

SECTION 9700 AUXILIARY SUBSTATION AND GROUNDING SYSTEM

9701 General

(1) General

- All Sub-Sections under Section 9000, General Technical Specification shall be applied to this section.
- This specification covers the technical requirements for the auxiliary substation and grounding system, which are installed in the El Salaam No. 7 Pumping Station.
- General description

Any items not described herein shall also be considered part of the work if they are shown on the drawings or are considered necessary for the proper operation of the substation or the described equipment. Any deviation from this specification or drawings shall be clearly stated with reasons for the deviation. The Contractor shall coordinate timing of delivery of equipment from all equipment manufacturers. The Engineer shall be notified upon the arrival of all major equipment. All equipment shall be installed in strict accordance with manufacturer's recommendations. The Contractor shall purchase, receive, unload, transport (as necessary), store (as necessary), install and commission all materials required for complete the substation.

(2) Demarcation of Works between MED and REA

The Auxiliary Substation is separated into two parts, that is, the first part is 11 kV power receiving equipment and the second is 11 kV and 380/220 V power distribution equipment. The first part shall be supplied, installed, testes and maintained by REA (Rural Electrification Authority). The second part shall be furnished by this contract.

(3) Scope of Works

The works shall include the designing, testing, transport to the site, erection and site tests of the auxiliary substation equipment listed hereinafter.

9702 Applicable Codes, Standards and Specification

All equipment, materials and fabrication shall conform to the codes, specifications and standards listed below and all applicable codes, specifications and standards referenced therein.

- IEC 60298: A.C Metal-enclosed switchgear and control-gear for rated voltages above 1 kV.
- IEC 60470: High-voltage alternating current contactors
- IEC 60694: Specification for A.C switchgear for voltage above 1 kV
- IEC 6076: Specification for transformers and reactors
- IEC 6047: Low voltage switchgear and controlgear

Equivalent codes specifications and standards established and approved in the country of equipment or materials manufacture may be used subject to the Engineer's approval. When this election is made, the Contractor shall so stated and include in his bid the governing codes, specifications and standards proposed together with an itemized list of specific deviations from the requirement.

The latest issue of all codes, specifications and standards shall govern. The most stringent requirement, in the event of code, standard or specification conflict, shall govern. This specification shall govern in the event of discrepancies between it and applicable codes, standards and specifications.

9703 Execution

The Contractor shall install the auxiliary substation cabinets as indicated on the drawings and as approved by the Engineer. The Contractor shall provide all tools required for installation, including any special tools, and all the tools specified. All special tools and appliances shall be furnished also, and become the property of the Engineer after installation. All anchoring bolts shall be welded to the reinforced iron bars in the floor slab. The metal clad shall be leveled to ensure that the vertical sides are perfectly vertical and aligned, and that doors panels operate freely. The works to be done includes, but not limited to, the assembly and installation of specified substation equipment and all necessary and unspecified accessories required completing the auxiliary substation.

The Contractor shall be responsible for all assembly and disassembly required in the handling and erection of the equipment. The recommendations and instructions of equipment manufacturers shall be followed. All internal and external surfaces, protective coatings and foreign materials shall be cleaned. All marred and damaged spots on equipment and materials shall be refinished to match the original finish.

9704 Equipment Requirements

(1) General

The auxiliary substation is indoors metal clad type and installed in the ground floor of the pump station building. The dimensions of metal clad shall be less than the specified value indicated on the drawings. Location of the switches and meters mounted on a dead-front panel shall be layout considering good convenience handling or watching. Each piece of equipment shall have a securely attached metal nameplate. The name plate engraving shall be durable and readily legible and shall be in the English language. The nameplate shall show equipment rating and other information in accordance with the requirements of the Engineer. Drawings for approval shall include equipment nameplate details including compliance with the above requirements.

(2) Performance

The auxiliary substation will receive two 11 kV, 3-Phase power from the power receiving

panels located near by the auxiliary substation and executed by REA, by connecting two 11 kV, 3-Phase, 3000 A Bus duct. The auxiliary substation shall supply power to four main pump motors in the manner of 11 kV, 3-Phase, and to main pump auxiliary equipment, building equipment, and lighting and socket outlet system in the manner of 380 V or 220 V.

(3) Design and Construction

(a) Composition

Composition of the metal clad is as shown on the drawings, or described hereinafter.

(i) Panels executed by REA

- Two (2) 11 kV Feeder Cable Termination Panels each consist of that Feeder Cable connecting terminals for 24 Cables of 11 kV, XLPE, 1C-500 square mm, because two 3-Phase feeders connected to the main power substation and each 4 cables required per phase.
- Two (2) 11 kV Power Receiving Panels each consist of that,
 - a. 12 kV, 3000 A, Vacuum Circuit Breaker with surge current protector and the vacuum circuit breakers shall be provided with local and remote operation mechanism.
 - b. Measuring and Protection Devices such as current transformers, ammeter with switch, volt meter with switch, kilo-watt meter, power factor meter, reactive power meter, kilo-watt hour meter with maximum demand recorder, over current relays, under voltage relays and transducers as shown on the drawing.
- Two (2) 11 kV PT Panels in which a potential transformer is installed.

(ii) Panels Included in This Works

- Two (2) 11 kV GPT Panels each consist of GPT, under voltage relay, over voltage relay, transducer and voltmeter with switch as shown on the drawing.
- Four (4) 11 kV Main Pump Motor Feeder-A Panels, each consist of 11 kV vacuum circuit breaker with rush current absorber, current transformers, zero phase current transformers, over current relays, grounding over current relays, ammeter with switch, kilo-watt hour meter and a transducer as shown on the drawing.
Operation mode of these circuit breakers shall be supervised on the front panel and on the remote control panel.
- Four (4) 11 kV Main Pump Motor Feeder-B Panels, each consist of 11 kV vacuum circuit breaker with rush current absorber and potential transformers as shown on the drawing.
Operation mode of these circuit breakers shall be supervised on the front panel and on the remote control panel.
- Two (2) 11 kV Station Transformer Feeder Panels each consist of 11 kV vacuum circuit breaker with rush current absorber, current transformers, potential transformers, ammeter with switch, kilo-watt hour meter and transducer as shown on the drawing.
Operation mode of these circuit breakers shall be supervised on the front panel and on the remote control panel.
- Two (2) Station Transformer Panels each consist of three phase 1000 kVA molded type transformer of voltage 11 kV/380-220 V, 380 V potential transformers, voltmeter with switch and 600 V class molded case circuit breaker as shown on the drawing. Also, ventilation system shall be provided to the cabinets.

- Double 11 kV, 3000 amp copper bus system shall be adopted.
All buses shall be adequately braced to withstand the stresses created by fault current.
- Two (2) 11 kV, 3-Phase, 3000 A, Molded type Copper Conductor Bus Duct.

(b) 11 kV Circuit Breaker

The circuit breakers shall be specified as follows.

- Type: Vacuum Circuit Breaker (VCB), draw-able type, and all VCB shall be unable to withdraw out when the VCB is closed.
- Rated voltage: 12 kV
- Frequency: 50 Hz
- Rated continuous current: 1,250 A
- Lightning impulse withstand voltage: 75 kV
- Rated power frequency withstands voltage: 28 kV
- Rated short circuit breaking current: 40 kA
- Rated peak withstands current: 63 kA
- Rated break time of circuit breaker: 3 cycle
- Operation method: Motor spring charged, powered by DC 110 V
- Indication lights for operation mode (ON, OFF and Alarm) of the VCB shall be installed to the all front panel of the cabinet with build-in VCB.
- Vacuum Circuit Breakers shall be provided with surge current protector

(c) 11 kV Current Transformer

Current transformers shall be of whether bushing type or bar-primary type and cast resin molded type complies with the requirements of IEC 185. Current transformers shall be designed to be 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.

- Rated Primary Current: For main pump motor feeder: 800 A
For auxiliary transformer feeder: 75 A
- Rated Secondary Current: 5 A
- Ratio of Error: ± 0.5 % measuring and 1.0 % for relays
- Maximum Voltage: 11.5 kV
- Rated withstand current: 40 times of rated current
- Rated burden: 60 VA
- Rated frequency: 50 Hz
- Withstand voltage to 50 Hz: 28 kV
- Withstand voltage to surge: 90 kA

(d) 11 kV Voltage Transformer

Potential transformers shall comply with the requirements of IEC 186. The rated voltage of potential transformer 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.

- Rated primary voltage: 11 kV
- Rated secondary voltage: $110/\sqrt{3}$ V, $110/\sqrt{3}$ V

- Ratio of error: ± 0.5 for measuring, 1.0 % for relays
- Maximum voltage: 11.5 kV
- Rated withstands current: 40 times of rated current
- Rated burden: 50 VA
- Rated frequency: 50 Hz
- Withstand voltage to 50 Hz: 28 kV
- Withstand voltage to surge: 90 kV

(e) 11 kV Zero Phase Current Transformer

- Rated primary current: For main pump motor feeder: 800 A
For auxiliary transformer feeder: 100 A
- Rated secondary current: 5 A
- Rated zero phases primary current: 200 ma
- Rated zero phase secondary current: 1.5 ma
- Ratio of error: ± 1.0 % (used for grounding relays)
- Maximum voltage: 11.5 kV
- Rated withstands current: 40 times of rated current
- Rated burden: 10 Ω
- Rated frequency: 50 Hz
- Withstand voltage to 50 Hz: 28 kV
- Withstand voltage to surge: 90 kV

(f) Low Voltage Circuit Breakers

Type: Molded Case Circuit Breaker

Rated insulation voltage: 1000 V, AC

Rated operation voltage: 380 V, AC

Frequency: 50 Hz

Rated short circuit breaking capacity: 85 kA

Rated current: Frame rating: 2000 A, the circuit breaker shall be installed to the second side of the station transformer as isolator then trip function shall be abandoned.

(g) Meters

All meters except kilowatt-hour meter shall be square 90-degree angle type, AC 220 V operation and ration of error shall be less than plus and minus 1.5 percent. The kilowatt-hour meter shall be single disk type, AC 220 V operation and ratio of error shall be less than plus and minus 2.0 percent.

(h) Protection Relays

All protection relays shall be digital type, AC 220 V operation and withstanding voltage shall be as follows.

- Between power line and earth: 2000 V, AC
- Between each power line: 2000 V, AC
- Between each contact line: 1000 V, AC

(i) Bus Bars and Connectors

Double bus system shall applied to 11 kV bus bars. The bus assembly shall be designed to

withstanding the dynamic forces arising from the initial peak value of short circuit current and no mechanical distortion shall take place due to electromagnetic forces. Connection shall be kept as short and straight as possible and all surface of connecting parts shall be tinned. Clamps shall be of phosphorus bronze and for bus bar joints a galvanized steel bolts shall be used.

(j) Panel Earth Conductor

Along the entire length the earth conductor connected to grounding system shall be installed. The earth conductor shall be made of copper and sectional area shall be not less than 120 mm².

(k) Wiring and Terminal Boards

All wiring in the panels shall be fixed in position preferably at the inner sides of the panels and shall be arranged so as to enable connections to be easily traced. Secondary wiring subject to movement of a circuit breaker in service shall have stranded conductors and the insulation shall be adequately protected against abrasion. All small wiring shall be marked in accordance with approved manner. Terminal boards shall be provided with separated terminals for incoming and outgoing wires and not more than two wires shall be connected to one terminal.

(l) Protection

The protecting system shall be designed to disconnect faulty circuits immediately with certainty without interference with healthy circuits.

- Each feeder shall be separately protected
- Test links shall be provided to enable the system to be tested without removing wires
- Over current function shall be supplied with separately adjustable time and current settings
- Under voltage function shall be provided for motor protection and shall trip the circuit breaker when the feeding voltage falls to the lowest permissible limit or the supply fails
- All connections and components within reach shall be provided with guards to avoid accidental touching

(m) Instruments

- All instruments shall be carried out, without damage, carrying an expected 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 results shall be indicated on the display of digital control unit mounted in front of the panel

(n) Control for Circuit Breakers

The sequential control for circuit breaker shall be done by the digital control unit, which shall be mounted on a front panel. The control unit shall be provided, but not limited, with the following functions.

- Protection
- Over current

- Grounding over current
- Low voltage

(o) Measurement

- Main circuit current
- Circuit breaker status

(p) Display

- Main circuit current
- Tripped current of circuit breaker
- Status of circuit breaker

The above information and data shall be transmitted to the common equipment control panel through communication bus-system.

(q) Interlocks

For keep safety operation and maintenance and ensure correct operating sequence, mechanical interlocks shall be furnished. The switchgear composed with draw-able type circuit breaker shall be fitted with the following mechanical interlocks.

- Circuit breaker can not be closed in intermediate position (between test and service position)
- The closing of the circuit breaker shall be blocked by the lockout relay when it is activated by the operation of the protections.
- The opening of the circuit breaker is always allowed.

(r) Metal Clad for Auxiliary Substation

All equipment and devices of the auxiliary shall be installed in the steel clad as specified as follows.

- Type: Vertical stand type
- Enclosure: Sheet steel unit type
- Index of protection: IP 51
- Separation of unit: Unit enclosed
- Doors: Front and Rear of each unit

Each clad shall consist of a front hinged panel, rear hinged door, top cover, bottom plate side walls and formed steel members, as required, to form a rigid self-supporting steel structure having an overall dimensions as shown on the accompanying drawings. Each unit panel and door shall be fabricated from sheet steel of minimum 3-mm thickness. When the unit width equals or exceeds 1200 mm, double doors shall be provided. The front panel and rear door shall swing open a minimum 90 degrees and shall have a stop for latching in the fully open position. All unit clad shall be furnished complete with bolted on steel channel bases which shall be anchored to the floor. The unit bottom plate shall be provided with an open to lead in of cables as required.

9705 Grounding System

(1) Scope of Works

This Sub-Section shall covers the technical requirements for the materials, workmanship, fabrication and installation works for the Grounding System. The grounding system shall consist of underground earth conductors, internal earth conductors and grounding rods used to distribution system earth, protection earth and lightning protection earth. The reinforced concrete structures of bottom slab of the pumping station building shall be considered that it will effect to earth resistance when it is connected to the above mentioned earth conductors. Total earth resistance of the grounding system shall be less than 0.5 ohm.

(2) Materials

The following materials shall be adopted to compose the grounding system.

- Grounding conductors
- Grounding rods
- Connectors

(a) Grounding Conductor

The conductor shall be copper bare stranded cable, sectional sized as 120 mm².

(b) Grounding Rod

The rods shall be made of copper plated steel or copper rod sized as 14-mm diameter and 3 m length.

(c) Connector

The connector used to connection grounding rod and conductor shall be made of tinned bronze.

(3) Installation Requirement

- The grounding rods shall be separated at least 5 meter each other.
- The grounding conductors shall be buried at 600 mm under ground level rounding the pump house building about 1.5 meter apart from the building walls.
- Every building column shall be connected to the rounding earth conductor by the copper stranded cable of 120 mm².
- All earth conductors installed in switchgears or panels shall be connected to the rounding earth conductor by the copper stranded cable of 120 mm².
- All connections each grounding or earth conductor shall be made of welding.
- Connection of conductor to earth rods shall be made by bolts and connector and connection shall be fabricated as to be supplying permanent and effective earth.
- Connection devices or fittings that depend on solder will not be permitted.
- Connection between equipment grounding terminal and earth conductor shall be fabricated by grounding screws or using approved grounding devices.
- Not more than one conductor shall be connected to the grounding rod.

- Paint, lacquer and other non-conductive coatings on equipment to be grounded shall be removed from contact surface to assure good electrical continuity.

9706 Tests

The Contractor shall be required the factory and site tests as mentioned hereafter, but not be limited to.

(1) Factory Tests

All equipment composed the auxiliary substation shall be tested at the factory in accordance with related items of the IEC or standard of the factory and the auxiliary substation shall be tested the following.

- Wiring continuity tests
- Wiring insulation resistance tests
- Instrument and meter calibration tests
- Electrical sequence tests
- Mechanical operation tests.

The test items and implementation guidance shall be submitted to the Engineer before 14 days test execution for approval.

(2) Site Tests

The Contractor shall execute the sit test after completion of the auxiliary substation in accordance with the followings.

- Insulation resistance tests
- Voltage withstands tests
- Protection relay tests
- Electric sequence tests
- Mechanical interlock system tests
- Grounding resistance measuring
- Others required by the Engineer

The Contractor shall submit the test schedule to the Engineer for approval before 14 days date of execution. The Contractor shall bare the cost of furnishing these tests.

(3) Test Reports

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

9707 Spare Parts

The Contractor shall submit spare part lists, which are considered to be necessary during the two years normal operation. The spare parts and accessories as described hereinafter shall be

included in this spare parts list.

For Auxiliary Substation	Quantity
- Complete of VCB	1
- Set of trip coils, operation coils and servo motor for VCB of each type	1
- Set of indication lamp for each type	1
- Set of protection relays	1
- Vacuum tester of 30 kV	1
- 11 kV phasing tester for testing parallel operation of 2 feeders	1
- Current relay tester 220 V, 0 to 150 amp	1
- Note book type computer and printer with cables	1
- 5 kV Battery megger	1
- Set of fuse for potential transformer and control unit	1
- Set digital control unit	1
- Set of auxiliary relay	1

9708 Appliances and Tools

The Contractor shall furnish all special appliances and tools that the equipment manufacturer deems necessary for satisfactory installation, operation, testing and maintenance of the equipment, including assembly.

Special tools and appliances shall be construed as those that are not readily available from appliance and tool suppliers in Egypt and those that the equipment manufacturer has procured or fabricated for use with the equipment or similar equipment. The Contractor shall submit to the Engineer for approval a list of all appliances and tools required for the above stated purposes and shall indicate thereon all appliances and tools he proposes to furnish.

9709 Data, Descriptive Documents and Drawings

(1) Submittals of Information

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

- One line diagrams
- General layout plans
- Catalogs of the equipment or devices used to the system
- Deviation lists
- Spare parts list

(2) Submittals for Manufacturing

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

- Detail drawings of complete auxiliary substation

- Mounting dimensions including location and size of anchor bolts holes.
- Location and size of all cable entry holes.
- Total net weight of auxiliary substation.
- Control cable connection diagram
- Manufacture's catalogs or data sheets for all equipment or devices installed to the auxiliary substation, which clearly indicate the characteristics, specification, composition, dimensions and etc.

9710 Instruction Manuals

The Contractor shall be required to furnish and submit the instruction manuals to the engineer. The instruction manual shall include, but not limited to, the followings.

- Table of contents
- As built drawings
- Installation manual
- Handling manual
- Maintenance manual
- Detailed instructions or manuals for each equipment or devices composed the auxiliary substation
- Complete parts list including ordering part number or drawing and item numbers together with part identification drawings as required.
- Complete certified test data

9711 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 auxiliary substation 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 9800 CABLE AND WIRING SYSTEM

9801 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 materials, workmanship, fabrication and installation of cabling, conduits and related works installed in the El Salaam No. 7 Pumping Station.

(2) Scope of Works

The works shall include the design, supply, testing, transportation to the site, installation and site tests of the following cable lines.

- 11 kV Power Feeders to main pump motors
- 380 V Power Feeders to main pump auxiliary equipment
- 380/220 V Power feeder and branch lines to miscellaneous equipment
- System control cables

All cable works shall include cable trays, conduit pipes, cable trays and wiring accessories as required to cable works.

9802 Material and Workmanship

(1) General

All cables and conduits supplied under this specification shall be unused, of recent manufacture, free of defects or irregularities and the best available considering durability, strength and intended service suitability and best engineering practice. Workmanship shall be high quality and in accordance with the best, modern standards. All cables shall be delivered to the site on substantial no returnable wooden drums, each bearing a securely fixed label stating gross weight, serial number, length of cable and other description.

Battens shall be provided around the periphery of the drum to protect the cable during transportation and the inner cable end shall be brought through the side of the drum, which end shall be adequately protected by a metal guard or other approved means. Both ends of cable shall be sealed by suitable method to prevent the entrance of moisture or dust. Requirements shall be applicable to all electrical cables and wires and installation for work under this contract unless otherwise specified.

(2) Type of Cables

Cable and wire shall be used in accord with requirements as follows.

(i) For 11 kV Power Feeders

12 kV Class Cross Linked Polyethylene Insulated Power Cable (XLPE)

(ii) For 380/220 V Power Feeders

600V Class Cross Linked Polyethylene Insulated Power Cable (XLPE)

(iii) For Control Cables

600 V Class Polyvinyl Chloride Insulated and Sheathed Shielding Type Control Cable

For all cables conductor shall be annealed copper with conductivity of not less than 98 percent.

9803 Installation

(1) General

No cables shall be installed in conduits, cable trays or cable pit until such systems has been completed and cleaned. All feeder cables installed in the building shall be continuous from origin to destination. Where bending is required the radius of curvature shall be more than 15 times of the diameter for 11 kV cables and 10 times for 600 V cables. Any cable used to different circuit or purpose such as control, protection and measurement shall not be installed in the same conduits. All 11 kV Class cables shall be separated from any other cables when it is installed in cable trench a metallic separator shall be provided between 11 kV cables and others. All cables terminals and splices shall be made as follows.

- Secure using solder less pressure-type connectors
- All 11 kV cable splices, connection and termination shall be made using approved termination or splicing kits, containing all necessary connectors and insulation materials, as manufactured by respective cable manufacturer.
- Where 600 V XLPE cable splice, connection shall be made using prefabricated kits protected by manufacturer.

All brackets, hangers, cable cleats and supports required to make a neat and substantial cable installation shall be included in this work.

Each cable when completely erected shall have permanently attached to it at each end and at intermediate positions as may be required by the Engineer, no corrosive metal plates upon which shall be engraved or stamped, identification number of cable, voltage, rating, conductor size and name of manufacture.

Cable identification numbers shall comply with cable schedule, which shall be prepared by the Contractor and approved by the Engineer. These cable schedules shall indicate cable numbers, cable size, voltage, conductor size, termination and connection at each end and cable route. Identification of final sub-circuit conductors shall be by colour coding. Colour coding of cables for different phases, neutral and earth shall be as follows, unless otherwise specified.

- Phase A: red
- Phase B: Black

- Phase C: White
- Earth: Green

(2) Installation in Conduit

No cable shall be installed until inside of conduit has been cleaned. Conductor ends at least 15 cm in length shall be left at each outlet or connection point for splices or for connection of fixtures or devices. All cables shall be installed in good order in pull boxes, manholes and hand holes. Cables used for different purposes shall be in separate conduit.

(3) Installation in Cable Trench

All cables shall be supported in trench using wood or plastic cleats, which shall be installed at not less than 500 mm intervals. All cables shall be installed in orderly rows. Where cable passes through metallic covers of cable trench, an adequate space and protections shall be provided between cable and cover.

(4) Installation on Cable Trays

Cable trays shall be ladder types constructed of sheet steel with a nominal depth of 75 mm. Cable trays shall provided with joints, end plate, risers, tees, elbows, hangers and other miscellaneous parts. Cable trays and the associated accessories and hardware shall be so fabrication on the site. All cable trays shall be hot-dip galvanised steel or epoxy resin coated. All trays, accessories and hardware shall have sufficient structural strength and rigidity to withstand the weight of cables. The sizes are as shown on the drawings. The cable trays shall be property aligned according to the drawings and the erected trays shall present smooth and clean appearance. All connections shall be made with couplers and fastening to the structural members or cabinets shall be made with proper hardware. Separators shall be provided where control or signal cables are installed with power cables. Cable trays shall be suspended from the structural members by means of supports.

The cables shall be secured to the trays by means of purpose made saddles, PVC sheathed aluminium strips, or cable cleats. Cable splices made and insulated by approved methods shall be permitted within a cable tray provided they are accessible and do not project above side rails. Cable shall be fastened security to transverse members of cable trays. Where plural single conductor cables comprising each phase in parallel, all conductors shall be installed in-groups consisting to prevent current unbalance in paralleled conductors due to inductive reactions. And single conductors shall be security bound in circuit groups to prevent excessive movement due to fault current magnetic forces. All cable clamps and cleats shall have clearances sufficient to allow contraction or expansion of cable under normal condition. Welding or other of operations, which may cause damage to the cables, shall not be carried out near the cables.

(5) Installation for Conduits

All conduits shall be reamed and cleaned inner ends before the installation and scratched or

rusted conduit shall be remedied with approved paints. Bending machine or approved conduit bender shall be used for bending of conduit at site. Bend portion shall not be deformed or damaged. Conduits shall be cut square to the axis, and joints connected with couplings as to be mechanically and electrically sound. Where a number of conduits converge at a point, a large box made of heavy gauge sheet steel shall be provided. Conduits shall be connected to the box as specified above. Heavy hexagonal locknuts shall be used for all running joint in such a way that they seat firmly and evenly on to the mating faces of coupling. All junction boxes, draw-in boxes and inspection fitting shall be so installed that the cables therein can be inspected and, if necessary, without and re-run.

Conduits shall be anchored to the building structures at intervals not longer than 1.5 m by use of approved saddles or other approved systems. Except where a box or other conduit fitting is directly and firmly anchored to the building structures, conduits shall be saddled and anchored to the structures within 150 mm of each box or fitting. Care shall be taken to project the conduit, boxes, fittings etc. from ingress of concrete, pilaster, dirt, trash, mortar and other harmful substances during the course of the works. Conduits shall be thoroughly cleaned free from any obstructions. A pulling wire shall be inserted in each empty conduit, the wire shall be of 2 mm diameter zinc-coated or PVC sheathed mild steel. A stack not shorter than 250 mm shall be left at each end of the conduits.

Wall surface mounted conduits shall be fixed with approved saddles or purpose made clips. Conduits shall be run in square unless otherwise permitted by the Engineer. Concealed conduits shall be securely fixed to the base materials, such as structural members, before screening, plastering, connecting, etc. fixing shall be made with purpose made clips or other suitable means which will not cause damage to the conduits. Conduits to be embedded in the concrete slabs or walls shall be located as close to the center of the slabs or walls as practical provided that they will not disturb the arrangement of the reinforcement. Unless otherwise approved, distance between centers of any two adjacent than 3 times the diameters of the larger conduits, except at locations of distribution boards. Fixable metal conduit shall be used to connect end of conduit and terminal box of the motors.

9804 Measurement and Payment

The quantity of cable or wiring works, cable tray work and underground conduit work shall be the meters installed complete including conduits, bends, couplings, rock nuts, pull boxes, outlet boxes, flexible conduits, supporting materials and all fittings and incidentals and certified by the Engineer for payment.

SECTION 9900 CENTRAL MONITORING SYSTEM

9901 General

(1) General

- All Sub-Sections under Section 9000, General Technical Specification shall be applied to this section.
- This Section shall covers the technical requirements for the central monitoring system 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.

- Monitoring Console
- CRT Display
- Central Processing Unit (CPU)
- Printer
- Printer Desk
- Power Supply Unit (UPS)

9902 Service Condition

All equipment of the system shall be installed in air conditioned Control Room then, service condition will be as follows.

- Maximum ambient air temperature: 30°C
- Minimum ambient air temperature: 5°C
- Maximum relative humidity: 85 %

9903 Equipment Requirements

(1) General

The system shall be provided with the following functions mainly.

- Monitoring the running status for mechanical and electrical equipment in the Pumping Station
- Displaying the fault status for mechanical and electrical equipment in the Pumping Station
- Logging the running status and fault status in the plant.

The running status for mechanical and electrical equipment shall be displayed on the CRT, in the manner of manual and automatic scanning, so that the operator can easily obtain the necessary information. All information and data shall to be able recording by printer as

required. For the main pump units they shall be operated on the Main Pump Unit Control Panel located to near the each pump unit.

(2) Performance

The main specifications for the component of this system shall be as follows.

(a) CRT Display

- CRT size: 21 inch
- Resolution: 1280 × 1024 dots
- Colors: 256 colors
- CRT Refresh time: Less than 1 sec.

(b) Operation Keyboard

- Type: Sheet key type,
- Usage: Operation of the monitoring system

(c) Digital Controller

- CPU: 32 bits
- Main memory: 64 MB
- Auxiliary memory: HDD and FDD
- Operating system: MS Windows NT

(d) Printers

Three type printers shall be provided, or

- Color hard copy: Color laser beam type, A4 size printer paper
- Page printer: Laser beam type, A3/B4/A4 size printer paper
- Serial printer: Bubble jet type, 15-inch printer paper

(3) Design and Construction

(a) Operator Console

The operator console shall be made of sheet steel figure as shown on the drawing and it shall consist of two CRT displays, CPU and system operation keyboard. Two CRT displays shall be used as dual operation manner.

(b) Printer Desk

The desk shall be made of sheet steel figure as shown on the drawing. Three type of printer may be contained in the desk.

(c) Monitoring Items

The following items shall be monitored on the CRT displays

- Water level in suction and delivery side
- Total operating hour for each unit
- Existing status for each pump unit (Run, Stop or Trouble)
- Instantaneous discharge water volume of each pump unit.

- Total electric power consumption of the Pumping Station
- Alarm and fault indication
- Running status of each main pump such as power supply voltage, current consumption, power consumption etc)

These status, signal, and data of main pumps and auxiliary machines shall be transmitted from each PLC unit installed in the main pump unit control panel through the ring type optical data transmission line which has loop back function.

9904 Tests

(1) Factory Tests

(a) General

Before shipping, a routine test 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. Shall 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.

(b) Tests Items

- Dielectric test
- Insulation resistance test
- Performance test
- Sequence test
- Operation test

(2) Site Tests

- Dielectric test
- Insulation resistance test
- Performance test
- Sequence test
- Operation test

(3) Test Reports

The contractor shall submit three copies of the reports for approval. The test reports shall include any analyses of these tests.

9905 Spare Parts

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 listed hereinafter shall be included in the spare parts list at least.

For Central Monitoring System	Quantity
- Complete of PLC unit for main pumps	1
- Set of soft ware for PLC	1
- Set of micro relay for PLC	1
- Set of protection relays for UPS	1
- Set of inverter for UPS	1
- Set of converter for UPS	1
- Set of fuse for potential transformer and control circuit	1
- Set of lamp for indicator	1
- Set of paper for printer	1
- Set of FD, CD for computer	1
- Note book type computer and printer with cables	1

9906 Appliances and Tools

The Contractor shall supply all appliances and tools, which are necessary for installation and testing of the system.

9907 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 central monitoring 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.