At elevation 13.40 m
Height of gate leaf: Approx. 1.55 m
Total height of stoplogs: 7.75 m
Numbers of stoplog leaf: 5
Clear span of gate: 5.50 m
Hoist: Gantry crane

The stoplog leafs shall be operated to up under water load of 1.55 m between up and down stream sides of the gate, and be down by own weight.

(c) Roller gates

Max. Water level: At elevation 10.71 m
Sill beam: At elevation 7.40 m
Gate deck: At elevation 16.90 m
Height of gate: Approx. 3.50 m
Clear span of gate: 10.00 m
Hoist: Motor operated winch.

(3) Design and Construction

(a) General

The basic materials to be used shall be in accordance with Section 7003. 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) Bulkhead gates for suction sump.

(i) General

The gate shall be designed for water load specified and for loads such as reaction due to its own weight, loads imposed during starting, raising or lowering the gate due to the overload hoist or the gate jammed conditions.

The guide frames and anchors shall be capable of transferring the all loads from the wheels, seals, and side rollers of the gate to the concrete structure. The loading on the guide frames shall be the wheel and seal loads and other loads due to the most adverse operation of the gate and crane.

The lifting beam shall be designed to lift the dead weight, plus all frictional load between the gate and frame. The lifting beam shall withstand all loads imparted to the lifting beam under the condition that it is carrying becomes jammed in the guides. The lifting beam shall be designed as the strongest item in the lifting assembly.

(ii) Gate

The gate shall consist of skin plate, main beams, seals, wheel assemblies, side rollers, and all other necessary components. The gate shall be of fixed-wheel gate type and of all welded construction, except that the high-tensile bearing bolts and reamer bolts shall be used for all field connections

All cuttings, chamfering and other necessary preparations of each segment for field connections shall be done at the shop, if required. Adequate temporary bolts and nuts shall be provided to hold sub-assemblies rigidly and in proper alignment during field erection. The openings for the gate shall be 5.5 meters wide by 4.0 meters high. The details of construction of the gate, not specified herein, shall be made by the contractor upon approval of the Engineer.

The skin plate shall be at the downstream side of the gate. The thickness of skin plate shall include a corrosion allowance of 0.5 millimetre and shall be not less than 9.0 millimetre.
The main horizontal beams shall be of H-beam or built-up plate girder construction. The deflection of the main beams shall be less than 1/800 of the supporting span of the gate under full load condition.

The gate seals shall be of the moulded rubber shapes clamped to the downstream face of

the gate by means of steel bars and corrosion - resisting steel bolts, nuts and washers. The seals shall be spliced at the corners and shall be vulcanised to provide a single continuous seal at the factory. The tensile strength of all shop splices shall be not less than 50 per cent of the tensile strength of the unspoiled material.

The side and top seals shall be of J-type or other shape activated by the upstream water pressure. The bottom seal shall be a plain bar of rubber, which shall bear on the sill beam. The weight of the gate shall be transmitted to the sill beam through the skin plate. The permissible water leakage shall be less than 0.1 litter / sec / meter of the seal length under design condition.

The wheel assemblies shall consist of wheel, shaft, bushing and all other necessary components. The wheel shall be cast steel or other approved materials. The roller bushings shall be of "self-lubricating" metal type. The wheels shall be machine-finished and hardened to the value rather lower than the Brinell Hardness Numbers of track frame surface in the guide frames.

Two side rollers shall be provided on each side of the gate, to limit the lateral movement of the gate. The side rollers shall be provided with self-lubricating metal bushing and washers. If the side rollers are flanged to restrain the gate from moving in horizontal direction, the bushing inserted in the rollers shall have an integral thrust shoulder to transmit the resulting load. Each side roller and pin shall be designed to resist the imposed load due to the gate becoming jammed in the guide frames. The gate shall be fitted with two lifting lugs centred on the top of the gate. The attachment shall be designed to ensure that the linkage mechanism of lifting beam can catch and release on the pins of lifting lugs.

Tolerances for the alignment of roller and for roller paths and sealing surfaces shall be selected to prevent over-stressing of the gate parts and to effect watertight seal. Tolerances for machined and fitted parts shall comply with the requirements of this section. All tolerances and means of adjustment shall be defined on the contractor's drawings, which shall be submitted to the Engineer for approval.

(iii) Guide frame

Each guide frame shall consist of sealing plates, lintel frame, track guide frames, side guide frames, side frames, sill beam, and all other necessary components. The guide frames shall include one set of dogging device for supporting the gate at the top of the guide frame and below deck level.

The Contractor shall design the details of construction of the guide frames, unless otherwise specified herein, upon approval of the Engineer. The sealing plates shall be of stainless steel plates and be attached to the lintel beam, two track guide frames and sill beam. When the guide frames have been assembled, the sealing surfaces shall be straight, true and in the same plane, within a tolerance of plus or minus 1.0 millimetre per 4.0 meters. The minimum thickness of the sealing plates shall be 6 millimetres. The lintel

frames shall be true to form and free from twist and warps to provide a watertight seal with the gate top seal.

The track guide frames shall consist of guide plate, embedded track beam and enforcement and be capable of transmitting the water load from the wheels of gate to the concrete structures. The upstream surface of guide frames shall be true and flat. The deviation of the surface from the theoretical plane shall not exceed plus or minus 0.5 millimetres in any 3 meters length throughout the distance of twice the height of the gate leaf from the sill. The surface contacting to the wheels shall be suitably machined and hardened to prevent excessive wear.

The side guide frames shall consist of guide plate, embedded track beam and enforcement and shall have ample strength to resist the load from the side rollers of the gate. The variation from the theoretical true plane shall not be greater than plus or minus 2 millimetres throughout the total length on order to guide the gate properly during operation. No offset shall exist at each joint. The side frames shall be provided to connect the track guide frame and side guide frame together.

The sill beam shall consist of seal plate and embedded beam and be straight and true providing a close fit with the bottom of the gate and to carry the weight of the gate. The sill beam shall be conservatively designed to be able to transfer all loads applied on it to the concrete structures, without any deflection.

One set of dogging device shall be provided at an elevation of the uppermost portion of the guide frames as shown on the drawing. The dogging device shall be designed to support and hold the gate as designated on the Drawings. Four sets of gratings for gate slots including the embedded supporting frames, anchors, etc. will be designed and supplied by the Contractor to close the openings of gate floor EL. 13.40 m.

(iv) Lifting beam

The lifting beam made of all welded construction shall be provided with two flanged side rollers on each side of it so as to ride on the tracking bars of the guide frames. The lifting beam shall be provided with the attachment for connection of the hoisting wire. The hoisting wire connection shall be designed to be readily accessible and to be disconnected. The lifting beam shall provide with two lifting lugs pointy connected through a linkage mechanism to engage the gate lifting attachments.

(c) Roller gates for sand settling basin.

(i) General

The gate shall be designed for water load specified and for loads such as reaction due to its own weight, loads imposed during starting, raising or lowering the gate due to the over load hoist or the gate jammed conditions.

The guide frames and anchors shall be capable of transferring the all loads from the gate to the concrete structure. The loading on the guide frames shall be the seal loads and other

loads due to the most adverse operation of the gate. The hoisting equipment shall be designed to lift the dead weight, plus all frictional load between the gate and frame.

(ii) Gate

The gate shall consist of skin plate, main beams, wheel assemblies, seals, side rollers, and all other necessary components. The gate shall be of fixed-wheel gate type and of all welded construction, except that the high-tensile bearing bolts and reamer bolts shall be used for all field connections. All cuttings, chamfering and other necessary preparations of each segment for field connections shall be done at the shop, if required. Adequate temporary bolts and nuts shall be provided to hold sub-assemblies rigidly and in proper alignment during field erection. The openings for the gate shall be 10.0 meters wide by 3.5 meters high. Unless otherwise specified herein details of the gate construction shall be planed by the Contractor and finalised upon approval of the Engineer.

The main horizontal beams shall be of H-beam or built-up plate girder construction. The deflection of the main beams shall be less than 1/800 of the supporting span of the gate under full load condition. The skin plate shall be at the upstream side of the gate. The thickness of skin plate shall include a corrosion allowance of 0.5 millimetre and shall be not less than 9.0 millimetre.

The gate seals shall be of the moulded rubber shapes clamped to the upstream face of the gate by means of steel bars and corrosion resisting steel bolts, nuts and washers. The seals shall be spliced and be vulcanised to provide a single continuous seal at the factory. The tensile strength of all shop splices shall be not less than 50 per cent of the tensile strength of the unspliced material.

The side seals shall be of music note or other shape activated by the upstream water pressure. The bottom seal shall be a plain bar of rubber, which shall bear on the sill beam. The weight of the gate shall be transmitted to the sill beam through the skin plate. The permissible water leakage shall be less than 0.1 litter / sec / meter of the seal length under design condition.

Two side rollers shall be provided on each side of the gate, to limit the lateral movement of the gate. The rollers shall be provided with self-lubricating metal bushing and washers. Each roller and pin shall be designed to resist the imposed load due to the gate becoming jammed in the guide frames.

The gate shall be fitted with two lifting lugs centred on the top of the gate. The attachment shall provide the devices such as the hoisting pulley and linkage mechanism the wheel assemblies shall consist of wheel, shaft, bushing and all other necessary components. The wheel shall be stainless steel. The wheel bushings shall be of "self-lubricating" metal type. To provide a true alignment of the whole wheel treads, the journal surface of the axle shall be eccentrically located with respect to its end supports, so that all wheels will contact uniformly on and distribute the water loads safely to the track frames. The wheels shall be machine-finished and hardened to the value rather lower than the

Brinell Hardness Numbers of track frame surface of the guide frames.

Tolerances for the alignment of roller and for roller paths and sealing surfaces shall be selected to prevent over-stressing of the gate parts and to effect watertight seal. Tolerances for machined and fitted parts shall comply with the requirements of these specifications. All tolerances and means of adjustment shall be defined on the contractor's drawings and the drawings shall be submitted to the Engineer for approval.

(iii) Guide frame

The guide frames shall consist of the track and side guide frames, seal and guide frames, sill beam, and all other necessary components. The Contractor shall design the details of construction of the guide frames, unless otherwise specified herein, upon approval of the Engineer.

The track and side guide frames shall consist of guide plate, embedded track beam and enforcement and be capable of transmitting the water load from the fixed rollers of gate to the concrete structures. The upstream surface of guide frames shall be true and flat. The deviation of the surface from the theoretical plane shall not exceed plus or minus 0.5 millimetre in any 3 meters length throughout the distance of twice the height of the gate leaf from the sill. Both paths shall deviate in the same direction to maintain parallel paths. The surface to be contacted with the wheels shall be suitably machined and hardened to prevent excessive wear.

The side guide frames shall have ample strength to resist the load from the side rollers of the gate. The variation from the theoretical true plane shall not be greater than plus or minus 2 millimetres throughout the total length on order to guide the gate properly during operation. No offset shall exist at each joint.

The seal and guide frames shall consist of seal guide, embedded beam and enforcement. When the guide frames have been assembled, the sealing surfaces shall be straight, true and in the same plane, within a tolerance of plus or minus 1.0 millimetre per 4.0 meters. The minimum thickness of the sealing guide shall be 9 millimetres.

The sill beam shall consist of seal plate and embedded beam and be straight and true providing a close fit with the bottom of the gate and to carry the weight of the gate. The sill beam shall be conservatively designed to be able to transfer all loads applied on it to the concrete structures without any deflection. The minimum thickness of the seal plate shall be 6 millimetre.

(iv) Hoist

Each gate shall be provided with a stationary hoist. The hoist shall be of the cable lift type suitably mounted on the hoist deck. The hoist shall consist of steel framework, mechanical equipment including torque shafts, bearings, gear reducers, couplings, hoist drums, wire ropes, mechanical position indicator, manual operating device, etc., electrical equipment including electric motor, motor brake, limit switches, etc., and all other necessary

components for its proper and efficient operation. Drum assemblies and gear assemblies shall be provided with the steel plate covers to protect from danger.

The hoist shall be designed to withstand the rated hoisting loads at the specified allowable unit stresses and factors of safety and to operate the gate safely and smoothly under all conditions of operation and loads specified. The hoist shall also withstand the loads due to maximum hoist motor torque, without exceeding 90 per cent of the yield strength of the material.

The framework shall be of all welded steel construction using steel plates and /or shape steels. No deflection shall be such as to cause misalignment or over-stress of machinery parts.

The torque shafts shall be made of carbon steel or alloy steel and the information of the shafts shall be submitted to the Engineer for approval. The bearings shall be of self-aligning regresable ball or roller type. All gears except worm wheels in the gear reducer shall be of cast or forged steel with machine cut teeth and worm wheels shall be of phosphor bronze casting. If worm gears are used, they are their supports shall be sufficiently rigid to prevent undue movements. Gears shall have removable housing with easily accessible provision for lubrication. High-speed gears shall be encased and oil bathed. Adequate inspection openings shall be provided together with an oil filler plug, drain cock and oil level indicator.

Couplings shall be provided for field adjustment and permanently attached to torque shafts after field adjustment. The hoist drums shall be of cast and/or welded steel construction and be grooved to receive the full length of rope corresponding to the required lift plus two dead wraps on each drum at fully opened position, in addition to the length required for attachment to the drum. When the gate is at the fully closed position, at least three dead wraps of the rope shall remain unwound.

The minimum pitch circle diameter of drums shall be 20 times the diameter of the stranded wire rope. The rope grooves shall be in accordance with the recommendation of the rope manufacturer. All surfaces, which are to come into contact with the ropes, shall be machined true to approved tolerance and finished to minimise rope wear and to prevent permanent deformation of the rope.

A mechanical gate position indicator shall be mounted on each hoist base. The indicator shall be an easily readable dial type having pointer to rotate approximately 300 degrees for full travel. The dial plate shall be of stainless steel or brass with engraved markings. The dial and pointer shall be mounted in a dust-tight and weatherproof enclosure.

The hoist shall be provided with a manual-operating device, which can hoist under the full load condition. The operating force on the handle of the device shall be less than 12 kgf. While the device is operated, the electric motor shall be disengaged. The electromagnetic brake shall have a means of manually de-energising the brake when hoisting work has

ceased.

The wire rope assemblies shall be match-marked to exact length while under tension. The wire ropes shall be of galvanised steel, grease impregnated during manufacture, and shall be supplied by a reputable manufacturer of hoisting ropes. Wire ropes shall be selected with lay suitable for preventing kicking.

The rope shall be designed so that the normal working load does not exceed one-eighths (1/8) of the breaking strength of the rope. When the maximum hoist motor torque is applied, the working stress shall not exceed 60 per cent of the breaking strength of the rope.

(v) Control

The Contractor shall provide a local control cabinet for each gate. The control cabinet shall be completely enclosed and weatherproof type, with keyed access door and/or window, assembled using angle or channel structural members, seam welded at the corners and finished smooth.

The gate shall be opened or closed by motor using the "open" or "close" push button switch in the local control cabinet. Limit switches shall be provided to stop the gate in the fully "opened" and "closed" positions. Limit switches shall be provided to stop the hoist if a rope goes slack. All necessary power and control cables for the operation of the gates shall be provided and installed by the Contractor.

The following instruments shall be mounted on or within each local control cabinet. All indicators and meters shall be visible from outside without opening the keyed door or window.

- Incoming power supply circuit breaker (Moulded Case Circuit Breaker) lockable in "off" position
- Power source pilot light
- Supply power voltmeter
- Load ammeter
- Gate opening indicating lamp
- Gate closing indicating lamp
- "Open", "Close" and "Stop" push button switches
- Lamp check button
- 220 volts AC convenience outlet
- Motor branch circuit breaker to protect the connected motors and other consumers
- Change-over (Local/Remote operation) switch
- Space heater
- Inside lighting fixtures
- All other necessary relays, fuses, contractors, switches transformer and miscellaneous wiring components

(d) Stoplogs for Suction Entry

(i) General

The gate shall be designed for water load specified and for loads such as reaction due to its own weight, loads imposed during starting, up or down the gate due to the overload hoist or the gate jammed conditions. The guide frames and anchors shall be capable of transferring the all loads the gate to the concrete structure.

The loading on the guide frames shall be the seal loads and other loads due to the most adverse operation of the gate and crane. The lifting beam shall be designed to lift the dead weight of the gate, plus all frictional load due to the gate. The lifting beam shall withstand all loads imparted to the beam under the condition that it is carrying becomes jammed in the guides. The lifting beam shall be designed as the strongest item in the lifting assembly. The Contractor will be embarrassed supply of the lifting beam for the stoplogs by using one for the bulkhead gate.

(ii) Stoplog leaves

The stoplog leaf shall consist of skin plate, main beams, sub beams, bearing plates, seal, front and side shoes, lifting attachments and all other necessary components. The stoplog shall be slide type and of all welded steel construction. Each stoplog leaf shall completely be interchangeable within one another for easy operation.

The thickness of skin plate including a corrosion allowance of 0.5 mm shall not be less than 9.0 mm. The main horizontal beams shall be of H-beam and channel shape steel or built-up plate girder construction. The deflection of the main beams shall be less than 1/800 of the supporting span of the stoplog under full load condition.

The stoplog seal shall be of the moulded rubber shapes and clamped to the skin plate of the stoplog by means of steel bars and corrosion resisting steel bolts, nuts and washers. The seals shall be spliced at the corners and be vulcanised to provide a single continuous seal at the shop. The tensile strength of all shop splices shall not be less than 50 per cent of the tensile strength of the unspoiled material.

The side seal shall be music note or other shape activated by the water pressure. The bottom seal shall be plain bar or other shape of rubber, which shall bear on the sill beam. The weight of the stoplog shall be transmitted to the sill beam through the skin plate. The seals shall be arranged to provide complete water tightness when they are positioned in the slot. Two steel side shoes shall be provided on each side of the stoplog to limit the lateral movement of the stoplog. And two steel front shoes shall also be provided on each side faced to guide frames to limit forward and backward movement of the stoplog.

The stoplog shall be fitted with two lifting attachments on the top of the stoplog. The attachments shall be designed to ensure that the linkage mechanism of lifting beam can catch and release the pins of lifting attachments.

(iii) Guide Frames

The guide frame shall consist of sealing plates, sill beam, track frames, side guide frames, and all other necessary components. The sealing frames shall be of corrosion-resisting steel plates and be attached to the two side guide frames and sill beam.

When the guide frames have been assembled, the sealing surfaces shall be straight, true and in the same plane. The minimum thickness of the sealing plates shall b e 6 mm. The sill beam shall be straight and true to provide a close fit with the bottom seal of the stoplog and to carry the weight of the stoplog. The sill beam shall be designed to be able to transfer all loads applied on it to the concrete structures without any deflection.

The guide frames shall be capable of transmitting the water load from the bearing plates of the stoplog to the concrete structures. The surface of guide frames shall be true and flat. Both paths shall deviate in the same direction to maintain parallel paths. The side guide frames shall have ample strength to resist the load from the side of the stoplog. The variation from the theoretical true plane shall not be greater than plus or minus 2.0 mm throughout the total length in order to guide the stoplog properly during operation. No offset shall exist at each joint.

(iv) Lifting Beam

The lifting beam made of all welded steel construction shall be provided with two flanged side rollers, on each side of it so as to ride on the side guide frames. The lifting beam shall be provided with the attachment for connection of the hoisting hook of the gantry crane and be provide with two lifting hooks jointly connected through a linkage mechanism to engage the stoplog lifting attachments by a manually operated counter weight lever.

(e) Protective Coating

(i) General

All equipment shall be cleaned and to be coated in the manner of specified hereinafter, except galvanized metal and nonferrous metal parts will not be required unless otherwise specified. Where, Stainless steel, austenitic grey iron, and high nickel cast iron shall be considered as nonferrous in this section.

Surfaces not required to be coated, but which are adjacent to surfaces to be cleaned and coated, shall be protected from contamination and damage during the cleaning and coating operations.

Cleaning and coating shall be performed only on thoroughly dry surfaces and during periods of favorable weather. Application of coating materials will not be permitted when the ambient temperature is below 18 degrees C or when the metal surface temperature is less than 3 degrees C above the dew point of ambient air.

Surfaces, except those exposed to concrete, shall receive a prime coat to the specified dry film thickness within six hours after being cleaned unless otherwise specified.

Surfaces exposed to concrete shall not coated and be thoroughly cleaned, de-greased and de-rusted.

(ii) Coating Schedule

Coatings, minimum thickness, minimum number of coats, and surface preparation for the various items shall conform to the following schedule.

a. All machined and finished surfaces of ferrous metals to be exposed to the atmosphere during shipment shall be solvent cleaned and coated with one heavy coat of rust preventive compound.

b. All surfaces of the gate equipment such as gate leaf, gate guide, and lifting beam normally in contact with water, except stainless steel, shall be applied epoxy resin paint system.(receive a coating of epoxy zinc-rich primer of 20 microns, epoxy resin paint of 60 microns as under coat, epoxy resin MIO paint of 60 microns as intermediate coat respectively at the shop. And 2 coat of epoxy resin paint of 40 microns as intermediate and top coat at the field) with a total minimum dry film thickness of 200 microns. (MIO means micaceous iron oxide)

   All surfaces of the gate equipment such as Hoisting device normally in expose under sunlight at the outdoor, except stainless steel, shall be applied epoxy polyurethane resin paint system.(receive a coating of organic zinc-rich primer of 20 microns, epoxy resin paint of 60 microns as under coat, epoxy resin MIO paint of 60 microns as intermediate coat respectively at the shop. And polyurethane resin intermediate paint of 40 microns, and polyurethane resin top paint of 30 microns at the field) with a total minimum dry film thickness of 190 microns. The color of paints applied in the painting and coating shall be from those offered as coating schedule of the plant by the Contractor and approved by the Department.

c. The Contractor's standard painting system will be acceptable for practical and economical reason for standardized motors, instruments, cranes and equipment used in all station as far as possible.

(iii) Preparation of Surfaces

All surfaces to be coated shall be cleaned with approved equipment before application of coating materials. Any grit or dust remaining on the surface after the cleaning operations shall be removed before proceeding with the application of coating materials. Surfaces upon which rust forms, or which otherwise becomes contaminated in the interval between cleaning and coating or between coats of material, shall be re-cleaned. Surface preparation for each specific item shall be in accordance with the following methods.

a. Solvent Cleaning

   All oil, grease, and wax shall be removed by wiping or scrubbing the surface with clean rags or brushes wetted with solvent. A final wiping shall be performed with clean solvent and rags or brushes to avoid leaving a thin film of greasy residue on the surfaces being cleaned. Mineral spirits or other approved low toxicity solvent having a minimum flash point of 38 degrees C shall be used as general purpose cleaning solvent during normal weather conditions. In hot weather, heavy mineral

spirits, Grade 2, with a minimum flash point of 52 degrees C shall be used. Surfaces to be coated with coal tar epoxy shall be cleaned with xylol.

b. White Metal Sand-blasting
All welds shall be ground smooth and weld splatter shall be removed. The surfaces to be coated shall be blast cleaned to white metal using hard, sharp, dry sand or steel grit, to produce a surface with a gray-white uniform metallic color. The compressed air used for blasting shall be free of oil and condensed moisture.

(iv) Application of Materials
Application of Materials shall conform to the following schedule:

a. All materials shall be thoroughly mixed at the time of application as recommended by the paint manufacturer. Any dust remaining on prepared metal surfaces from the cleaning operation shall be removed before proceeding with the application of coating materials.
b. Effective means shall be provided for removing free oil and moisture from the air supply lines of all spraying equipment. Nozzle pressure consistent with acceptable finish results shall be employed when spray painting. Each coat shall be free from runs, pinholes, holidays, and sags, and shall be allowed to dry or harden before applying the succeeding coat.
c. Zinc-rich primer shall be applied by spray or brush in conformance with the paint manufacturer's printed instructions.
d. Spare containers of coating materials shall be furnished in sufficient quantities to make field touch-up repairs to all coating systems

7005 Tests

(1) Factory Tests

(a) Bulkhead gate
The gate including seals, side rollers and fixed wheels shall be assembled in the shop. While assembled, the gate shall be checked for dimensions, tolerances and accuracy of alignment, any error and misalignment discovered shall be promptly corrected. The seals shall be fitted to their supports during the shop assembly. Parts shall be clearly match-marked before disassembly for transportation.

Sealing frames, track frames, side guide frames, front guide frames, lintel beam and sill beam for the guide frames shall be checked by means of straight edge and feeler gauges. All dimensions of guide frames that correspond to the gate dimensions shall be checked and any errors and misalignments shall be corrected.

(b) Stoplog
The stoplog including seals shall be assembled at the manufacturer's shop. While assembled, the stoplog shall be checked on dimensions, tolerance and accuracy of alignment. Any errors

and misalignment discovered shall be promptly corrected. Sealing frames, track frames, side guide frames and sill beam for the guide frames shall be checked whether satisfactorily manufactured or not. All dimensions of the guide frames that correspond to the stoplog dimensions shall be checked and any errors and misalignment shall be corrected.

(c) Roller gate

Tests shall be done as specify in sub clause (a) above and below. The hoist shall be completely shop assembled and tested for smooth and proper performance. All units shall be tested at normal operating speed and at no load and closely checked to ensure that all necessary clearances and tolerance have been provided and that no binding occurs in any moving parts. All bearings shall be carefully checked.

All lubrication grease and oil required for the performance of the tests shall be furnished. An operation test of the control shall be made by local control cabinets to the hoist at no load condition to prove specified functions. If any defect or improper operations are discovered, they shall be corrected and the entire test shall be repeated.

(2) Site Tests

(a) Bulkhead Gates

The guide frames shall be assembled in their block outs in accordance with the final approved drawings, brought to line and grade within the tolerance specified and firmly secured in place. Alignment bolts or other necessary devices shall be used to install the guide frames at their corresponding accurate positions. Connections between guide frames, anchored materials and the alignment devices shall be adjustable and firmly tightened to hold the guide frames securely in position while concrete is being placed in the block out.

Additional bracing shall be provided where necessary to ensure the required alignment. Extreme care shall be taken to ensure that the guiding, bearing and sealing surfaces lie in a true plane for their entire length. Placement of concrete in block out shall not proceed until the guide frames have been completely assembled and secured. During the placement of the concrete, alignment tolerance shall be checked and remedial action taken if readings indicate that displacement has occurred.

The gate leaf complete with seals, guide rollers and fixed wheels shall be assembled and erected in accordance with the details shown on the final approved drawings. Joints shall be watertight where required. The bottom of the gate, when erected, shall be in true alignment to ensure a tight and even bearing of the skin plate and rubber seal on the embedded sill beam.

The sides of the gate shall be in true alignment so that the rubber seals, when installed, shall have a tight and even bearing on the sealing surfaces embedded in the concrete. The gate shall be assembled and erected within the shop tolerance necessary to meet the specified tolerance.

(b) Stoplogs

As for the guide frames, the procedure shall conform to the requirements of this section. The stoplog complete with seals shall be assembled and provided in their slot for the purpose of checking the water tightness. After testing, the Contractor shall store the stoplog following the Engineer's instruction.

(c) Roller Gate

As for the guide frames, and gate leaf the procedure shall conform to the requirements of this section. The contractor shall conform to the requirement the hoist as follows. Before assembly, all bearing surfaces, journals, grease and oil grooves shall be carefully cleaned and lubricated with an approved oil or grease. After assembly, each lubricating system shall be filled with an approved lubricant furnished by the contractor. No solvents shall be used for cleaning self-lubricating bearings.

The hoist complete with all accessories shall be assembled and installed in accordance with the final approved drawings. The hoist drums shall be located and adjusted so that they are in true alignment with the wire rope attachments of the gate. After installation of the hoists and prior to placing the wire ropes, the hoists shall be operated and checked for proper operation.

After completion of the above tests, the wire ropes shall be connected to the gates and the gates shall locally and remotely be tested, at which time all controls such as limit switches, electromagnetic brakes and position indicators, etc., shall be adjusted and tested for proper operation. Any defect or improper operations discovered during the tests shall be corrected and the entire test repeated.

(3) Test Reports

The Contractor shall be required to submit the test reports with certified copies of all the tests specified in this section. The reports shall include any analyses of these tests.

7006 Spare Parts

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

For Roller Gate and Stoplog	Quantity
- Set of seals for a bulkhead gate for suction sump (with set bolts)	1
- Set of seals for a roller gate for sand settling basin (with set bolts)	1
- Set of seals for one complete stoplog (5 leaves) for suction sump (with set bolts)	1

7007 Data, Descriptive Documents and Drawings

(1) Drawings and Data to be submitted

The Contractor shall submit the drawings and data to conform that the proposal are satisfying the requirements of these specifications.

- General drawings and descriptive data of their proposals together with complete detailed specifications, technical schedule, catalogues, etc.
- 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.
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.

7008 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.

7009 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 gates 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 7100 VALVES

7101 General

(1) General

- All Sub-Sections under Section 8000 General Technical Specification shall be applied to this Section 7100.
- This section shall cover several type valves installed around the El Salaam No. 7 Pumping Station and pressured delivery pipelines.

(2) Scope of Works

The works shall include the designing, manufacturing, testing, transport to the site, erection and site tests of the following valves.

- Butterfly Valves for serge tanks
- Check valves for serge tanks
- Gate valves
- Small valves

7102 Equipment

(1) General

Following requirements are specified as general so that the Contractor shall be provided necessary materials to complete satisfactory pumping operation and pipelines as a whole.

(2) Butterfly Valve

(a) General

The butterfly valves are used as the isolating valve for the check valves of surge protection at one way surge tanks provided in the pipelines.

(b) Technical data

(i) Valves for surge tank No. 1

- Number of valves: 6
- Nominal diameter: DN 1500
- Nominal pressure: 10 bars max.
- Type of valve: Eccentric type
- Flange rating: PN 10
- Flange regulation: ISO 2531, ISO 7005 or equivalent (See Note-2)
- Laying distance: 700 mm
- Operator: Worm gear operators

(ii) Valves for surge tank No. 2

- Number of valves: 6
- Nominal diameter: DN 700
- Nominal pressure: 5 bars max.
- Type of valve: Eccentric type
- Flange rating: PN 7.5
- Flange regulation: ISO 2531, ISO 7005 or equivalent (See Note-2)
- Laying distance: 610 mm
- Operator: Worm gear operators

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

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

(c) Construction

The butterfly valve shall conform to the following general requirements

(i) Valve Body

The valve body shall be of cast iron or spheroidal graphite iron casting adequately stiffened to prevent deformation under any load conditions specified. The valve body shall be with integrally flanges to conform in dimension and drilling to ISO 2531 PN rating flange on the inlet and outlet sides and supporting feet and lifting lugs. The body seat shall be of stainless steel 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 against a closed valve from damaging equipment or the concrete pier.

(ii) 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 consist of a one–piece unit extending completely through the valve disc, or may be of the stub shaft type, which comprises two separate shafts, inserted into the valve disc hubs. 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.

(iii) Valve Disc

The valve disc shall be of cast iron or spheroidal graphite iron casting 1083 and be designed to sustain full differential pressures across a closed valve disc without exceeding allowable stress of the material used.

(iv) Valve Seat

The valve seats shall be of a design that permits removal, replacement and adjustment. The valve seat shall provide tight shutoff with full pipeline pressure (nominal pressure

specified) on the upstream face (pipeline side) of the valve and 0 bar on the downstream face (surge tank side) 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.

(v) 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.

(vi) 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.

(vii) Operator

The worm gear operators shall be provided to sufficient to seat, unseat and hold the valve disc rigidly in any intermediate position under any operating condition.

(3) Check Valves (Swing type)

(a) Description

The swing type ordinary check valves shall be used to prevent a counterflow and be installed for surge protection at one way surge tanks provided in the pipelines.

(b) Technical Data

(i) For surge tank No. 1

- Number of valves: 6
- Nominal diameter: DN 1500
- Nominal pressure: 10 bars max.
- Type of valve: Ordinary swing type
- Flange rating: PN 10
- Flange regulation: ISO 2531, ISO 7005 or equivalent (See Note-2)
- Laying distance: manufacturer' standard

(ii) For surge tank No. 2

- Number of valves: 6
- Nominal diameter: DN 700
- Nominal pressure: 5 bars max.

- Type of valve: Ordinary swing type
- Flange rating: PN 7.5
- Flange regulation: ISO 2531, ISO 7005 or equivalent (See Note-2)
- Laying distance: manufacturer' standard

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

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

(c) Construction

The check valve shall be consist of valve body, body seats, valve discs, disc seats and stems and be installed in a horizontal position. The check valve shall conform to the following general requirements.

(i) Valve Body

The valve body shall be of spheroidal graphite iron casting adequately stiffened to prevent deformation under any load conditions. The valve body shall be with integrally flanges to conform in dimension and drilling to ISO 2531 PN rating flange on the inlet and outlet sides and supporting feet and lifting lugs. The valve body shall be provided with a structurally adequate base and mating sole plate with foundation bolts and nuts, which will be supported by a concrete pier.

(ii) Body Seat

The body seat shall be of bronze casting or 18-8 stainless steel casting and be mechanically attached to the valve body.

(iii) Valve Disc

The valve disc shall be of cast steel or spheroidal graphite iron casting and be designed to suspend by a hinge from a stem provided in the valve body above disc. The valve disc shall be comprised of two or four doors, depending upon the valve size and be fitted the valve seat and metal retainer. The hinge shall be of cast steel or spheroidal graphite iron casting.

(iv) Disc Seat

Synthetic rubber sheets shall be clamped to the disc and be mechanically held in place by metal retainer. The retaining rings and fasteners to be used shall be of 18-8 stainless steel.

(v) Stem

The stem shall be of stainless steel and have sufficient strength to hold the valve disc.

(4) Gate Valve

(a) General

This paragraph specify the small size gate valves which are used in the auxiliary equipment such as the pipeline filling system, de-watering system and cooling water supply system.

(b) Construction

The valve shall consist of valve body, bonnet, gate, seat rings, stuffing box, stem as main

parts and shall conform to the following general requirements.

(i) Valve Body and Bonnet

The valve bodies and bonnets shall be of cast iron adequately stiffened to prevent deformation under any load conditions specified. The valve body shall be with integrally flanges to conform in dimension and drilling to ISO 2531 PN rating flange on the inlet and outlet sides and supporting feet as necessary. The valve body shall be machined and threaded for body seat rings. And seating surface of the seat rings shall sufficiently accurate to prevent leakage behind the body seat rings.

(ii) Gates and Rings

Gates shall be made of cast iron and be fitted separate rings that have a cross section stiff enough to resist accidental deformation in handling and assembly. The gate rings shall be made of bronze and be rolled, penned, or pressed into grooves machined on the disc.

(iii) Body Seat Ring

The seat rings shall be made of bronze and be back faced, with threads accurately cut, and be screwed into machined seats in the body.

(iv) Valve Stem

The valve shaft shall be made of stainless steel ISO TR 15510 L-No.48 or cast, forged, or rolled bronze.

(v) Stuffing Box

The stuffing box shall be designed that the valve can be packed under non pressure when in the fully open position.

(vi) Operator

The valves shall be equipped with a handle, for the valves of 125 mm and larger, which are used frequently, shall be provided the worm gear operators as required. The electrically actuators shall be provided as requested to sufficient to open and close the valves under any operating condition in according to the drawing.

(5) Small Valves (for General use)

The gate, butterfly, ball valves shall be used for shutoff service and the glove or butterfly valves shall be used for modulating or flow control. The valve shall be of the same material as the pipeline in which they are installed. The valves shall be equipped with a handle, for the valves of 125 mm and larger, which are used frequently, shall be provided the worm gear operators as required. The valves 50 mm or smaller in diameter shall be of the screwed type and the valves larger than 50 mm shall be of flanged connection and be made of cast or forged materials.

7103 Tests

After completion of manufacture, the valve shall be committed operation and hydrostatic tests at the manufacturer's plant as specified below. The Contractor shall submit test procedure before the tests for approval. Following shows general guidance:

(1) Operation Test

Each valve shall be operated in the position for which it was designed, to insure free and perfect functioning of all parts in the intended manner. Any defects of workman ship shall be corrected and the tests shall be repeated until satisfactory performance is demonstrated.

(2) Hydrostatic Test

Each valve shall be subjected to hydrostatic test. A hydrostatic test pressure equal to 1.5 times of the rated working pressure of the valve shall be applied except otherwise specified. This test shall show no leakage through the metal or flange joints.

(3) Leakage Test

Each valve shall be subjected to leakage test. Test at rated working pressure applied through bulkheads alternately to each side of closed disc with opposite side open for inspection. The valve shall show no leakage through metal, flanged joints or stem-seals except allowable quantity accepted by the Engineer.

(4) Test Reports

The Contractor shall be required to submit the Test Reports with certified copies of all the tests specified in this section. The report shall include any analysis of these tests.

7104 Spare Parts

The Contractor shall submit spare parts list, which are considered to be necessary during the 2 years normal operation. The spare parts as described in below shall be included in the list.

(1) For Surge tank No. 1 Butterfly valve (Diameter 1500 mm)	Quantity
- Valve seat(with set of screws or bolt)	2
- Set of hydraulic packing for stuffing box	2
- Set of bearings	2
- Set of flange gaskets (only special one)	1
- Set of float valve D=200mm	3

(2) For Surge tank No. 2 Butterfly valve (Diameter 700 mm)	Quantity
- Valve seat (with set screws or bolts)	2
- Set of hydraulic packing for stuffing box	2
- Set of bearings	2
- Set of flange gaskets (only special one)	1
- Set of float valve D=100mm	3

(3) For Surge tank No. 1 Check Valve (Diameter 1500 mm)	
- Set of disc seats (with set of screws or bolts)	2
- Set of bearings	2
- Set of flange gaskets (only special one)	1

(4) For Surge tank No. 2 Check Valve (Diameter 700 mm)	
- Set of disc seats (with set of screws or bolts)	2
- Set of bearings	2
- Set of flange gaskets (only special one)	1

7105 Data, Descriptive Documents and Drawings

(1) Drawings and Data Submission

The Contractor shall submit the drawings and data to conform that the proposal satisfying the requirements of these specifications.

- General drawings and description data of their proposals together with complete detailed specifications, technical schedule, catalogs, etc.
- General information as to method of assembling, installation and other information as may be needed to show that the materials proposed meet to 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.
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.

7106 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.

7107 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.