

SECTION 9300 MAIN PUMP MOTOR CONTROL EQUIPMENT

9301 General.

(1) General

- All Sub-Sections under Section 9000, General Technical Specification shall be applied to this section.
- This Section covers the technical requirements for the control equipment of the main pump motor, as listed hereinafter, which shall be installed in the El Salaam No. 7 Pumping Station.

(2) Scope of Works

This works shall include the designing, testing, transport to the site, erection and site tests of the equipment listed as follows.

- Auto transformers
- Main Motor Starting Panels
- Exciter Panels
- Exciter Transformer Panels
- Main Pump Unit Control Panel and Common Control Panel

9302 Equipment Requirements

(1) Main Motor Starting Panel

(a) General

Auto-transformer starting method shall be selected for this pump station. The electrical circuit of the auto-transformer starting method is shown in the attached drawings. The principal of the auto-transformer starting method is as follows.

	CB Activity	Function of Auto-transformer unit
Step 1	VCB-2 and VCB-3: ON VCB-1 : OFF	As starting transformer
Step 2	VCB-2: ON VCB-1 and VCB-3: OFF	As reactor
Step 3	VCB-1: ON VCB-2 and VCB-3: OFF	Unit to be released from main circuit and the main motor put into normal operation

These panels are mainly composed of the circuit breakers the protection system and the instruments. These panels shall be indoor use and the installation environment is sandy and dusty. The specifications of each component are as follows. The single line diagram of the scheme of electrical connection of this equipment is shown in the attached drawings.

When these panels are designed and manufactured, the same philosophy, as the safety, the structure and the selection of main components of 11 kV Switchgears installed in to the Auxiliary Substation shall be taken into consideration.

(b) Performance

These panels shall perform start and stop of the main pump motor. The main motor specification will be quoted to the performance of the starting panel is as follows.

- Type: synchronous motor
- Rated voltage: AC 11 kV, 3-Phase
- Rated Frequency: 50 Hz
- Rated output: 13,000 kW

These panels shall be designed for starting, accelerating and running the main motor. The motor shall be designed for reduced voltage starting by use of these panels to reduce the starting current.

(c) Design and Construction

(i) Circuit Breaker

- Type: Vacuum Circuit Breaker
- Service voltage: 11 kV
- Short circuit current symmetrical: 40 kA
- R.M.S: For 3 phases
- Rated current: 1250 A
- Impulse withstanding voltage 1/50 wave: 75 kV (for positive and negative polarity)
- One minute power frequency tests Voltage: 28 kV
- Nominal frequency: 50 Hz
- Surge arrester against switching

(ii) Protection System

This protection system shall be achieved by the following protection functions.

a. Multi function relay

The multi function relay shall be performed:

- Over load protection
- Start up time supervision
- High start over current protection and ground relay
- Unbalance and phase reverse
- Under current protection
- Commutative starting time supervision

b. Differential relay

c. Motion detector

d. Frequency meter

All functions of these protection relays shall be incorporated in one digital control unit.

This control unit shall also have the following functions.

- Measuring instrument
- Control for circuit breaker
- Display for running condition and alarm of these panels

Above signals of this digital control unit shall be transmitted to the main pump unit control panel to easily obtain the status information and data of the main motor and pump when required. Each digital control unit shall be connected to the main pump unit control panel through a bus-system. The bus-system shall be transmission rate of 1 M bps.

(iii) Instruments

- All instruments shall be carried out, without damage, within calculated fault current and the ratings of the associated main electrical circuit.
- All voltage circuits for instruments shall be protected by fuse.
- The measurement values shall be indicated on the display of digital control unit mounted on the surface of the front panel.

a) Current Transformer

Current transformers, whether bushing or bar-primary type shall comply with the requirements of IEC 185. They shall be of the cast resin type. Metering current transformers shall have an accuracy class of 1% at rated primary current and accuracy limit factor of less than 5.0. Relaying current transformers shall have an accuracy of + / - 5% at rated primary current. The secondary output current shall be 5 amperes.

Current transformers shall be designed to be withstanding mechanically and thermally, to the short circuit current capacity. Secondary circuit of current transformers shall be furnished with terminal blocks having short circuit provisions and socket-contacts.

b) Potential Transformer:

Potential transformers shall comply with the requirements of IEC 186 and shall be of the adequate accuracy class as current transformers. The rated voltage of potential transformers is furnished with an open delta winding for grounding over voltage detection. This winding shall be connected to a restricted current resistor. Potential transformers shall be fitted with primary fuses, which have a fault current interrupting capacity. Potential transformers shall be protected on secondary side by fuse.

(iv) Control Devices

The operation of a circuit breaker shall be done by the digital control unit, which shall be mounted in front of the panel. This control unit shall have the following functions at least.

a) Protection

- Over current relay with instantaneous trip
- Single phase/reverse phase
- Out of step detecting
- Differential
- Grounding over current
- Low voltage

b) Measurement

- Main circuit current
- Circuit breaker condition

c) Control

- Sequential control

d) Display

- Measuring instrument
- Control for circuit breaker
- Display for running condition and alarm of these panels

The control unit shall be provided with minimum operating function for the main circuit. The information and data described above which shall be stored in this unit, shall be transmitted to the main pump unit control panel.

(v) Panel

All motor starting panels shall be of the totally metal enclosed type .The outline of the panels is shown in the attached drawings.

- The motor starting panels shall be of the indoor steel totally enclosed withdrawing type.
- The motor starting panels shall be Degree of Enclosure and watertight compartment IP 2X.
- The panel shall be constructed of steel sheets mounted on a strong steel structure. The thickness of steel sheets shall be not less than 2 mm.
- Panels shall be vermin proof and insect proof and shall be provided with front and rear doors, also with floor plates to seal the bottom of the panels round the outgoing cables.
- The panel, which has a circuit breaker in it, shall be equipped with space heater for prevention of moisture within the panel.
- The inside of all panels shall be painted with suitable color.
- Each panel shall be provided with cable entry accesses for power cables and control cables.
- Panel heater with hygro-stat sensor
- Panel color shall be white gray (MED Standard RAL 7030)

(vi) Interlocks

In order to guarantee the maximum degree of safety for an operating and maintenance staff member and to ensure the correct operating sequence and mechanical interlocks shall be fitted. The withdrawal mechanism for the circuit breaker shall be fitted with the functional of mechanical interlocks for safety and convenience of operation:

- Circuit breaker can not be closed in intermediate position (between test and service position)
- The closing of the circuit breaker in the panel shall be blocked by the lock-out relay if it is activated by the operation of the protections.

- The opening of the circuit breaker is always allowed.

(2) Auto Transformer

(a) General

This transformer shall have two functions, which shall act as the starting transformer of the main motor and the starting reactor of the main motor. These functions of auto-transformer shall be changed over by plural numbers of vacuum circuit breakers as shown on the drawings. When the auto-transformer act as a starting transformer, or as a step-down transformer, which shall reduce the input voltage of motor to limit the starting current of motor. The specifications of this transformer are as follows.

(b) Performance

The auto transformer capacity shall be determined in order to start the following main motor sufficiently.

- Type: Synchronous motor
- Rated voltage: AC 11 kV, 3-Phase
- Rated Frequency: 50 Hz
- Rated output: 13,000 kW

The motor shall be designed so as to be suitable for reduced voltage starting method by auto-transformer.

(c) Design and Construction

(i) Auto-transformer

The auto-transformer shall be specified as follows.

- Type: Oil immersed natural cooling type
- Rated voltage: 11 kV
- Rated capacity for 3 minutes: 57 MVA
- Withstand impulse voltage for 1/50 wave: 75 kV
- Off load tap changer: 50%, 65% and 80% of rating capacity
- One minute power frequency test Voltage: 28 kV
- Nominal frequency: 50 Hz
- Operation time rating: 3 minutes

(3) Exciter Panel and Exciter Transformer Panel

(a) General

The panels shall be supply DC power to the field winding of AC exciter system (brush-less) for the main motor field circuit. The panels shall consist of the DC power supply to the brush-less exciter, the automatic voltage regulator and the power transformer.

(b) Brush-less Exciter

The exciter panel shall have continuous ampere capacity at least 10 percent in excess of the actual capacity required for field circuit of the AC exciter of the main pump motor.

(c) Automatic Voltage Regulator

The system shall be designed for automatic power factor control with an automatic voltage regulator (AVR). The AVR shall be mounted in the exciter panel and control the main pump motor field by adjusting the stator field current of AC exciter to the suitable value. The system shall be able to control the power factor of the main pump motor from 0.625 lead to 0.75 lagging.

(d) Power Transformer

The rating of the power transformer shall be as follows. The transformer shall be provided with primary protection fuse.

- Type: class dry type
- Rated primary voltage: 11 kV
- Rated secondary voltage: 380V
- Rated capacity: 20 KVA
- Impulse withstanding voltage for 1/50 wave: 75 kV
- One minute power frequency test voltage: 28 kV
- Nominal frequency: 50 Hz

(4) Main Pump Unit Control Panel and Common Control Panel

(a) General

The system shall consist of the Unit control panels and the central control system. The unit control panel shall be installed by the each main pump unit and shall be provided with the following functions.

- Indication the operation status of the main pump unit
- Indication electrical and mechanical faults of the main pump unit
- Local operation the main pump and auxiliary equipment

The central control system shall consist of CRT display panel, operation board, relay board and related equipment. The CRT display panel shall indicate the existing situation of each main pump, main motor and auxiliary equipment. When some trouble occur the alarm signals will be received and indicated on the display panel automatically. These information signals and data shall be recorded in the central control system. The operation board shall be provided with remote control switches for each main pump motor and other motors for auxiliary equipment.

The all signals shall be transmitted from the unit control panel to the central control system for easily obtain the necessary information and data. Data transmission system shall be of PLC (Programmable Logic Control) and one component of PLC shall be installed in each unit control panel and each PLC shall be connected by the PLC communication-system to

the central control system in the control room. The maximum distance of this communication system between local and central stations shall be 1000 m for a transmission rate of 10 M bps with optical fibers. For the other equipment than the main pump unit will be controlled or supervised by the common control panel located in control room. The system shall be installed in the building however the system equipment shall be provided with sand and dust proof.

(b) Performance

The start and stop operation of the main motor or common equipment can be done from these panels. The indication lamp of running status and fault status for main motor, pump and common equipment shall be mounted to the front panel. The operating switches and meters which are necessary for operation of the main motor, pump and common equipment shall be also mounted on the front panel.

(c) Design and Construction

(i) Fault Indicating Lamps

The control panel shall have the following indication lamps

a) For Main Pump

- Oil pump for guide bearing fault
- Temperature of lower/ upper guide bearing (high /very high)
- Vibration of pumps high
- Suction level
- Discharge level
- Oil pressure low
- Oil pressure for lower guide bearing
- Oil flow low

b) For Main Motor

- Winding temperature (high / very high)
- Vibration of motor high
- Oil temperature of motor thrust bearing
- Oil level low
- Oil tank level (low / very low)
- Cooling water flow
- Filter dirties for cooling

c) For Common Equipment

- Auxiliary transformers
- Auto-transformer
- Incoming 11 kV feeders
- AC 380 V feeder
- DC 110 V feeder
- Control system voltage

(ii) Operation Indicating Lamps

a) System Conditions

- Ready for start

- Main pump running
- Stand by
- Tender repair

(iii) Panel

Main pump unit control panel shall be of the totally enclosed type. The outline of the panels is shown in the attached drawings.

- The panel shall be of indoor use steel totally enclosed type
- The panel shall be degree of enclosure and watertight compartment IP 2X.
- The panel shall be constructed of steel sheets mounted on a strong steel structure. The thickness of steel sheets shall be not less than 2 mm.
- Panels shall be vermin proof and insect proof and shall be provided with front and rear doors, also with floor plates to seal the base of the panels round the outgoing cables.
- The inside of all panels shall be painted with the color indicated by the Engineer.

(iv) Communication System for PLC (Programmable Logical Control)

a) Communication with the Central Control System

- Communication speed: 10 M bit/sec
- Communication type: Ring type, with loop back function or duplex type
- Communication distance: Not less than 1000m
- Cable media: Optical fiber

b) Communication with the Motor Starting Panels and Motor Control Centers

- Communication speed: 1 M bit/sec
- Communication type: Bus type
- Communication distance: Not less than 200 m
- Cable media: Twisted pair cable

(v) PLC System

- Type: Miniature module type
- CPU System: Duplex CPU and high speed processing type
- Control system: Cyclic operation and stored program
- Programming language: Sequential function chart, ladder programming shall be available
- Program capacity: 30 kilo steps RAM
- Process I/O signals
 - Digital input signal: DC 48V photo-couple isolated
 - Digital output signal: Dry relay contact
 - Analog input signal: DC 4 to 20 mA/0, ± 10 V (photo-couple isolated)
- 20% of actual process I/O points shall be provided as spare capacity

(vi) Operation Block Diagram

The operation diagram of main pump shall as shown on the contract drawings.

9303 Tests

(1) Factory Tests

Before shipping routine tests shall be performed on each component of panel according to IEC standards. All inspection and test of the equipment and workmanship shall be performed under the witness of the third party. Should any inspected or tested equipment fail to conform to the Specifications, the Contractor shall either replace the rejected equipment or make all alterations necessary to meet specification free of charge to the contractor.

(a) Tests for the Exciter Panel

- Dielectric test:
- Insulation resistance test:
- Performance Test:

(b) Tests on Power Transformer

- Visual inspection
- Checking the ration and connection group.
- Measurement the winding resistance.
- No load test to determine no load loss.

(2) Site Tests

(a) Tests for Exciter Panel

The exciter panel shall be tested to achieve the nominal operation, including the operation by their control and protective devices as far as applicable. The test procedure of the exciter panel shall be submitted to the Engineer for approval.

(b) Tests for Power Transformer

- Visual inspection
- Power frequency voltage withstanding tests on the main circuit.
- Voltage withstanding tests on control and auxiliary circuits.

(3) Test Reports

The Contractor shall submit to the Engineer for approvals of four copies of all reports of the tests. The reports shall include any analyses of these tests.

9304 Spare Parts and Accessories

The Contractor shall submit the recommendable lists of spare parts and accessories for 2 years normal operation. The spare parts and accessories as described in below shall be included in the list.

For Main Pump Motor Control Equipment	Quantity
- Set of protection relays for each type	1
- Set of indication lamps for each type	3
- Complete of VCB for each rating	1
- Set of trip coils and operation coils and servo motors for VCB of each rating	1
- Set of fuse for potential transformer and control circuit	3
- Set of digital control unit	2
- Set of auxiliary relays	2
- Set of the printed boards for each type	1
- Set of I/O unit and CPU unit for PLC	1

9305 Appliances and Tools

The Contractor shall supply all appliance and tools, which are necessary for installation and testing.

9306 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 motor control equipment 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 9400 LOW VOLTAGE DISTRIBUTION AND CONTROL PANELS

9401 General

(1) General

- All Sub-Sections under Section 9000, General Technical Specification shall be applied to this section.
- This Section covers all 380 V class distribution and motor control panels listed hereinafter, which installed in the El Salaam No. 7 Pumping Station.

(2) Scope of Works

This works shall include the designing, testing, transport to the site, erection and site tests of the equipment listed as follows.

- Four main pump auxiliary motor control centers
- One 380 V Load center
- Two common motor control centers
- Five lighting distribution boards
- One emergency light control panel

9402 Execution

(1) 380 V Load Center

The load center shall be of the indoor use metal clad, withdraw type. The degree of enclosure and compartment watertight for this load center shall be above IP 2X. The panel shall be constructed of steel panels mounted on the base frame made of formed steel. The thickness of steel sheets of the panel shall be not less than 2 mm. Panels shall be vermin proof and insect proof provided with front and rear doors, also with floor plates to seal the bottom of the load center round the outgoing cables. The outside and inside of panel shall be painted with selected color from the manufacture standard. Each panel is to be arranged for power cable and control cable entry at bottom.

(2) Main Pump Auxiliary Motor Control Center (MCC)

The motor control center shall be of totally enclosed metal clad type. The components of motor starter shall be mounted in one compartment, which has enough space to check the malfunction of component of feeder circuit. The enclosure protection grade shall be IP 2X of Degree of Enclosure and compartment watertight The MCC shall be constructed of steel panels mounted on the base frame made of formed steel. The thickness of steel sheets shall be not less than 2 mm. The MCC shall be vermin proof and insect proof provided with floor plates to seal the bottom round the outgoing cables. The out side and inside shall be painted with the selected color from the manufacture standard. Each MCC shall be arranged for power cable and control cable entry at bottom. The operation of a circuit breaker and a magnetic contractor can be done in front of the compartment with the digital control unit.

(3) Common Motor Control Center (CMCC)

The common motor control center shall be of totally enclosed metal clad type. The components of motor starter shall be mounted in one compartment, which has enough space to check the malfunction of component of feeder circuit. The enclosure protection grade shall be IP 2X of Degree of Enclosure and compartment watertight. The CMCC shall be constructed of steel panels mounted on the base frame made of formed steel. The thickness of steel sheets shall be not less than 2 mm. The CMCC shall be vermin proof and insect proof provided. The outside and inside shall be painted with the selected color from the manufacture standard. Each CMCC shall be arranged for power cable and control cable entry at bottom. The operation switches of motor control devices shall be installed on the front panel.

(4) Lighting Distribution Board (DB)

The lighting distribution board shall be totally enclosed, dust proof metal clad wall surface mounted type. All components installed in the distribution board shall be mounted in one compartment, which has enough space to check the malfunction of component of feeder circuit. The enclosure protection grade shall be IP 2X of Degree of Enclosure and compartment watertight. The enclosure shall be made of sheet steel thickness shall be not less than 2 mm. The DB shall be vermin proof and insect proof type. The outside and inside shall be painted with the selected color from the manufacture standard. Each DB shall be arranged for power cable and control cable entry at both sides of ceiling and bottom. The remote contactor of lighting circuits shall be controlled by the local remote control switch installed the location as shown on the drawings.

(5) Emergency Lighting Control Panel (ELC)

The emergency lighting control panel shall be totally enclosed, dust proof metal clad wall surface mounted type. All components installed in the distribution board shall be mounted in one compartment, which has enough space to check the malfunction of component of feeder circuit. The enclosure protection grade shall be IP 2X of Degree of Enclosure and compartment watertight. The enclosure shall be made of sheet steel thickness shall be not less than 2 mm. The ELC shall be vermin proof and insect proof type. The outside and inside shall be painted with the selected color from the manufacture standard. Each ELC shall be arranged for power cable and control cable entry at both sides of ceiling and bottom. The magnetic contactor of emergency light circuits shall be turn on by the no-volt relay installed in the panel, automatically when the normal power supply interrupted.

9403 Equipment Requirements

(1) Main Pump Auxiliary Motor Control Centers (MCC)

The MCC shall consist of the following equipment as shown on the drawing.

- Four Molded Case Circuit Breakers (MCCB) rated as 380 V, 3-Pole, 100 A (frame rating), 50 kA of short circuit capacity.
- Three Molded Case Circuit Breakers (MCCB) rated as 380 V, 3-Pole, 50 A (frame rating), 50 kA of short circuit capacity.
- Four motor starters of magnetic contact, star/delta type.
- Four over current ground relay and protection system
- One voltmeter and supply power indication lamp
- Others required

All cables shall be installed into panel from the bottle panel then the panel shall be provided with cable protection devices to prevent injure and damage the cables.

(2) 380 V Load Center

The 380 V Load Center shall consist of the following equipment as shown on the drawing.

- Two Air Circuit Breakers (ACB) rated as 380 V, 4-Pole, 1600 A (frame rating), 50 kA of short circuit capacity to receive 380/220 V supply power.
- Thirteen MCCBs rated as shown on the drawing.
- One change over switch rated as 3-Pole and 1- Neutral switch, 500 V, 400 A, double throw type, and the change over switch shall be change power source from normal supply to emergency generator supply when the normal power is interrupted.
- Others required

All cables shall be installed into panel from the bottle panel then the panel shall be provided with cable protection devices to prevent injure and damage the cables.

(3) Common Motor Control Centers (CMCC)

The Common Motor Control Center shall consist of the following equipment as shown on the drawing.

- Several numbers of MCCBs rated as shown on the drawing.
- Several numbers of motor starters of magnetic contact, star/delta type.
- Several numbers of over current ground relay and protection system
- Others required

All cables shall be installed into panel from the bottle panel then the panel shall be provided with cable protection devices to prevent injure and damage the cables.

(4) Lighting Distribution Board (DB)

Supply power to the DB shall be 3-Phase, 4-Wires, 380/220 V, AC. The DB shall consist of the following equipment as shown on the drawing.

- One main circuit breaker (MCCB) rated 3-Pole, 1-Neutral, ampere rating as shown on the drawings
- Several numbers of remote controlled magnetic contactors to turn on or off of the connected lighting fixtures.
- For the branch circuit of exterior lighting, automatic controlled magnetic switches and photo cell and pre-set type time switch shall be provided
- Several numbers of single pole 20 A trip rating miniature circuit breakers of branch circuit.
- All branch circuit shall be provided with earth leakage relay.
- One power supply indication lamp to each phase
- Others required

(5) Emergency Light Control Panel (ELC)

Emergency power shall be automatically supplied from the DC Power Unit to the ELC in the manner of DC 110 V, when the normal power supply is interrupted. When the no volt relay in the ELC detect normal power interruption the relay turn on the all magnetic contactors installed each branch circuit, then the emergency light is turn on. The no volt relay shall be connected to nearest AC 220 V such as socket outlet. The ELC shall consist of the following equipment as shown on the drawing.

- One main circuit breaker (MCCB) rated 2-Pole, 100 A.
- Several numbers of remote controlled magnetic contactors to turn on or off of the connected lighting fixtures.
- Several number of 2-Pole DC, 20 A trip rating miniature circuit breakers of branch circuit.
- All branch circuit shall be provided with earth leakage relay.
- One no volt relay
- DC Power supplying indication lamp
- Others required

9404 Performance

(1) Main Pump Auxiliary Motor Control Center

The panel shall supply power to the auxiliary equipment of the main pump in the manner of 3-Phase. 380 V, and to control system in the manner of single phase 220 V. The motor starting equipment in the panel shall be controlled local and remote for each auxiliary equipment motor. A grounding faults and over current faults of power supply lines to the equipment or of equipment itself shall be protected by the protection devices in this panel.

(2) 380 V Load Center

The panel shall supply power to miscellaneous equipment, which are installed inside or outside of the pumping station as shown on the drawing in the manner of 3-Phase. 380 V, and to control system in the manner of single phase 220 V. A over current faults of power supply

lines to the equipment or of equipment itself, shall be protected by the protection devices in this panel.

(3) Common Motor Control Centers

The panel shall supply power to miscellaneous equipment, which are installed inside or outside of the pumping station as shown on the drawing in the manner of 3-Phase. 380 V, and to control system in the manner of single phase 220 V. A over current faults and grounding faults of power supply lines to the equipment or of equipment itself shall be protected by the protection devices in this panel.

(4) Lighting Distribution Board

The panel shall supply power to interior and exterior lighting fixtures and socket outlets, which are installed in the pump house as shown on the drawing in the manner of single phase. 220 V. For the light fixtures installed to high ceiling or corridors the magnetic contactor shall be provided in the board, to remote control the light fixtures. A over current faults and earth leakage faults of lighting and socket outlet circuits shall be protected by the circuit breaker and earth leakage relay installed in this panel.

(5) Emergency Light Control Panel

The panel shall supply power to emergency lighting fixtures installed in the pump house as shown on the drawing in the manner of DC 110 V. All emergency light fixtures controlled automatically by the magnetic contactor in the panel only normal power is interrupting. A over current faults and earth leakage faults of lighting and socket outlet circuits shall be protected by the circuit breaker and earth leakage relay installed in this panel.

9405 Design and Construction

The main components of distribution and control panels shall be specified as follows.

(1) Air Circuit Breaker (ACB)

The breaker shall be three poles, single throw, mechanically and electrically trip free, draw-out type. The circuit breaker shall have self-aligning and self-coupling fixed contacts for power circuit and plugs with sockets for control circuit. Each circuit breaker shall have solid state over current protection device with short time and long time tripping characteristics. Rated shall be as follows.

- Type: Air circuit breaker
- Rated voltage: AC 600V
- Rated interrupted capacity: 50 kA
- Rated current: 1600 A

(2) Molded Case Circuit Breaker (MCCB)

The molded case circuit breaker shall be installed inside the steel housing and operated by push buttons of the control unit fitted on the switchboard. The circuit breaker shall be designed in tropical use and have adequate capacity to suit the motor starting current. Rated shall be as follows.

- Type: Molded Case Circuit Breaker
- Rated voltage: AC 600 V
- Rated interrupted capacity: 50 kA
- Rated current: According to the connected load

(3) Magnetic Contactor

The magnetic contactor shall be provided with the following specifications.

- Class of duty: AC 3
- Switching capacity per hour: 30 times
- Total switching capacity: 1,500,000 switching under following conditions
 - Voltage range: 85 to 110% of nominal voltage
 - Frequency range: 90 to 110% of nominal frequency

(4) Protection

The protection system shall consist of the followings.

- Over current
- Grounding over current

All functions of the protection shall be incorporated in one digital control unit. This control unit shall be provided with the following functions.

- Measuring instrument
- Control for magnetic contactor
- Display for running condition and alarm of the connecting equipment

All signals of the digital control unit shall be transmitted to the main pump unit motor control panel or common control panel.

(5) Instruments

- All instruments shall be carried out, without damage, carrying a calculated fault current within the ratings of the associated main electrical circuit.
- All voltage circuits to instruments shall be protected by fuse in such unearthed phase or line of circuit.
- The measurement values shall be indicated on the display of digital control unit mounted on the front panel.

(a) Current Transformer

Current transformers, whether bushing or bar-primary type shall comply with the requirements of IEC 185. They shall be of the cast resin type. Metering current transformers

shall have an accuracy class of 1% at rated primary current and accuracy limit factor of less than 5.0. Relaying current transformers shall have an accuracy of + / - 5% at rated primary current. The secondary output current shall be 5 amperes. Current transformers shall be designed to mechanically and thermally withstand the short circuit current capacity. Secondary circuit of current transformers shall be furnished with terminal blocks having short circuit provisions and socket-contacts.

(b) Potential Transformer

Potential transformers shall comply with the requirements of IEC 186 and shall be of the adequate accuracy class as current transformers. The rated voltage of potential transformers are furnished with an open delta winding for grounding over voltage detection. This winding shall be connected to a restricted current resistor. Potential transformers shall be fitted with primary fuses, which have a fault current interrupting capacity. Potential transformers shall be protected on secondary side by fuse.

(6) Control Devices

(a) For Load Center

The operation of ACB shall be done by the digital control unit, which shall be mounted on the front door of the load center. This control unit shall have the following functions at least.

(i) Protection

- Over current (long time, short time)
- Rounding over current

(ii) Measurement

- Main circuit current

(iii) Control

- Operation of ACB

(iv) Display

- Main circuit current
- Alarm and fault
- Status of ACB

The above information and data shall be transmitted to the main pump unit control panel or the common control panel through communication bus-system.

(b) For Motor Control Center

The operation of magnetic contactor shall be done by the digital control unit, which shall be mounted in front of panel. This control unit shall have the following functions at least.

(i) Protection

- Over current
- Grounding over current

(ii) Measurement

- Main circuit current

(iii) Control

- Sequential control of motor circuit

(iv) Display

- Motor circuit current
- Status of MCCB
- Alarm and fault

The function that necessary for operation of motor circuit, shall be achieved by this control unit. All of the above mentioned information and data shall be transmitted to the main pump unit control panel or the common control panel through communication bus-system.

9406 Tests

(1) Factory Tests

Before shipping, a routine test shall be performed on each component of center according to IEC standards. All inspection and test of the equipment and workmanship shall be performed under the witness of the third party. Shall any inspected or tested equipment fail to conform to the customer's specifications, the Contractor shall either replace the rejected equipment or make all alterations necessary to meet specification free of charge to the Contractor. Test items shall be as follows.

- Visual examination
- Power frequency voltage dry tests on the main circuit.
- Voltage tests on control and auxiliary circuits.
- Mechanical operating tests.
- Insulation resistance test
- Sequence test
- Protection relay test

(2) Site Tests

- Visual examination
- Mechanical operating tests.
- Insulation resistance test
- Sequence test
- Protection relay test

(3) Test Reports

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

9407 Spare Parts and Accessories

The Contractor shall submit spare parts list, which are considered to be necessary during the 2 years normal operation. The spare parts and accessories as described hereinafter shall be included in this spare parts list at least.

(1) Spare Parts

For Low Voltage Distribution and Control Panel	Quantity
- Set of protection relays for each type	1
- Set of indication lamps for each type	2
- Complete of ACB 600 V, 1600 A	1
- Set of MCCB for each rating	2
- Set of fuse for potential	1
- Set of digital control circuit	1

(2) Accessories

- Each one set of test plug for CT and PT
- One set of draw out handle of ACB
- One set of lifter for ACB

9408 Appliances and Tools

All appliance and tools, which necessary for installation and testing, of the panels shall be supplied by the Contractor.

9409 Data Descriptive Documents and Drawings

(1) Submittals of Information

The Contractor shall submit the following drawing and documents to the Engineer.

- Catalog
- Data sheet
- Outline drawing
- Deviation list (if any)
- Spare Parts list
- Supply list

(2) Submittals for Manufacturing

After issuance of purchase order or letter of intent, the below documents shall be submitted.

- Approval documents list
- Data sheet
- Spare Parts list
- Factory test procedures
- Factory test report
- Installation, Operation and Maintenance Manual
- Shipping Documents

(3) Instruction Manuals

Instruction manuals shall be submitted as within 2 weeks after shipping.

9410 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 low voltage distribution and control panels, 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 9500 EMERGENCY GENERATOR SYSTEM

9501 General

(1) General

- All Sub-Sections under Section 9000, General Technical Specification shall be applied to this section.
- This Section shall covers diesel engine driven AC generator unit used to emergency power supply to all essential electrical consumers installed in the El Salaam No. 7 Pumping Station.

(2) Scope of Works

The works shall include the designing, testing, transport to the site, erection and site tests of the equipment listed as follows.

- Diesel Engine
- Synchronous Generator
- Generator control panel
- Fuel storage and supply system

9502 Equipment Requirements

(1) General

This system shall be used for emergency power supply when the normal power interruption, however the generator unit shall be required to be conform continuous operation. The electronic controller shall be adapted for an engine starter and an AVR.

(2) Performance

The unit shall be automatically started when the low voltage relay detecting normal power interruption and audible signal of that generating voltage reaches to the rating value, will be transmitted to central control panel. Then the operator will change position of the Change over Switch in the [380 V Load Center] as to be connecting to the generator. Then, all essential consumers connected to the 380 V Load Center will be supplied emergency power. The rating of the system shall be as follows.

- Rated output power: 100 kVA
- Running time: Continuous
- Rated overload capacity: 110 % for 1 hour
- Voltage regulation: Within $\pm 3\%$ under any load condition or from no load to full load
- Adjusting of voltage: $\pm 5\%$ of rated voltage
- Operation: Automatically start and manual stop

(3) Design and Construction

(a) Diesel Engine

- Output capacity: 125 PS
- Rating: Continuous
- Starting method: Electrical type (DC 24 V cell motor)
- Starting time: Within 10 sec after normal power failure
- Cooling system: Air-cooled by radiator
- Lubricating system: By recommendation
- Noise level: Low noise type with a noise silences
- Accessories:
 - Fuel oil storage tank: 2,000 litter
 - Self contained fuel oil service tank for 10-hour operation
 - Self contained fuel oil pump
 - Silencer
 - Taco generator

(b) Synchronous Generator

- Rated output power: 100 kVA
- Rating: Continuous
- Protection: IP 20
- Output power system: 3-Phase, 4-Wire, 380/220 V
- Rated current: 151 A
- Frequency: 50 Hz
- Power factor: 80 % lag
- Excitation: AC rotary exciter, brushless type
- Insulation: Class H

(c) Generator Control Panel

- Type: Metal clad type
- Dust-proof construction: IP 2X
- Meters: Voltmeter, Ammeter, Frequency meter, Wattmeter, Running hour meter
- Indicator: Status indicators
- Protection devices: Over current relay, Over voltage relay, Under voltage relay and Grounding over current relay
- Main component:
 - DC power supply for engine starter
 - Field circuit of AC exciter during starting
 - Automatic voltage regulator
 - AC circuit breaker for main circuit

9503 Tests

Before shipping, a routine test shall be performed on each component of generator system according to IEC standards. All inspection and test of the equipment and workmanship shall be performed under the witness of the third party. Should any inspected or tested equipment fail to

conform to the customer's specifications, the contractor shall either replace the rejected equipment or make all alterations necessary to meet specification free of charge.

(1) Factory Tests

This system shall be tested in accordance with the test procedure of the manufacturer. The Contractor shall submit the test procedure for approval of the Engineer before the test shall be started.

(2) Site Tests

Components shall be tested to achieve the nominal operation, including the operation by their control and protective devices as far as applicable. The test procedure of this system shall be submitted to the Engineer for approval.

(3) Test Reports

The contractor shall submit the three copies of test report for the emergency generator system.

9504 Spare Parts and Accessories

The Contractor shall submit spare parts list, which are considered to be necessary during the 2 years normal operation. The spare parts and accessories as described hereinafter shall be included in this spare parts list at least.

(1) Spare Parts

For Emergency Generator System	Quantity
- Set of O-ring	1
- Set of oil level gauge	1
- Set of printed board for electronic controller	1
- Set of oil flow meter	1

(2) Accessories

The Contractor shall supply the accessories in accordance with his recommendation.

9505 Appliances and Tools

The Contractor shall supply all necessary appliances and tools used to the installation, maintenance and tests of the system.

9506 Data Descriptive Documents and Drawings

(1) Submittals of Information

The Contractor shall submit the following drawing and documents with the tender to the Engineer.

- Catalog
- Data sheet
- Outline drawing
- Deviation lists
- Spare Parts list
- Supply list

(2) Submittals for Manufacturing

The Contractor shall submit the following documents after issuance of purchase order or letter of intent to the Engineer.

- Approval documents list
- Data sheet and generator capacity calculation
- Spare Parts list
- Factory test procedures
- Factory test report
- Installation, Operation and Maintenance Manual
- Shipping Documents

(3) Instruction Manuals

Instruction manuals shall be submitted within 2 weeks after shipping.

9507 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 emergency generator system 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 9600 DC POWER SOURCE PANEL

9601 General

(1) General

- All Sub-Sections under Section 9000, General Technical Specification shall be applied to this section.
- This Section shall covers the DC Power Source Panel, installed in the El Salaam No. 7 Pumping Station.

(2) Scope of Works

The works shall include the designing, testing, transport to the site, erection and site tests of the equipment listed as follows.

- Battery chargers
- Nickel cadmium batteries with capacity as indicated on the drawings
- DC power output switches
- Meters and relays

9602 Equipment Requirements

(1) General

This DC power source panel shall supply DC 110 V power to the control or operation circuits of power supply equipment and emergency lights in the pumping station building.

(2) Performance

The electric characteristic of the DC power source panel shall be described as follows.

- Rated capacity: 200 AH at rated discharge rate 1 hour
- Input voltage of charger: Single phase, 3 wire, 220 V, 50 Hz
- Input capacity of charger: 20 kVA
- Load voltage compensater of charger: 100 A
- DC output voltage of charger: 110 V

(3) Design and Construction

Connection of these equipment described hereinafter shall be as shown on the drawing.

(a) Molded Case Circuit Breaker

The molded case circuit breaker shall be installed inside the steel cabinet and shall be designed in tropical use and adequate capacity to suit the circuit. The electrical specification of circuit breaker shall be as following.

(i) Incoming feeder circuit

- Type: Molded case circuit breaker
- Rated voltage: AC 600 V
- Rated current: 100 A
- Rated interrupted capacity: Not less than 25 kA

(ii) Outgoing feeder

- Type: Molded case circuit breaker
- Rated voltage: DC 250 V
- Rated current: As shown on the drawing
- Rated interrupting capacity: 2.5 kA to DC 110 V

(2) Magnetic Contactor

The contactor shall be rated as follows.

- Type: Magnetic contactor
- Rated voltage: DC 250 V
- Rated current: As shown on the drawing
- Rated interrupting capacity: 2.5 kA to DC 110 V

The contactor shall be applied to the emergency light feeder and when the AC power supply fault the contactor shall be automatically closed by a low voltage protection relay. The contactors shall be also closed by means of a manually operated push-button in front of the panel.

(3) Meters

Meters listed as follows shall be provided to the panel.

- Volt meter: For AC input voltage, with phase selector switch
- DC Voltmeter: For DC output voltage
- DC Ammeter: For output current

(4) Control Devices

(a) Relays

Solid state relays shall be furnished for remote alarm of the following malfunctions and conditions.

- Failure of input power to the battery charger
- Failure of the DC output from the battery charger
- DC system earth fault
- Battery electrolyte level low
- Battery charger malfunction isolated.

Relays shall be provided with two volt-free single pole changeover contacts, wired to a terminal strip for connection to the external wiring.

(b) Indication Lumps

For the battery charger, the following indicating lights shall be provided

- AC Input power supplying
- High rate charge
- DC output earth fault

Indicating lights shall be assemblies consisting of low voltage and low wattage lamp, with series resistor, lenses and mounting devices. Lamps shall be accessible from the front of the panel to facilitate lamp replacement. Lump test devices shall be provided in the panel. For each battery charger, the main circuit breaker shall be able to operate at front of the panel.

(5) Batteries

The batteries shall be specified as follows.

- The battery shall be of the nickel cadmium type in plastic containers
- The cells shall be arranged for side-by-side mounting method
- The batteries shall be installed on steel rack and the rack shall be completely protected against corrosion with the paint.
- All battery units shall be connected as fabricate DC power source.
- Inter cell connectors shall be designed to be able facilitate cell removal.

(6) Panels

The panels shall be specified as follows.

- The battery chargers and distribution panel shall be floor mounted, free standing metal clad type
- The batteries shall be mounted on a steel rack located in metal clad by the charger panel.
- The panel shall be constructed of heavy gauge steel, suitably braced, vermin proof, degree of protection shall be IP 51 to IEC or equivalent
- All control devices, switches, circuit breaker, indicating lights and instruments shall be mounted on the hinged front door of charger.
- All cables connected to the panel shall be entering from the bottom.
- The branch circuit breaker shall be bolt-on 2-pole type
- The branch circuit breaker handles shall be directory accessible in front of the panel

9603 Tests

(1) Factory Tests

Before shipping, a routine test shall be performed on each component of DC power source panel according to IEC standards. All inspection and test of the equipment and workmanship shall be performed under the witness of the third party. Shall any inspected or tested equipment fail to conform to the specifications, contractor shall either replace the rejected equipment or make all alterations necessary to meet specification free of charge to the contractor. Tests items for DC power source panel shall be as follows.

- Visual examination
- Power frequency voltage dry tests on the main circuit.
- Voltage tests on control and auxiliary circuits.
- Insulation resistance test:
- Sequence test

(2) Site Tests

The test items of the site test shall be as follows

- Visual examination
- Power frequency voltage dry tests on the main circuit
- Voltage tests on control and auxiliary circuits
- Insulation resistance test

(3) Test Reports

The contractor shall submit three copies of all test reports of the DC power source panel.

9604 Spare Parts and Accessories

The contractor shall submit spare parts lists, which are considered to be necessary during the 2 years normal operation. The spare parts and accessories as described hereinafter shall be included in this spare parts list.

For DC Power Source Panel	Quantity
- Set of fuse for each type	1
- Set of indication lamp for each type	1
- Battery cell	3
- Set of protection relays	1

9605 Appliances and Tools

The contractor shall supply all appliance and tools, which are necessary for installation, maintenance and testing the DC power source panel.

9606 Data Descriptive Documents and Drawings

(1) Submittals of Information

The Contractor shall submit the following drawing and documents to the Engineer.

- Catalog
- Data sheet
- Outline drawing
- Deviation lists
- Spare Parts list

(2) Submittals for Manufacturing

After issuance of purchase order or letter of intent, the below documents shall be submitted.

- Approval documents list
- Data sheet and battery capacity calculation
- Spare Parts list
- Factory test procedures
- Factory test report
- Installation, Operation and Maintenance Manual
- Shipping Documents

(3) Instruction Manuals

Instruction manuals shall be submitted within 2 weeks after shipping.

9607 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 DC Power source panels 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.