



PSPP MANARA

ISRAEL

Particular Switchyard Control Building IEC Specifications

Specification for Electrical Works in Switchyard

Volume 2

Section IX

Attachment A

Written:	Y. Borenstein	26.01.2017
Checked:	E. Marynko	26.01.2017
Approved:	Binder, Uri	15.02.2017

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1.0 **GENERAL REMARK**

This specification covers all the works related to four incoming line fields, a coupler field and two 161kV cable feeds. The works described herein relate to all works and equipment listed on Specification Document General Provisions clause 4.0. The works are divided into chapters for ease of read. All chapters of this specification should be considered as guidelines of a specific work.

2.0 **GENERAL CONDITIONS**

2.1 Warranty- refer to RFP Document –section IX ,general provisions clause 7.0

2.2 Data to be provided by Contractor:

The Works described herein are an integral part of the contract and as such all requirements regarding DATA submittals specified in Section I- Owner's Requirements and Section VI-Particular EM and HM specifications shall be applicable to this specification.

Notwithstanding the above mentioned the Contractor shall also be required to perform the following:

2.2.1 Information to be submitted with Quotation

Contractor shall forward his own complete and detailed Proposal covering the specified performances, delivering and conditions. The Proposal shall include as a minimum:

2.2.1.1 Completed data sheets as per this spec.

2.2.1.2 General specifications of Contractor's delivery, clearly stating scope of supply.

2.2.1.3 Drawings or standard diagrams showing overall dimensions, installation requirements, weights, etc.

2.2.1.4 Type test report.

2.2.1.5 Delivery date.

2.2.1.6 Proposed deviations from requirements, if applicable.

2.2.1.7 Conformity with RFP Documents.

2.2.2 Data to be submitted after contract award

No later than 8 weeks after award of the Contract the Contractor shall submit the following data:

- 2.2.2.1 Detailed final dimension drawing including weights.
 - 2.2.2.2 Civil engineering requirements for mounting of equipment.
 - 2.2.2.3 Catalogues for all equipment.
 - 2.2.2.4 Schematic and wiring diagrams.
- 2.2.3 Data to be submitted prior to erection
- 3 weeks prior to commencement of works Contractor shall submit the following:
- 2.2.3.1 Project book including all drawings, all catalogues, all instructions for erection, all instructions for commissioning and detailed data sheets.
 - 2.2.3.2 Final test report.
- 2.2.4 All the above data mentioned in 5.2.1÷5.2.3 shall be submitted in four copies. All drawings and Data Sheets shall be submitted also on magnetic media: Drawings in AUTOCAD (DWG format) and Data Sheets in Word for Windows format.
- 2.3 Language
- Quotes, data, documentation plus any magnetic media and any communication shall be in English
- 2.4 Delivery time
- 2.4.1 Contractor shall submit his best delivery time including major milestones.
- 2.5 Type of equipment
- ALL equipment and installation works specified under this specification must get IECo.'s (Israel Electric Company) approval. Equipment shall be of similar make and type used by IECo. In the last 5 years.

3.0 **DATA SHEETS TO BE FILLED IN BY PARTICIPANT**

The data sheets in Volume 0, Section IV are a technical questionnaire to be furnished in filled-in form with the Proposal. They are an integral part of the Proposal.

4.0 **DEVIATIONS FROM REQUIREMENTS**

Manufacturer is requested to describe or indicate any proposed deviations of tendered equipment and materials from all requirements in this Specification, as stipulated in the Instructions to Participants.

CHAPTER 1

Control and Protection Panels Local Control Panels & Junction Boxes

1.0 **GENERAL**

- 1.1 This specification covers the design, manufacture, test, supply, mounting in place and commissioning of Low Voltage Control and Protection Panels, Local Control Panels and PT and CT junction boxes for the 161KV switchgear and execute all related work.
- 1.2 All Panels construction ,types and wrings shall be approved by IECO
- 1.3 This specification covers the manufacturing and mounting at site of the following panels:
 - 1.3.1 Outdoor panels
 - 1.3.1.1 161kV equipment panels
 - 1.3.1.2 CT junction boxes
 - 1.3.1.3 PT junction boxes
 - 1.3.2 Indoor panels
 - 1.3.2.1 Field 1 control and protection (PR1)
 - 1.3.2.2 Field 3 control and protection (PR3)
 - 1.3.2.3 Field 7 control and protection (PR7)
 - 1.3.2.4 Field 9 control and protection (PR9)
 - 1.3.2.5 Field 8 control and protection (PR8)
 - 1.3.2.6 Resynchronization Panel
 - 1.3.2.7 Bus bar protection (BBP)
 - 1.3.2.8 Interface panel
 - 1.3.2.9 Annunciator panel
 - 1.3.2.10 MAC1 Panel (400VAC customer)
 - 1.3.2.11 MAC2 Panel (400VAC IECO)
 - 1.3.2.12 MDC1 Panel (220VDC customer)
 - 1.3.2.13 MDC2 Panel (220VDC IECO)

- 1.3.2.14 Two 60VDC Panels
- 1.3.2.15 Two 48VDC Panels
- 1.3.2.16 Three UPS panels
- 1.3.2.17 Event recorder Panels
- 1.3.2.18 Communication and control Panels

1.4 The work shall include:

- 1.4.1 All parts and components of the panel including all small materials and work.
- 1.4.2 Design of panels including full wiring diagrams
- 1.4.3 Construction and testing
- 1.4.4 Transportation to site.
- 1.4.5 Installation in place.
- 1.4.6 Field testing

2.0 **APPLICABLE DOCUMENTS**

The following documents according to their latest published issue, form part of this specification:

Israel Standard Electrical Law

SI 61439..... Low Voltage switchgear

IEC 60364..... Erection of Low Voltage Installation

IEC 60947..... Low Voltage Control gear

IEC 61000..... EMC

The panels shall be approved for outdoor installation by the SII and IECo.

3.0 **TECHNICAL REQUIREMENTS**

3.1 **System data**

Rated voltage/insulation.....1000V

Operating voltage.....up to 400V, 50Hz and 220VDC

Lightning impulse withstand voltage5kV 1.2/50µs peak value

Power frequency withstand voltage.....2.5kV (RMS value – 1min.)

Short circuit breaking capacity400VAC – 10kA

3.2 **Control Description**

3.2.1 **Panel Construction (Outdoor)**

3.2.1.1 The control gear shall be outdoor type UV resistant.
Desired protection degree: IP66.

3.2.1.2 The panels shall be made of sheet stainless steel and shall include two front doors:

- The outer one – for sealing purposes without any equipment installed on
- The inner one – from rolled steel sheet (even and smooth) of 2.5 mm thickness (at least), with all the control equipment (push buttons, semaphores. Mimic, switch, etc.).

3.2.1.3 The control gear shall be designed so that normal service and maintenance operations including usual earthing fault locating, voltage tests and elimination of electrostatic charge, can be carried out safely.

3.2.1.4 All components of the same rating and construction shall be interchangeable.

3.2.1.5 All current carrying parts and supports shall withstand without any damage the forces exerted at rated peak current, three phase short circuit or single phase short circuit to earth during 1 second.

- 3.2.1.6 The control gear shall be provided with anti-condensation space heating element. Quantities and arrangement shall be designed to prevent condensation. The heating elements shall be fitted in a way to enable their replacement by normal operations (230V AC supply). Control of heating shall be by humidity and temperature controllers. Adjustable current relay with alarming contact shall supervise the proper operation per each section of the control gear. The panel shall be mounted on a steel frame (included in the scope of supply), about 50 cm height, to enable cables routing from the middle of the concrete base, to the bottom of the panel. This base frame shall be covered with removable steel plates.
- 3.2.1.7 All parts of metal structure shall be thoroughly cleaned and painted to give effective protection in the site's atmosphere (see "Site Environmental Conditions") even if the control gear will be located in the Electrical room. Two coats of primer and two finishing coats of epoxy paint shall be applied with a total thickness of not less than 200 microns. An electrostatic painting process shall be utilized.
Color: According to Owner's Requirement.
Coating technique and procedure, coating materials and coat thickness are subjected to prior approval of Owner.
- 3.2.1.8 Each panel shall have front doors; each shall have hinges and fast lockers.
Door's hinges shall be of stainless steel. Other accessories such as nuts, lockers, bolts, latches, operating handles shall be plated (anticorrosive). Sealing of the doors shall be achieved by rubber gaskets mounted around all the doors. Doors to be equipped with door stoppers to prevent the doors to be moved by wind.

- 3.2.1.9 Every panel shall bear durable designation label (plate) on front and rear side. Internal components shall be labeled according to the codes within the electrical diagrams. Labels shall be with engraved characters. Warning labels shall be red. All external labels and warning labels shall be fixed by metal screws or by other agreed technique not to the equipment but to the steel sheet near the equipment.
- 3.2.1.10 Each panel shall be provided with a 230V PL type, fluorescent lamp having an operating switch, a protective cover and protected by a M.C.B. Contractor shall specify lamp type and manufacturer.
- 3.2.1.11 The compartment shall be large enough with 30% free space, to permit future installation of equipment. Cable ducts shall be on both sides of the cubicle and shall be large enough to contain all cables and wires with 30% spare volume.
- 3.2.1.12 Panels for indoor installation shall be made of 1.5mm sheet steel.

3.2.2 Wiring and Auxiliary Equipment

- 3.2.2.1 All auxiliary and control equipment and all necessary wiring shall be supplied by the Contractor and installed at his premises. Conductor bundles shall be protected by metal duct or flexible metal conduit where required.
- 3.2.2.2 Conductors of auxiliary and control circuits shall be of flexible copper, 1.5 sq.mm cross section. Secondary current transformers circuit conductors shall have a 4 sq.mm cross section, and voltage transformer shall have 1.5 sq.mm. Conductors shall have a 90°C flame retardant insulation, for 600V. Conductors shall be terminated by compression type ferrules or lugs for connection to the terminal boards or instruments terminals.
- 3.2.2.3 Each conductor shall be marked at both ends by original marking ferrules according to terminal number or device connection point.

In case connection is by flexible cable and plug - socket arrangement, the conductors of this cable may be of 1.5 sq.mm cross section only.

- 3.2.2.4 The control gear might be controlled and monitored from a remote control room. Therefore, all measuring signals, protections, trips, position of C.B's and earthing switch, position of selector switches, remote operation of closing and tripping coils, etc. shall be wired to separate terminal blocks.
- 3.2.2.5 Terminals shall be UK10 "Phoenix".
For current transformers secondary, terminals current type, with suitable bridges and other accessories shall be installed. All terminals shall be mounted on proper assembly rails with all proper parts, arranged in boards according to the wiring diagrams and in the order shown on the diagrams. Conductors shall be connected according to the wiring diagrams, and attention is to be paid to connect the conductors to that side of the terminals as shown in the diagram.
Only one conductor shall be connected to each side of terminal.
(Contractor shall take this requirement into consideration during the design). Where shown in the wiring diagrams, partition plates shall be inserted between terminals to avoid flashover. Assembly rails shall have ample reserve to add 10 percent of quantity of terminals designed in the future, but not less than 5 terminals.
- 3.2.2.6 Control and measuring circuits shall be protected by miniature circuit breaker (M.C.B.). Each M.C.B. shall include 2 aux. alarm contacts wired to terminals for Owner use.
- 3.2.2.7 The D.C control mini circuit breaker shall be two poles and shall withstand short circuit current of 10kA/1.3 msec.
- 3.2.2.8 All outdoor panels shall be provided with cable glands for sealing all cables connected to the panels.

3.3 Equipment Specifications

3.3.1 Control Switches

A spring return control switch, having a target indicating "close after close" and "trip after trip" position with pistol grip handle.

3.3.2 Indicating Lamps – Semaphores (LED type)

Semaphore (round type) indicating status of CB (open-close). Semaphore indicator (square type) for earthing switch On-Off indicating disconnector.

Semaphore indicator (square type) indicating disconnector status (open-close).

3.3.3 Rotary Switch

Rotary switches shall be panel mounted and shall have all the contacts required for the control circuits and in addition also a contact for each position for remote monitoring.

3.3.4 Terminal Blocks

Terminal blocks shall be mounted on the back or side walls and/or other easily accessible areas of the cubicle.

All terminal blocks shall be arranged to permit convenient termination for the incoming control cables which will enter the switchgear through floor openings. A minimum of 20 percent spare terminals shall be provided in each compartment.

3.3.5 Nameplates and Labels

Nameplates shall identify the panel at the back and at the front, each front panel mounted electrical device and each electrical device within each panel.

The nameplates and labels shall be fixed by self-tapping screws.

Nameplates lettering size for panel identification shall be 25 mm and for electrical device identification shall be 8 mm.

For electrical device within the panels, laminated plastic type nameplates with white core and black surface may be used. "Warning" plates having red letterings "DANGER" on white background shall be provided on all panels with access to live parts.

3.3.6 Cables

- 3.3.6.1 Cable entry shall be from the bottom only.
- 3.3.6.2 Cable supports shall be provided for all outgoing connections.

3.3.7 MCB's

Manufacturer ABB or similar

Model for DC S282 UCK

Model for AC S270

3.3.8 Auxiliary Control Relays

Manufacturer Enderis or similar

Model..... RE3000

Coil voltage..... 60/220VDC

Contacts 4 CH/O

3.4 Protection relay functions

All protection relays models and types shall be approved by IECo

3.4.1 Line Protection

3.4.1.1 The cubicle shall provide protection for incoming line from IECo switchyard.

3.4.1.2 For each line, the following protections shall be provided:

- Line differential 87L
- Directional distance..... 21
- Auto closing 79
- Synchro check 25
- Under voltage 27
- Directional earth fault..... 67N

3.4.1.3 For each line a separate disturbance recording unit shall be included.

3.4.2 Busbar Protection

3.4.2.1 The cubicles shall provide protection for the switch yard busbar.

3.4.2.2 The following protections shall be provided:

- Busbar protection with up to 8 end points87B
- Breaker failure protection.....50BF
- Synchro check25

3.4.2.3 Disturbance recording shall be included.

3.4.3 Synchronization system

3.4.3.1 The switchyard protection system shall include a dedicated synchronization and re-synchronization protection panel. The panel to include the following functions:

- Synchronization check between both sides of IECo circuit breaker
- RE-synchronization system directly linked to national supervision command center and under its control (incoming and bus tie circuit breakers)
- Re – synchronization system directly connected to generator controller

3.4.4 Operation Panel

3.4.4.1 The cubicles shall allow full remote control of seven 170kV switch yard bays:

- Four incoming fields, with disconnectors, earthing disconnectors and circuit breaker.
- One Tie field.

3.4.4.2 The cubicle shall also include metering of incoming lines.

3.4.4.3 The cubicle shall also include an annunciator and an active MIMIC.

3.4.5 Power Lines Field Cubicles

- 3.4.5.1 The cubicles shall provide full remote control of the main power lines (MPL) 170kV bay with 3 disconnectors, and circuit breaker.
- 3.4.5.2 The cubicle shall also provide protection as follows:
- MPL differential.....(87T, 87N, 87 TN)
 - MPL over current(50, 51)
 - MPL earth leakage over current.....(50N, 51N)
 - MPL over current(50, 51)
 - MPL residual voltage(59N)
 - MPL V/Hz Overfluxing.....(24)
- 3.4.5.3 The cubicles shall also provide metering, annunciator, disturbance recording and an active MIMIC

3.4.6 Decoupling and Cubicles

- 3.4.6.1 The cubicle shall provide a decoupling and load shedding system.
- 3.4.6.2 Decoupling shall be activated as a result of abnormal voltage (27,59) and/or frequency (81) and/or rate of change of frequency (df/dt-81R).
- 3.4.6.3 Measurement of the above parameters is at the 170kV bus.
- 3.4.6.4 The decoupling is achieved by tripping of the 170kV breakers on customer 170kV buses.
- 3.4.6.5 Local shedding shall be activated only after decoupling and shall be a result of under frequency (81) and/or rate of decay of frequency (df/dt-81R).

CHAPTER 2

Switchyard Grounding

1.0 **GENERAL**

- 1.1 This specification covers the installation of grounding system for the switchyard.
- 1.2 The main items the grounding system consists of are:
 - 1.2.1 Bare copper wires 185sqmm installed underground at a depth of 80 cm, lengthwise and widthwise at intervals of about 5 meters. The crossing points of the wires shall be connected.
 - 1.2.2 Copper clad 3/4" 12 m long electrodes with manholes.
 - 1.2.3 Connection from grounding grid to 161kV equipment.
 - 1.2.4 Grounding of metal structures.
 - 1.2.5 Grounding of electrical panels.
 - 1.2.6 Foundation grounding of all concrete bases.
 - 1.2.7 Foundation grounding of control building.
- 1.3 All grounding wire crossing, equipment connection wire, fence grounding and other metallic structures in the switchyard premises shall be done either with exothermic welds or underground compression connectors. The installation shall be carried out as per manufacturer guidelines regarding mold usage, surface preparation, crimping equipment, accessories storage prior to installation. All work shall be made with original manufacturer equipment and accessories designed for the work. No replacing/equivalent tools shall be approved.
- 1.4 The exothermic connection system or the underground compression system manufacturers shall receive IECo's written approval for underground substation installations prior to commencing of work.
- 1.5 All work shall be carried out in professional manner, as required under the EPC Contract. In addition to any approval or certification needed, all workers shall have valid certification from the system manufacturer for the performance of the works described herein.

2.0 **GROUNDING DETAILS**

2.1 **Grounding of equipment**

- 2.1.1 Supply and install on support structure of a grounding copper bus-bar 250x50x4 mm.
- 2.1.2 Supply and connect 95 sqmm copper wires as shown on detail drawing.
- 2.1.3 Supply and connect 35 sqmm copper wires as shown on detail drawing for panel grounding.
- 2.1.4 Welding of S.S. M10 bolts for bus-bar and structure grounding. Repair galvanization.

2.2 **Grounding of structure**

- 2.2.1 Supply and install on support structure of a grounding copper bus-bar 250x50x4 mm.
- 2.2.2 Supply and connect 95 sqmm copper wires as shown on detail drawing.
- 2.2.3 Welding of S.S. M10 bolts for bus-bar and structure grounding. Repair galvanization.

2.3 **Grounding electrode**

- 2.3.1 "Copperweld" or equal inserted in the soil.
- 2.3.2 60 cm concrete men-hole with lid.
- 2.3.3 Connection of 185 sqmm ground grid wire to electrode, without cutting the wire, with suitable connector.

2.4 **Fence grounding**

- 2.4.1 A 95 sqmm grounding wire installed at 1m from fence on both sides, as part of underground grid.
- 2.4.2 A 35 sqmm copper wire connected from the grid (by cadweld) to one section of the fence but in intervals of not more than 10 m.

- 2.4.3 Welding of S.S. M10 bolts (G9) for fence structure grounding.
Repair galvanization.

Welding of S.S. M10 bolts (G9) for fence gates. Use 35 sqmm flexible wire.
- 2.4.4 Provide a 35 sqmm vertical wire connected to one section of the fence but in intervals of not more than 10m.

Provide a 35 sqmm horizontal wire at 1m above grade, connected to the fence each 1m.

CHAPTER 3

DC System

1.0 **GENERAL**

This Specification covers the supply of D.C. Power Supply/Battery chargers and rack mounted batteries for 220VDC systems.

2.0 **SCOPE OF WORK**

- 2.1 Manufacture, test, pack, deliver, install on site of the following:
- D.C Power Supply/Battery Charger for 220VDC. (Type A), for stationary battery bank (IEC).
 - D.C Power Supply/Battery Charger for 220VDC. (Type B), for pure lead maintenance free battery bank (MANARA).
 - D.C Power Supply/Battery Charger for 220VDC. (Type C),for stationary battery bank (MANARA operational building).
 - D.C Power Supply 48V and two 60V model approved by IECO
 - 220V 200Ah stationary battery bank including racks. (Type A)
 - 220V 200Ah pure lead battery bank including racks. (Type B)
 - 220V 600Ah stationary battery bank including racks. (Type C)
- 2.2 Supply and connection of all cables, as required between the chargers and the batteries.
- 2.3 Battery real time monitoring system for type B and C systems.

3.0 **SHIPMENT AND TRANSPORTATION**

All components and accessories shall be packed suitably for shipping, transportation and storage until erection.

Equipment shall be sealed and protected during shipment and transportation to prevent damage to the paint work, corrosion and penetration of foreign matter.

The battery rack will be supplied dismantled. All components and accessories shipped loose for field assembly shall be suitably tagged to show identification.

Contractor shall prepare a detailed list of all field mounted items.

4.0 **STANDARDS**

Unless otherwise stated, all equipment shall be designed, constructed and tested in accordance with the requirements of the latest relevant publications of the International Electro Technical Commission (IEC). These include but are not limited to:

IEC 60076	Transformers
IEC 60146	Rectifiers
IEC 60947	Switchgear
IEC 60896-2	Lead/Acid batteries
IEC 60335-2-29	Battery chargers

Other relevant documents are:

Israel Standard	703 – Transformers
Israel Standard	165 – Electric Equipment Test Procedures
Israel Standard	959 – Printed circuits

5.0 **DRAWINGS**

- 5.1 The Contractor shall submit with his Proposal the following drawings data:
 - 5.1.1 Catalogues showing the batteries being offered, including the charge/discharge rate curves.
 - 5.1.2 Catalogues showing the Power Supply/Battery Charger
- 5.2 After award of the Contract, the Contractor shall submit for approval the following Engineering details:
 - 5.2.1 Arrangement and layout drawings of battery rack.
 - 5.2.2 Catalogues or drawings of the rectifier/charger unit with a detailed list of the equipment installed.
 - 5.2.3 Charge and discharge curves with work point.
 - 5.2.4 Calculations of battery ratings and charging requirements.
 - 5.2.5 Detailed construction drawings showing mounting details, wiring space, terminal blocks etc.
 - 5.2.6 Complete catalogue information on all equipment and accessories proposed.
 - 5.2.7 Circuit components list.
 - 5.2.8 Schematic wiring diagrams including circuit diagrams of all electronic devices. All wire numbers and terminal numbers shall be indicated.
 - 5.2.9 List of settings for timers, for protection and alarm devices (if necessary).
 - 5.2.10 Test reports according to the Israel Standards as per paragraph 6.
 - 5.2.11 On completion of equipment installation the Contractor shall supply six (6) complete sets of all catalogues and drawings as was specified above, together with operating and maintenance instructions.
 - 5.2.12 All data and documents shall be in English, and shall include as a minimum the following identifying information:
 - Project name
 - Unit equipment number

6.0 **SPARE PARTS**

Contractor shall provide a list of spare parts as stipulated in the Instructions to Participants.

7.0 **NAME PLATES**

The charger shall be provided with a name plate of suitable material which shall include at least the following data:

- Manufacturers' name
- Manufacturers' type and designation number
- Rated current
- Rated voltage
- Rated frequency
- Floating charge voltage setting limits
- Boost charge voltage setting limits

8.0 **TECHNICAL SPECIFICATION OF POWER SUPPLY/CHARGER**

8.1 Site Conditions

8.1.1 The battery rack and the power supply/chargers shall be located indoors.

8.2 AC Input Power Characteristics

8.2.1 Voltage: 400V, ±10%, 3 phase

8.2.2 Frequency: 50Hz, ±6%

8.2.3 Short circuit capability at input to power supply: 15kA

8.3 Required DC output

8.3.1	Voltage:	Type A,C	Type B
		187-242V	187-242V
8.3.2	Current (total):	50 Amp,100Amp	50 Amp
8.3.3	Output static stability: $\pm 1\%$ with 0÷100% DC load and $\pm 1\%$ simultaneous variation of input voltage and frequency of respectively $\pm 10\%$ and 6% and ambient temperature variations up to 50C.		

8.4 Efficiency: greater than 90%

8.5 Operation

- 8.5.1 In normal operation the power supply/charger shares the load and charge the batteries.
- 8.5.2 The two banks shall be connected to each power supply/charger.
- 8.5.3 The battery bank can be tested by reducing the DC power supply voltage to 1.8 volt/cell and verifying that all the load is now supplied by the batteries.

8.6 Installation

- 8.6.1 The charger shall be based on a full wave, thyristor controlled rectifier (SCR) connected through an isolating transformer, to the AC supply.
- 8.6.2 The charger shall be able to operate at withstandin inadvertent operation, with connection to a load, without a battery in parallel to the load.
- 8.6.3 The chargers shall be able to work at inadvertent operation with no load, or after it was disconnected for a long time.
- 8.6.4 The chargers shall be designed to prevent the battery from discharging back into the chargers in case of AC power failure or other charger malfunction.

- 8.6.5 The chargers shall have filters or other means to prevent voltage spikes or other distortions being fed back into the AC power supply due to the firing of SCR's or for any other reason. Harmonic content of the AC current shall be not more than 5%.
- 8.6.6 A filtering system shall be provided to limit the ripple content of the output voltage to max 1% RMS of nominal voltage, while the charge is delivering full load and the battery being not connected to the charger during this test. The filter shall be fused and provided with fuse failure indicator. Suitable discharge resistors have to be provided.
- 8.6.7 Chargers shall be provided with automatic load limiting feature that will limit the output current beyond 110% of the rated current by rapidly diminishing output voltage.
- 8.6.8 The Chargers shall be protected electronically against short circuit in the output leads or reverse battery connection.
- 8.6.9 Silicon diodes, thyristors, etc., shall be conservatively rated for long life and shall be protected against voltage transients with solid state surge protectors.
Other components shall be suitably protected by surge arrestors. Suitable means shall be provided for equal distribution of currents between parallel semi-conductors.
Suitable provisions shall also be provided to ensure equal and symmetrical phase currents.
- 8.6.10 Each charger shall be isolated from the AC source of supply by a dry-type three-phase transformer. Transformer shall be at least Class "H" insulation.
- 8.6.11 The winding wires shall be isolated with grade H (1800C) enamel, with mylar sheets between the layers; the windings will be vacuum impregnated (1 millibar).
- 8.6.12 The chargers shall have a DC reverse current-protection through a proper diode of reverse voltage not less than 600V and strength current not less than rated one.
- 8.6.13 Cabinet control circuits shall be made at 230V AC. The Fan Control Circuit shall be protected separately from the other control circuits.

- 8.6.14 Power AC and DC terminals will be of such a size and type that they will be able to carry the rated input and output currents. They will be protected against accidental contacts of operating personnel. Separate terminals shall be provided for connection to the battery and to the load.
- 8.6.15 The output filter capacitors shall have not less than 200V rated voltage. The discharge resistors that provide full discharge time less than 3 sec. shall be fixed to the capacitors. Pre-charge of above mentioned capacitors shall be provided via suitable resistors.
- 8.6.16 The maximum noise level at 1m distance shall be no more than 50dB.
The above mentioned sound noise level shall be measured while the charger is operating at rated voltage and frequency and at maximum rated output current. It shall be measured in accordance with ANSI 51.2.
- 8.6.17 The chargers shall be housed in a heavy gauge sheet metal cabinet (with min. 2 mm thickness), of modern design enclosure IP54.
- 8.6.18 Equipment components shall be ventilated so they will operate well below their critical temperature. Thermostats will disconnect such sensitive components before they reach dangerous temperatures.
- 8.6.19 Doors shall be mounted on the front side of the charger cabinet. The doors shall be provided with 3 point hinges and shall be of removable type. Each cabinet shall be of floor mounting type.
- 8.6.20 Conduit entrances into the cabinets will be on the bottom side.
- 8.6.21 Cabinet shall be manufactured so that it can be serviced in the field without needing special tools.
- 8.6.22 Cabinet shall be provided with appropriate lifting hooks for transportation.
- 8.6.23 The load terminal connection shall have provision to maintain the output voltage in limits of +10% during full charge of batteries (2.4V/cell).

8.7 Instrumentation

Each Charger shall be provided with the following:

- 8.7.1 AC input circuit disconnecting switch, three phase with 1 NO + 1 NC auxiliary contacts.
- 8.7.2 AC input voltmeter with three phase selector switch.
- 8.7.3 AC input ampermeter, 2% accuracy at full scale. Ammeter range shall be at least 10% greater than rated input current.
- 8.7.4 DC output circuit breakers (one for load and one for batteries), two pole, thermal magnetic protection with trip alarm contact and 2 NO +1 NC contacts.
- 8.7.5 Output DC voltmeter, 1.5% accuracy at full scale.
- 8.7.6 Output DC ampermeter, type, 2% accuracy at full scale. Ammeter range shall be at least 10% greater than charger DC rated current.
- 8.7.7 Output to batteries DC ampermeter 2% accuracy at full scale. Range shall be at least 10% greater than charge DC current with zero center scale. All the measuring instruments shall be digital true type with wide LCD display.
- 8.7.8 All the measuring a.m. data shall be stored in microprocessor based memory.

8.8 Alarms and Signalization

- 8.8.1 The following alarms shall be provided on the front panel of the charger:
 - a. Charger DC Output Breaker Open
 - b. Charger AC Input Breaker Open
 - c. Charger AC Power Failure
 - d. Charger DC Power Failure
 - e. Charger Overloaded
 - f. High temp. in the charger
 - g. Charger Ventilation Failure
 - h. Filter Capacity Bank's Failure
 - i. Earth Leakage (+) and (-)

j. Low voltage DC

k. High voltage DC

8.8.2 On the front panel to the charger, there shall be installed multi-led lamps, one for each alarm and one for "Power On". A button "Lamp Test" for all indications shall be provided.

8.8.3 Two (2) Remote Alarm Relays, with 110V DC coil, to be powered from the batteries with 1 NO + 1 NC aux. contacts, rated 125V DC 1 Amp. or 220V AC 3A 50Hz shall be installed:

1. One alarm relay shall combine the alarms a, b, c, d, e, h, i, k, and l.

2. The second alarm relay shall combine the alarms f & g.

3. The contacts of these relays shall be wired to terminal blocks.

8.8.4 The charger shall have the possibility to remote signal for charger in function.

8.8.5 All controls, lamps and instruments mounted on the front side of the charger will be labeled with a legend labels, 5 mm high, black letters on white background.

8.8.6 The labels shall be in Hebrew and English. Inside mounted components and wiring shall be also labeled in full accordance with manufacturer's drawings.

8.8.7 The labeling technique is left to the manufacturer's decision, but shall get Owner's approval.

8.9 Tests

8.9.1 The Contractor shall conduct charger/rectifier routine tests according to its parameters and tolerances list.

8.9.2 All necessary tests shall be carried out at the Contractor's shop. The Owner and the O&M Contractor shall have the right to inspect and witness all tests.

9.0 **BATTERY TECHNICAL SPECIFICATION (TYPE A and TYPE C)**

9.1 Battery Data

- 9.1.1 The battery shall be rated at 150 Ah/220V, 600Ah/220V.
- 9.1.2 Battery shall consist of 106 cells to give a total nominal voltage of 220V.
- 9.1.3 Discharge rates:
- 9.1.4 15A for 10 hours (150 Ah)
- 9.1.5 20A for 5 hours
- 9.1.6 23.5A for 3 hours
- 9.1.7 Cell voltage at the end of each of the above mentioned discharge period shall not be less than 1.85V at the 25°C.
- 9.1.8 Initial cell voltage (“Floating” range) -
2.23V +2% per cell
-0%

9.2 Battery Technical Requirements

9.2.1 Installation

- 9.2.1.1 The battery shall be rated in ampers and ampere-hours for a given time period to a specified end voltage, at temperature of 250C.
- 9.2.1.2 The battery shall be lead acid plant type for stationary service. (GROE). The batteries shall be supplied with safety vents and recombination plugs for minimum escape of explosive gases and conversion of hydrogen and oxygen to water.
- 9.2.1.3 The battery shall include the cells, inter-cell and inter-tier connectors, terminal lugs, racks-cell numbers and accessories as hereinafter specified.
- 9.2.1.4 The cell jars shall be individual and they shall be made of plastic. They shall be of substantial construction with walls of uniform thickness, and designed to withstand without breakage the conditions of normal operation.

Jars shall be fitted with sealed covers that shall remain tight during the life of the cells.

A cell replacement guarantee against jar breakage shall be made with the proposal.

- 9.2.1.5 All inter-cell, inter-row and inter-rack connectors, bolts and terminal lugs shall be lead-plated.
- 9.2.1.6 The necessary number of acid resisting cell numbers shall be included.

The storage battery shall be provided with a battery rack. The rack shall be the heavy-duty type arranged so that the cells will stand with the plates at right angles to rack rails. The rack shall be of all metal construction and shall be painted with a minimum of two coats of acid-resistant pain.
- 9.2.1.7 The cells shall be shipped after formation and fully charged to provide for full capacity ready use.
- 9.2.1.8 The battery shall be arranged for mounting in shelves on each rack.
- 9.2.1.9 The battery shall be provided with main terminals and lead-plated terminal lugs to accommodate the Owner's two copper cables per polarity coming from above. Cable sizes will be furnished after award.
- 9.2.1.10 The battery will be operated in an ambient temperature not exceeding 50°C.
- 9.2.1.11 The battery shall have a guaranteed service life of 10 years at least.
- 9.2.1.12 As early as possible, the Contractor shall indicate on the Civil Engineering drawings the amount of fresh ventilation air required to prevent hydrogen accumulation, especially when the batteries are being charged.
- 9.2.1.13 The battery rack shall be provided with isolating links for groups of batteries up to 50V.

9.2.2 Operation Mode

9.2.2.1 These batteries are floating, which means that each battery does not output any current under normal operating conditions, with the exception of occasional transient peaks. However, the battery supplies all the consumption requirements when the AC power supply fails.

The corresponding charging set can be used to select one of the four operating modes below:

9.2.2.1.1 Automatic Operation

The sequence is as follows:

After the charging set AC power is restored, operation re-starts at the charging voltage, i.e. “floating mode” or “full charge”, depending on the time during which the charging set AC power was interrupted.

The initial allowable charging current value is 0.1xC10 A.

9.2.2.1.2 Monitored “Floating Battery Operation

In this case the voltage across the charging set terminals is held constant and equal to the “floating operation” set point value.

9.2.2.1.3 Monitored Charging

In this case the voltage across the charging set terminals is kept constant and equal to the “full charge” set point value.

Variation of voltage in function from cell temperature needs to be provided if required.

9.2.2.1.4 Manual Operation

(Charger disconnected from battery).

In this case the voltage is adjusted by a manually controlled potentiometer independently of the regulation. This allows the voltage to be varied from 0 to 2.4V per cell.

9.2.2.2 Nominal Capacity

The nominal battery capacity, designated by the symbol C10 Ah, is the guaranteed capacity when discharging in 10 hours at 0.1 C10 (A), at 25°C ambient temperature and for a shutdown voltage of 1.75V per element. This value has a tolerance of -5%

9.2.2.3 Voltage Values

The following battery terminal output voltages are adopted for floating battery operation:

- Floating mode voltage: 2.23V +2% -0% per element.
- Full charge load: 2.40V ±1% per element

The voltage at the end of discharge is fixed at 1.85V per element to avoid dropping below the minimum specified voltage.

9.3 Testing

- 9.3.1 The battery shall be given full discharge factory test to prove that it will meet the specified 10 hour discharge rate.
- 9.3.2 The Owner shall be notified at least 48 hours in advance so that he may witness the test, if he so desires.
- 9.3.3 The Contractor shall provide certified test reports.
- 9.3.4 The battery shall be tested in accordance with IEEE Standard 450, "IEEE Recommended Practice for Maintenance, Testing and replacement of Large Type Power Plant and Switchyard Lead Storage Batteries".

10.0 **BATTERY TECHNICAL SPECIFICATION (TYPE B)**

(Maintenance free)

10.1 **Battery Data**

10.1.1 The battery shall be rated at 150 Ah/220V

10.1.2 The 220V battery shall consist of 105 cells to give a total maximum voltage of 242V (105 cells by using 6 cell and 1 cell batteries). Discharge rates:

15A for 10 hours (150 Ah)

20A for 5 hours

23.5A for 3 hours

10.1.3 Cell voltage at the end of each of the above mentioned discharge period shall not be less than 1.85V at the 25°C.

10.1.4 Initial cell voltage (“Floating” range) -
2.25V +2% per cell
-0%

10.2 **Battery Technical Requirements**

10.2.1 **Installation**

10.2.1.1 The battery shall be rated in Ampers and ampere-hours for a given time period to a specified end voltage, at temperature of 25°C.

10.2.1.2 The battery shall be maintenance free pure lead type for stationary service with gas recombination chemical process.

10.2.1.3 The battery shall include the cells, inter-cell and inter-tier connectors, terminal lugs, racks-cell numbers and accessories as hereinafter specified.

- 10.2.1.4 The cell jars shall be individual and they shall be made of plastic. They shall be of substantial construction with walls of uniform thickness, and designed to withstand without breakage the conditions of normal operation. Jars shall be fitted with sealed covers that shall remain tight during the life of the cells.
- 10.2.1.5 All inter-cell, inter-row and inter-rack connectors, bolts and terminal lugs shall be lead-plated.
- 10.2.1.6 The necessary number of acid resisting cell numbers shall be included.
- The storage battery shall be provided with a battery rack. The rack shall be the heavy-duty type arranged so that the cells will stand with the plates at right angles to rack rails. The rack shall be of all metal construction and shall be painted with a minimum of two coats of acid-resistant paint.
- 10.2.1.7 The cells shall be shipped after formation and fully charged to provide for full capacity ready use.
- 10.2.1.8 The battery shall be arranged for mounting in shelves on each rack.
- 10.2.1.9 The battery shall be provided with main terminals and lead-plated terminal lugs to accommodate the Owner's two copper cables per polarity coming from above. Cable sizes will be furnished after award.
- 10.2.1.10 The battery will be operated in an ambient temperature not exceeding 500C.
- 10.2.1.11 The battery shall have a guaranteed service life of 10 years at least.
- 10.2.1.12 As early as possible, the Contractor shall indicate on the Civil Engineering drawings the amount of fresh ventilation air required to prevent hydrogen accumulation, especially when the batteries are being charged.
- 10.2.1.13 The battery rack shall be provided with isolating links for groups of batteries up to 50V.

10.2.2 Operation Mode

10.2.2.1 These batteries are floating, which means that each battery does not output any current under normal operating conditions, with the exception of occasional transient peaks. However, the battery supplies all the consumption requirements when the AC power supply fails.

The corresponding charging set can be used to select one of the four operating modes below:

10.2.2.1.1 Automatic Operation

The sequence is as follows:

After the charging set AC power is restored, operation re-starts at the charging voltage, i.e. “floating mode” or “full charge”, depending on the time during which the charging set AC power was interrupted.

The initial allowable charging current value is 0.1xC10 A.

10.2.2.1.2 Monitored “Floating Battery Operation

In this case the voltage across the charging set terminals is held constant and equal to the “floating operation” set point value.

10.2.2.1.3 Monitored Charging

In this case the voltage across the charging set terminals is kept constant and equal to the “full charge” set point value. Variation of voltage in function from cell temperature needs to be provided if required.

10.2.2.1.4 Manual Operation

(Charger disconnected from battery). In this case the voltage is adjusted by a manually controlled potentiometer independently of the regulation. This allows the voltage to be varied from 0 to 2.4V per cell.

10.2.2.2 Nominal Capacity

The nominal battery capacity, designated by the symbol C10 Ah, is the guaranteed capacity when discharging in 10 hours at 0.1 C10 (A), at 25°C ambient temperature and for a shutdown voltage of 1.8V per element. This value has a tolerance of -5% in accordance with IEC 623.

10.2.2.3 Voltage Values

The following battery terminal output voltages are adopted for floating battery operation:

- Floating mode voltage: 2.25V +2% -0% per element
- Full charge load: 2.40V ±1% per element

The voltage at the end of discharge is fixed at 1.8V per element to avoid dropping below the minimum specified voltage.

10.3 Testing

- 10.3.1 The battery shall be given full discharge factory test to prove that it will meet the specified 10 hour discharge rate.
- 10.3.2 The Owner shall be notified at least 48 hours in advance so that he may witness the test, if he so desires.
- 10.3.3 The Contractor shall provide certified test reports.
- 10.3.4 The battery shall be tested in accordance with IEEE Standard 450, "IEEE Recommended Practice for Maintenance, Testing and replacement of Large Type Power Plant and Switchyard Lead Storage Batteries".

11.0 **BATTERY REAL TIME MONITORING SYSTEM**

11.1 General

This chapter described the technical requirement for the battery real time monitoring system for battery Type B and C – see para. 10.0.

The battery real time Monitoring system shall have a local LCD display for viewing battery condition status on real time. The Contractor shall connect the system by suitable communication cable to the main switchyard PLC system and PSPP SCADA SYSTEM.

11.2 Battery type

Maintenance free – pure lead.

11.3 Component of the unit

11.3.1 Remote units for all the battery/cells connected by communication to the PLC.

11.3.2 Main PLC unit – for collect and analysis the battery/cell parameters.

11.3.3 Comm. converter (option).

11.3.4 Current shunt for measurement.

11.3.5 All the necessary components for the system operation.

11.4 Technical definition

All the parameters of the cells will be measured by using special units which will be installed on each battery/cell for measuring of the following parameters.

1. Internal impedance.
2. Cell Voltage.
3. Battery/cell temp.
4. Discharge current.
5. String current.
6. Discharge time.
7. Recharge time

11.5 Range of battery cells measurement parameters

- 11.5.1 Cell voltage range 1.5 – 3 Volts.
- 11.5.2 Temp. of cell measurement -10 – 70°C.
- 11.5.3 Cell impedance range 0.005-250mΩ.
- 11.5.4 Voltage measure accuracy ±0.5%.
- 11.5.5 Temp. measure accuracy ±2°C.
- 11.5.6 Impedance measure accuracy ±2%.

11.6 Real time battery system monitoring PLC unit

- 11.6.1 The main PLC unit shall collect the battery parameters from all the remote battery/cells units and shall display the analysis stored data.
- 11.6.2 PLC storage unit shall be at least for six months of the battery system data.
- 11.6.3 The PLC shall be equipped with a local LCD monitor and with RS-485 & RS232 comm. ports.
- 11.6.4 The system shall be supplied with a PC software for battery parameters indications and display.
- 11.6.5 The PLC shall test and display the battery/cell para. every day.
- 11.6.6 The PLC shall have at least two outputs contacts for general fault indication 1N.O+1N.C.

11.7 General requirements

- 11.7.1 The proposal shall include the connection of the real time battery monitoring system by comm. to the main PLC of the switchyard.
- 11.7.2 The proposal will include the system itself, all connection from the batteries to the remote units and from the remote units to the main PLC unit.

12.0 **GENERAL CONDITIONS**

12.1 Warranty- refer to RFP document –section IX ,general provisions clause 7.0

12.2 Data to be provided by Contractor:

The Works described herein are an integral part of the contract and as such all requirements regarding DATA submittals specified in Section I- Owner's Requirements and Section VI-Particular EM and HM specifications shall be applicable to this specification.

Notwithstanding the above mentioned the Contractor shall also be required the following:

12.2.1 Information to be submitted with Quotation

Contractor shall forward his own complete and detailed proposal covering the specified performances, delivering and conditions. The proposal shall include as a minimum:

12.2.1.1 Completed data sheets as per this spec.

12.2.1.2 General specifications of Contractor's delivery, clearly stating scope of supply.

12.2.1.3 Drawings or standard diagrams showing overall dimensions, installation requirements, weights, etc.

12.2.1.4 Type test report.

12.2.1.5 Delivery date.

12.2.1.6 Proposed deviations from requirements, if applicable.

12.2.1.7 Conformity with bid documents.

12.2.2 Data to be submitted after contract award

No later than 8 weeks after the award of the Contract the Contractor shall submit the following data:

12.2.2.1 Detailed final dimension drawing including weights.

12.2.2.2 Civil engineering requirements for mounting of equipment.

12.2.2.3 Catalogues for all equipment.

12.2.2.4 Schematic and wiring diagrams.

12.2.3 Data to be submitted prior to erection

3 weeks prior to erection Contractor shall submit the following:

12.2.3.1 Project book including all drawings, all catalogues, all instructions for erection, all instructions for commissioning and detailed data sheets.

12.2.3.2 Final test report.

12.2.4 All the above data mentioned in 12.2.1÷12.2.3 shall be submitted in four copies. All drawings and Data Sheets shall be submitted also on magnetic media: Drawings in AUTOCAD format and Data Sheets in Word for Windows format.

12.3 Language

Quotes, data, documentation plus any magnetic media and any communication shall be in English.

12.4 Delivery time

12.4.1 Contractor shall submit his best delivery time including major milestones.

12.5 Type of equipment

The equipment must get IECo. (Israel Electric Company) approval. Equipment shall be of similar make and type used by IECo. in the last 5 years.

CHAPTER 4

HV Equipment Electrical Installation

1.0 **SCOPE OF WORK**

- 1.1 The Contractor shall install all 161kV equipment and related apparatus, supply and connect all required control cables .

2.0 **DETAILED SCOPE OF WORK**

2.1 Installation of Disconnector switch

- 2.1.1 Assembly of 3 pole disconnecting switch.
- 2.1.2 Assembly of earthing switches.
- 2.1.3 Mounting of equipment control panel.
- 2.1.4 Supply all S.S. bolts, washers and nuts.
- 2.1.5 Supply and connection to grounding system as per appendix 2.
- 2.1.6 Assistance to commissioning engineer.
- 2.1.7 Painting for phases identification.

- 2.1.8 Connection of all power and control cables.
- 2.1.9 Modification of control panels' wiring according to IECo request and drawings.
- 2.1.10 Supply and mounting of equipment nameplates with 15mm letters.
- 2.1.11 Supply and mounting of all small materials such as cable ducts, cable ladders, supports etc.
- 2.1.12 Supply and connection of wire clamps for connection of AL 2X625 sqmm wires to CU bolts of the disconnecting switch. Price to include contact paste. Wire clamps shall be approved by IECo.
- 2.1.13 Check all control circuits according to schematic diagrams.

2.2 Installation of circuit breaker (CB)

- 2.2.1 Mounting in place of support structure supplied with CB.
- 2.2.2 Filling between structure and concrete base with epoxy based concrete.
- 2.2.3 Assembly of three poles of the CB mounting on support structure.
- 2.2.4 Supply all S.S. bolts, washers and nuts.
- 2.2.5 Mounting of CB control panel.
- 2.2.6 Supply and connection to grounding system as per chapter 2.
- 2.2.7 Assistance to commissioning engineer.
- 2.2.8 Painting for phase identification.
- 2.2.9 Connection of all power and control cables.
- 2.2.10 Modification of control panels' wiring according to IECo request and drawings.
- 2.2.11 Supply and mounting of equipment nameplates with 15mm letters.
- 2.2.12 Supply and mounting of all small materials such as cable ducts, cable ladders, supports etc.

2.2.13 Supply and connection of wire clamps for connection of AL 2X625 sqmm wires to AL plate of the CB. Price to include contact paste. Wire clamps shall be approved by IECo.

2.2.14 Check all control circuits according to schematic diagrams.

2.3 Installation of current transformer (Single phase CT)

2.3.1 Supply all S.S. bolts, washers and nuts.

2.3.2 Mounting of CT on support structure.

2.3.3 Supply and connection to grounding system as per appendix 2.

2.3.4 Supply and connection of wire clamps for connection of AL 2X625 sqmm wires to AL plate of the CT. Price to include contact paste. Wire clamps shall be approved by IECo.

2.3.5 Supply install and connect cables from CT to junction box mounted on the support structure.

2.3.6 Supply and mounting of equipment nameplates with 15mm letters.

2.3.7 Supply and mounting of all small materials such as cable ducts, cable ladders, supports etc.

2.3.8 Check current transformer and current circuits.

2.4 Installation of voltage transformer

2.4.1 Supply all S.S. bolts, washers and nuts.

2.4.2 Mounting of VT on support structure.

2.4.3 Supply and connection to grounding system as per appendix 2.

2.4.4 Supply and connection of wire clamps for connection of AL 1X625 sqmm wire to AL plate of the VT. Price to include contact paste. Wire clamps shall be approved by IECo.

2.4.5 Supply install and connect cables from VT to junction box mounted on the support structure.

2.4.6 Supply and mounting of equipment nameplates with 15mm letters.

2.4.7 Supply and mounting of all small materials such as cable ducts, cable ladders, supports etc.

2.4.8 Check voltage transformer and voltage circuits.

2.5 Installation of surge arrester

- 2.5.1 Supply all S.S. bolts, washers and nuts.
- 2.5.2 Mounting of SA on support structure.
- 2.5.3 Supply and connection to grounding system as per appendix 2.
- 2.5.4 Supply and connection of wire clamps for connection of AL 1X625 sqmm wire to AL plate of the SA. Price to include contact paste. Wire clamps shall be approved by IECO.
- 2.5.5 Supply and mounting of equipment nameplates with 15mm letters.
- 2.5.6 Supply and mounting of all small materials such as cable ducts, cable ladders, supports etc.
- 2.5.7 Check surge arrester.

2.6 Installation of post insulator

- 2.6.1 Supply all S.S. bolts, washers and nuts.
- 2.6.2 Mounting of post insulator on support structure.
- 2.6.3 Supply and connection to grounding system as per appendix 2.
- 2.6.4 Supply and connection of wire clamps for connection of AL 1X625 sqmm wire to AL plate of the post insulator . Price to include contact paste. Wire clamps shall be approved by IECO.
- 2.6.5 Supply and mounting of equipment nameplates with 15mm letters.
- 2.6.6 Supply and mounting of all small materials such as cable ducts, cable ladders, supports etc.
- 2.6.7 Check post insulator.

2.7 Installation of switchyard bas-bar

- 2.7.1 Supply and install bus-bar system made of Aluminum alloy (Mg Si 0.5 F22 E-AL) tubes 120/12mm including 300 sqmm AL damping wires.
- 2.7.2 Supply and mounting of all required post insulators. Post insulators shall be approved by IECO.

- 2.7.3 Supply and connection to grounding system as per appendix 2.
- 2.7.4 Supply and connect all 625 sqmm AL wire clamps required for all fields connected to the bus-bar.
- 2.7.5 Supply and mounting of all small materials such as cable ducts, cable ladders, bus-bar supports etc.

2.8 Installation of Line Trap

- 2.8.1 Assembly of the line trap and mounting on the support structure.
- 2.8.2 Supply and connection to grounding system as per appendix 2.
- 2.8.3 Supply and connection of wire clamps for connection of AL 2X625 sqmm wires to AL plate of the CT. Price to include contact paste. Wire clamps shall be approved by IECo.
- 2.8.4 Supply and mounting of all small materials such as cable ducts, cable ladders, supports etc.

2.9 161 kV Wiring

The wires to be used shall be aluminum 2x625 sqmm. The connection devices shall be RIBE or PFISTERER make or equal approved by IECo.

2.10 Control cables

All the control cables shall be supplied and installed by the Contractor. The cables shall be made of stranded copper and will be shielded, N2XCY, with flame retardant outer sheath (FR3). All wires of the cables shall be numbered. The cable shall be installed in cables conduits in the HV switchyard and on cable ladders, outside the switchyard. The “Control” cables include all low voltage cables: supply AC/DC to the control panels, signalization and control. Price to include connection of cables on both ends, marking of wires with plastic ferrules and marking of cable on both ends.

CHAPTER 5

Fire Alarm System

1.0 **EQUIPMENT INSTALLED ON SITE – DESCRIPTION**

The specification defines Fire Alarm Systems for Manara Switchyard control building.

The equipment shall be approved by IECo.

1.1 **Control and Command Panel**

1.1.1 This panel shall be addressable. The Panel incorporates emergency power supply system based on dry batteries that shall enter into operation automatically in case of the mains power failure.

The control and command Panel shall be equipped with timers to delay the power failure alarm, the extinguishing operation and the fault operation. The control and command Panel shall be operated on local network power 240VAC, 50Hz.

1.1.2 The control and command Panel shall be modular with plug in units (front draw). The detection system shall be connected through a Dialer to three preference telephone numbers.

1.1.3 The control Panel shall comply with the requirements of UL-864 and Israel Standard 1220.

1.1.4 The control switch board and the detector shall operate on low voltage, 24VDC and draw minimal currents.

1.1.5 During mains power failure the control Panel shall switch to emergency batteries that shall enable the detectors, alarm horn, control circuits and automatic dialer telephone line for 72 hours. When this period is elapsed, in case of fire alarm, the system shall operate and enable operation of the alarm horns, control circuits, telephone, remote control etc. for additional 60 minutes minimum.

1.2 **Detection and Alarm Equipment**

1.2.1 **Detectors**

The sub-contractor shall supply and install as necessary detectors of the following types, according to the detailed requirements.

All detectors shall comply with the conditions set by the System and their operation environmental conditions.

- 1.2.1.1 Ionization Detectors – employ the principle of the conduction change as a result of flame fumes penetration.
- 1.2.1.2 Electro-optic smoke Detectors – employ the principle of light refraction change in presence of smoke. The detector is equipped with photo-electric cell with permanent light source produced by a photo-diode.
- 1.2.1.3 Heat Detectors – When the temperature rise rate exceeds 8.3 degrees per minute, or when the external air temperature reaches the level of 740C or any predetermined level, the detector is operating.
- 1.2.1.4 Liquid Level Detectors:
1. The detector electrodes shall be installed at 0 level above the floor.
 2. The detector electrodes shall be gold-nickel plated and shall be applied to the floor with epoxy adhesive (avoiding accumulation of dirt or insects).
 3. The detector shall work on 12-24 VDC power supply. The detector alarm unit shall operate the alarm at a center station.
 4. The detector shall operate together with other systems. A horn connected to the detector shall produce 85 dBA level alarm.
 5. When the fluid surface is dropped, the horn shall stop its call.
- 1.2.1.5 Air-condition ducts smoke detectors This detector is installed in air-condition ducts to detect smoke in the air flowing in the duct.
- 1.2.1.6 Suction Detectors The suction detector consists of an active/passive suction system.

Air pumped from the protected space flows through the detectors that in presence of high smoke particle concentration produce an alarm signal.

The detectors in the specific installations shall have an identical base to that the various types of detectors are interchangeable with no need to modify the installation.

Each detector shall have an integral alarm lamp and all shall comply with Israel Standard 1220 and FM/UL certified.

The equipment Contractor shall submit the Atomic Energy Committee certificate (for ionization detectors) stating safe detector maintenance.

1.2.2 Manual Pushbuttons

Manual pushbuttons initiate manually the alarm or operation of the fire control system.

1.2.2.1 Extinguisher Control Pushbuttons. The gas extinguisher control pushbuttons shall be of the dual action type (pushbutton with glass or pulling), red colored.

A 2 x 10 cm sign shall be installed under the pushbutton, indicating Fire Extinguisher Control. The sign shall be of red laminated material with white engraving.

1.2.2.2 Alarm Control Pushbuttons

Pressing the pushbutton shall produce fire location indication in the control panel.

A 2 x 10 cm sign shall be installed under the pushbutton, indicating Fire Detection Pushbutton. The sign shall be of red laminated material with white engraving.

The pushbuttons of both types shall be installed at 1.5 meter height above the floor.

The material of the pushbutton structure – metal or thermostatic plastics.

1.2.3 Fire Alarm Horns

The fire alarm horns shall be capable to produce each two types of signals: a continuous single frequency tone and oscillating tone (up and down). The oscillating tone shall be used to indicate fire situation while the single frequency tone shall be audible in case of fault detection signal. Both signals levels shall be 105 dB at a distance of 5 meters.

The outdoor horns shall be of the type meeting severe environmental conditions for tightness, temperature resistance etc. Evacuation horns shall operate in case of automatic fire extinguishing in rooms to ensure rapid evacuation of the room. Signal level shall be 90 dB at a distance of 1 meter.

The horn shall be operated together with a flashing white lamp with attached sign stating: Extinguishing Operated, functioning when fire extinguishing is applied in rooms.

1.2.4 Alarm Lamps

1.2.4.1 Installation of fire alarm lamps (flashers) on electric switchboards with fire detection/closed spaces. The lamps shall flash in the event of operation or alarm. The lamps shall be of low current consumption type, and the lamp installation shall include signs as necessary, at an appropriate size so that the characters are clearly visible from height of 5 meters and from distance up to 10 meters.

The sign statement shall be: Fire Detection.

1.2.4.2 A lamp indicating “Extinguishing in Operation, No Entry” shall be installed at the entrance to the fire extinguishing area. The lamp shall flash as long as the fire extinguishing is running.

1.3 Operation and Extinguishing Equipment

1.3.1 Gas Storage Cylinders

1.3.1.1 Fire extinguishing gas cylinder shall comply with NFPA 12A, 2000 Standard requirements.

- 1.3.1.2 The cylinders shall contain gas FM200.
- 1.3.1.3 The cylinders shall be installed near the wall and shall route the extinguishing gas in pipes to the spaces.
- 1.3.1.4 The cylinders shall be appropriately installed so that the pulling handle and the pressure gage shall be 1.5 meter high above the floor (for convenience of the user). A sign shall be installed near each cylinder box, 15 x 20 cm in size, stating: Extinguishing Control: To Operate
- Extinguisher in Room _____ Draw Safety and Press Handle Up.
- The cylinders shall be secured well to the wall by means of appropriate seats.
- 1.3.1.5 Cylinder design pressure shall comply with the maximum pressure that may be developed at a temperature of 700C. At this temperature the cylinders shall discharge automatically its pressure outside. In addition, the pressure shall be discharged whenever the pressure will reach 1000 psi.
- 1.3.1.6 The system shall comply with ASTM, UL standards as well as other standards referenced in the technical specification.
- 1.3.1.7 The position of the pressure gage on the cylinder shall allow quick and clear reading of the gage.
- 1.3.1.8 Each system shall be equipped with backup cylinders including installation of check valves, piping and all accessories necessary to ensure normal and safe system operation. Cylinder change over shall be provided by means of a selector.
- 1.3.1.9 The FM200 cylinders shall be filled at a density not exceeding 0.897 kg/liter and no less than 0.48 kg/liter.
- Dry nitrogen shall be compressed into the tanks so that the added pressure shall be 360 psig or 600 psig at a temperature of 210C.

- 1.3.1.10 A stainless steel nameplate shall be applied to each cylinder stating:

Type of gas

Weight

Density level

Weight of empty cylinder

Qualified standard mark

In addition, a data plate shall be applied to each cylinder with the details mentioned above.

The cylinders are of standard size of the Contractor manufacturer only and shall be painted according to the paint specification.

- 1.3.1.11 The gas quantity proposed by the contractor shall not exceed by more than 10% the quantity specified in the drawings.
- 1.3.1.12 The cylinders shall be operated both manually and automatically.
- 1.3.1.13 Release valve shall be installed on the cylinder opening or neck to facilitate instantaneous drain of the cylinder gas. The valve shall be of a type operative by means of an electronic switch.
- 1.3.1.14 The valve may be operated either manually or electrically or both.
- 1.3.1.15 When opened, the valve shall be opened fully so that no part of the valve disturbs the gas flow within the assigned time period.
- 1.3.1.16 The pressure drop through the valve shall ensure 200 psi pressure minimum.

1.3.2 Extinguishing Measures

1.3.2.1 Extinguishing Gas

1.3.2.1.1 The quality of gas FM200 shall comply with the requirements of NFPA2001 and NFPA12A.

1.3.2.1.2 The gas shall be stored in cylinders at the required weights.

1.3.2.1.3 The gas shall be inserted into the cylinders after the system is complete and tested.

1.3.2.2 Quantities of the Extinguishing Gas.

See drawings.

1.3.3 Spray Nozzles

The gas spray nozzles shall be designed for direct installation on the piping system accessories. The nozzles shall comply with standards NFPA 12A, 2001 (for FM200) and NEPA12 for CO₂ and be of type and size that shall not be obstructed and shall spray the gas effectively into the protected area.

1.3.4 Distribution Piping System

1.3.4.1 The sub-contractor shall prepare detailed design of the distribution piping system for the various systems including the proposed layout of the piping system and all accessories installed from the cylinders up to the nozzles, the drawing of the proposed piping system on the building drawing, dimensions of the piping system considering the nozzles and the pressures of the gas cylinders including computerized calculations of gas flow through the nozzles and estimated discharge time for each system (the sub-contractor shall submit the piping system diameters and flow calculations for the COR approval).

1.3.4.2 The piping system shall comprise seamless pipes conforming to the standards:

ASTM A-53 or A-106 or ANSI-106 B-36-10 wall thickness Sch-40 and Sch-80.

Considering the pressure, the piping system and accessories joints shall be made by socket weld fitting or quick disconnect of 3000 lb. strength except for nozzle joints that shall be of NPT thread type. The piping system accessories shall comply with standard ASTM-234, and the system working pressure. The entire piping system shall be grounded to the main grounding bus of the building. When an approval for connecting certain section with screws, each such section shall be connected separately to the grounding bus.

The supports shall be made of steel profiles.

The piping system shall be cleaned after final installation by means of compressed gas.

Prior to the piping system installation, it shall be tested by means of inert gas at a pressure of 16 atmosphere for 6 hours minimum.

1.3.4.3 Copper piping system shall be approved according to ASTM.

1.3.5 Manual Control Devices (Pull Box)

The electric pull box used with gas extinguishing system installed in rooms and cabinets. The device has breakable cover and it is installed at a height of 1.5 meter above floor and marked by means of appropriate sign as necessary.

These devices are waterproof.

1.4 Wiring

The wiring to the various systems shall be made by 0.8 mm² minimum cross-section conductor pairs for the fire detection system and 1 m² for the fire extinguishing system as well as by means of multi-conductor cable NYBY 1.5.

The wiring shall be threaded in 23 mm fire retardant rigid or semi rigid pipes as follows:

1. In concealed installations above suspended ceilings: red "merihaf" flexible pipes.
2. In concealed installations to fire alarm stations: red concrete embedded or surface mounted conduits.
3. Unconcealed installations {HVAC, electric rooms): 23 mm gray "Meriron" rigid pipe.
4. Beneath raised floor: red "Merihaf" flexible pipes.

The wiring and piping installation includes passages, excavations, drilling, supports and joints of all necessary types. Including junction boxes. Outdoors the boxes shall be waterproof sealed with sealed inlets. The wiring supports shall be provided on cable ladders and construction. Wire and cable end connections shall be carried out through junction boxes. Wiring shall comply with Israel Standard 108, edition in effect and with the General Specification for Electric Installations No. 08 prepared by the special inter-ministry committee.

1.5 Marking and Signing

The marking and signing shall be produced in Hebrew as follows:

- 1.5.1 For the various boards (switchboards, junction boxes, etc.)
- 1.5.2 Cables, pipes, wires, ducts
 - 1.5.2.1 Each end of cable, wire threaded in pipe, duct shall be marked.
 - 1.5.2.2 Exposed cables shall be marked at 3 meters intervals.
 - 1.5.2.3 The disk shall be made of stable material, such as metal, rigid laminated plastic.
 - 1.5.2.4 The ducts, pipes and cables shall be marked so that marking is readable to a person standing on the floor.
 - 1.5.2.5 The identification number shall be stamped on the disk according to the number of wire in the drawings.

1.5.2.6 Color bands 20 cm wide shall be marked on extinguishing piping system at the exit from the extinguisher cylinder up to the spray nozzle, at 2 meters intervals.

1.6 Sealing Openings and Protective Coat Spray

1.6.1 Openings are sealed for two purposes:

1.6.1.1 Sealing by means of flame retardant material (two hour resistance) of cable passages, piping systems, vertical shafts to prevent spreading of fire and smoke in case of fire.

1.6.1.2 Sealing spaces protected by gas extinguishing system, to prevent gas exhaustion from the closed space.

1.6.2 The depth of the sealing according to the Manufacturer recommendations and the relevant specifications.

1.6.3 The sealing materials shall be certified by FM, UL or comply with DIN 4102, NFPA 251, Israel Standard 755, BS 476, ISOR-834.

1.6.4 The sub-contractor work shall include:

1.6.4.1 Installation of fire resisting sealing at electric and communication cable passages in walls.

1.6.4.2 Installation of fire resisting sealing at piping system passages in walls.

1.6.4.3 Installation of fire resisting sealing for electric cable passages at electric board entry and exit.

1.6.4.4 Installation of fire resisting sealing in electric boards to prevent escape of extinguishing gas.

1.6.4.5 Installation of fire resisting sealing in vertical passages (shafts) between the building stories.

1.6.4.6 For sealing holes in walls, the seal shall be made of the wall material.

2.0 **SPECIAL EXECUTION SPECIFICATIONS**

2.1 **Fire Detection and Extinguishing Panel**

The Panel shall be of the addressable type.

2.1.1 The Panel provides the following functions according to the alarm management program.

1. Operation of audible and visual alarm signals indicating the area from where the fire alarm signals have arrived.
2. Operating alarm signal indicating the area from where failure signals have arrived in case of wire disconnect.
3. Operating alarm in case of power failure.
4. Sending control signals to the gas extinguishing system.
5. Operating the alarm horns.
6. Shutting down the air-conditioning systems.
7. Sending fire alarm signals to the duty office room/gate or any other predetermined locating through a dialer.
8. Returning the system into operation status in any of the aforementioned events shall be manual only.
9. Operating the fire extinguishing system.

2.1.2 The entire wiring among the fire detector panels, detectors, pushbuttons, horns, lamps and gas control panels shall be continuously controlled and in case of wire disconnection the system shall generate an alarm signal in the detection panel and transmit an appropriate failure signal to the central alarm system.

2.1.3 The system shall allow silencing of the alarm horns in the building by means of a manual switch installed in the detection panel.

2.1.4 The fire detection system shall be designed so that upon receiving a fire alarm signal associated with a certain zone and silencing it, no other zone functions shall be disturbed (including reception of fire detection signal etc.)

- 2.1.5 In addition to the necessary control equipment, each Panel shall contain the following devices:
1. Lamp test switch.
 2. Fire alarm bell switch.
 3. Fire alarm bell silencing switch.
 4. Lamp indicating shut down zone (and shut down system).
 5. Alarm horn and failure buzzer.
 6. Lamp indicating general failure.
 7. General alarm indicator lamp.
 8. Zone alarm lamps
 9. Battery indicator lamp (voltage drop or open/short circuit on battery line).
 10. Alarm/failure horn silencing indicator lamp.
 11. Extinguishing system manual operation indicator lamp.
 12. Extinguishing system operation indicator lamp.
 13. Gas discharge system operation indicator lamp.
 14. Grounding failure indicator lamp.
 15. Failure zone indicator lamp.
 16. Timers – one for extinguishing delay and the other for failure system operation delay.

All switches are integral part of the Panel, though located separately of the electronic mechanism.

The Panel shall provide the following options:

1. Zone test and reset.
 2. Canceling a detection zone.
 3. Canceling an extinguishing zone
 4. Audio/visual indication of any change of status (indicator lamp, horn or buzzer).
- 2.1.6 All board indicator lamps shall be controlled in case of failure by either following options:
1. Two indicator lamps connected in parallel, so arranged that a failure of either lamp shall be located during routine inspection of lamp test.
 2. One lamp with alarm system for failures in the board indicator lamps.
- 2.1.7 Each detection zone shall have an additional discharge relay with enough contacts to carry out all functions described in the alarm management drawings plus one additional contact minimum.
- 2.1.8 The fire detection Panels incorporate equipment to pass signals required for the following systems:
- Central control system.
- The signals transmitted through by the fire detection Panels to the alarm system shall consist of Fire Alarm, and System Failure. Mains Power Breakdown signal is transmitted when the power break exceeds 24 hours. The failure alarm signal transmission equipment shall provide minimum 10 minutes power failure transmission signal. An automatic timer is provided for this purpose in the detection board and when the power returns prior to the 24 hour period is elapsed, the timer is reset and shall not transmit the message.
- 2.1.9 Outdoor boards and junction boxes shall be dust-proof at IP65 level and protected against corrosion, moisture proof. All lamps, switches and bells in the board shall be marked by engraved signs of laminated material both in Hebrew and English.

- 2.1.10 The Panel emergency power supply system comprises batteries that shall enable all system function, charge equipment and automatic changeover to emergency power in case of mains power breakdown. The batteries shall be designed to supply the permanent load for 72 hour period and maximum alarm load for 1 hour. The battery charge equipment shall be capable to charge an employ battery within 24 hour period with charge large enough to supply maximum alarm load during 1 hour. The battery recharge shall come on automatically when the power is returned. Battery automatic disconnect circuit in the board shall disconnect the batteries whenever their voltage drops beyond a certain value in order to avoid destruction of the batteries as a result of over discharge.
- 2.1.11 The Panel operation shall not be affected by RF signals of both military and civilian radio communication equipment, crane remote control etc.
- 2.1.12 The Panel shall be equipped with fuses protecting the system of any possible damage.
- 2.1.13 Access to the Panel interior shall be provided from all directions (except front) in order to enable insertion of cables and wiring to the board from all directions necessary.
- 2.1.14 The board shall be equipped with a transparent door, locked by means of a special key (the key is held by authorized personnel only). The sub-contractor shall supply at least five copies of this key.
- 2.1.15 The board shall not contain any switches that may allow unauthorized personnel to stop their operation as an integrated unit, interrupting certain zones or inhibit alarm horn prior to its operation. The disconnection of the entire board or part thereof shall be carried out by an authorized technician, and in this event the interruption shall be accompanied by individual audio-visual failure alarm indicating the disconnected circuit/zone.
- 2.1.16 The board shall incorporate a special horn silencing feature that will allow silencing of the alarm horn after it is audible though indication shall be initiated for the interruption and shall not prevent re-operation upon arrival of additional alarm signals.

- 2.1.17 The control board shall incorporate a charger unit that shall supply charging power to the emergency batteries which shall be controlled by means of an audio-visual alarm indicating the failure against open/short circuit failure, or battery voltage drop.
- 2.1.18 The control board shall have dry auxiliary contacts to provide, in case of alarm, the following functions:
 - 2.1.18.1 Local horn operation.
 - 2.1.18.2 Operating indications to initiate wireless transmission or through a dialer and through radio transmitter to the center manned 24 hours.
 - 2.1.18.3 Total power break.
 - 2.1.18.4 Operation of the extinguishing system.
 - 2.1.18.5 Interruption of the air-conditioning system operation as necessary.

2.2 Detectors

2.2.1 Electro-optical Smoke Detector

1. The detectors shall comply with UL requirements, last edition in effect.
2. The detectors shall be electro-optical operating on the principle of change of light refraction in presence of smoke created by fire.
3. The electro-optical detector shall respond to visual smoke concentration, starting of 2% obscuration rate for a distance of 1 foot.
4. The detector shall be installed on a common type base, so that detectors of all types may be changed with no modification to the electric installation, in case other types of detectors are required.
5. The operating range of the detector shall be through temperature range of 5-65°C and relative humidity of 5% to 90% minimum.

6. The detector shall consume small current and shall not be affected by external interference such as lightening, RF transmissions or any other instrument interference.
7. Each detector shall have an arrangement to change the detector sensitivity threshold. This device shall be set in advance in order to prevent false alarm.
8. Each detector shall be equipped with a lamp that will flash/constantly illuminate during the detector operation.
9. In close spaces there shall be a provision to connect additional lamp to the detector base lamps.
10. The detector shall be installed in a base so that its replacement shall be easy, with no need to open screws.
11. The detectors shall be protected against inverse voltage.
12. In electric boards, where a single detector is designed for the extinguishing space, the detectors shall be programmed to run an additional scan in case of detection and in case of repeated detection only, within 30 seconds (or other time period determined) the extinguishing procedure shall be run.
13. The detector shall be explosion proof (EXP) as necessary.

2.2.2 Heat Detector

1. The detectors shall comply with UL requirements, last edition in effect.
2. The detectors shall be heat detectors of ROR type and fixed temperature.
3. The heat detector shall respond to temperature rise rate of 8.3 degrees per second and when the temperature reaches 740C (or other temperature determined according to the conditions).
4. The detector shall be installed on a common type base, so that detectors of all types may be changed with no modification to the electric installation, in case other types of detectors are required.

5. The operating range of the detector shall be through temperature range of 5-650C and relative humidity of 5% to 90% minimum.
6. The detector shall consume small current and shall not be affected by external interference such as lightening, RF transmissions or any other instrument interference.
7. Each detector shall have an arrangement to change the detector sensitivity threshold. This device shall be set in advance in order to prevent incidental false alarm.
8. Each detector shall be equipped with a lamp that will flash/constantly illuminate during the detector operation.
9. The detector shall be installed in a base so that its replacement shall be easy, with no need to open screws.
10. The detectors shall be protected against inverse voltage.
11. The detector shall be explosion proof (EXP) as specified by the COR.

2.2.3 IR Flame Detector

1. The detectors shall operate on the principle of detecting infrared radiation created by fire flame (HZ-1-10).
2. The detector shall be installed on a common type base, so that detectors of all types may be changed with no modification to the electric installation, in case other types of detectors are required.
3. The operating range of the detector shall be through temperature range of 5-650C and relative humidity of 5% to 90% minimum.
4. The detector shall consume small current and shall not be affected by external interference such as lightening, RF transmissions or any other instrument interference.
5. Each detector shall have an arrangement to change the detector sensitivity threshold. This device shall be set in advance in order to prevent incidental false alarm.

6. Each detector shall be equipped with a lamp that will flash/constantly illuminate during the detector operation. In close spaces there shall be a provision to connect additional lamp to the detector base lamps.
7. The detector shall be installed in a base so that its replacement shall be easy, with no need to open screws.

2.2.4 Air-Conditioning Duct Smoke Detectors

1. The detectors shall be of a type approved by UL/FM and Israel Standard 1220.
2. The detectors are designed for installation in fresh air ducts or return air ducts to detect smoke mixed with the air flowing in the duct.
3. The unit shall be addressable or zone organized, of analog or interactive type, according to the system installed.
4. The unit shall filter the smoke particles out of the air flowing in the duct at high velocities and initiate an alarm signal whenever the concentration of the particles in the air exceeds certain level.
5. The installation of the detector in the duct shall be as simple as possible and the ducts shall not be dismantled or removed or parts thereof removed but rather shall be accomplished in existing and operating ducts.
6. The detector shall not be secured to the duct itself but rather to the duct construction elements. The detector installation shall not impair the function of the airconditioning system.
7. The detector and its installation shall be designed for normal operation under wind velocity of up to 20 meter per second (or otherwise, according to the design of the air-conditioning system in the building).

2.2.5 Air Flow Detector System

2.2.5.1 Active Smoke Detector Flow Detector System

2.2.5.1.1 The system shall be designed for early detection of smoke in the following spaces:

Simulator hall

2.2.5.1.2 The system comprises a detector or a number of detectors installed in a closed housing, a fan to draw air and a PVC piping system. The active unit shall suck air from the protected space through a piping system and suction orifices located along the piping system. the orifice diameter shall be determined according to the pipe system geometry and length.

2.2.5.1.3 Drilling the suction orifice shall be carried out as follows:

A 10 mm hole shall be drilled into the pipe. A special adhesive sticker shall be applied to the pipe, carrying a precise diameter orifice. The orifice diameter shall be marked on the adhesive sticker. This method shall ensure that the diameter of the suction orifices produced under site conditions shall be of the precise diameter and best fit to the suction piping geometry. The piping system installation shall be accomplished through adhesive application in order to avoid air leakage and build-up of pressure in the piping system.

2.2.5.1.4 The air shall be flown through the detector or through two detectors for cross zoning. When the concentration of smoke particles in the air reaches a certain value, the detector shall produce and transmit an alarm message. An alarm and failure indications shall be displayed by means of indicator lamps on the unit.

- 2.2.5.1.5 The detectors installed in the suction system shall be of analog or interactive type according to the nature of the system.
- 2.2.5.1.6 The unit shall be installed accessible to maintenance, calibrations and repairs. The maintenance shall be carried out on the fan unit only, rather than on the suction pipes.
- 2.2.5.1.7 The suction unit shall be connectable to the suction piping system, and an additional box containing detector may be installed on each branch of the piping with the air flowing in the branch shall pass through the box. This will be used to get precise information concerning the location of the smoke. This additional detector may be used for cross zoning.
- 2.2.5.1.8 Adapter to return the flowing air to the protected area may be installed at the system air exit producing under-pressure conditions.
- 2.2.5.1.9 The unit shall check continuously the piping system air discharge and shall alarm any event of opening or damaging the piping system or obstruction of the suction orifices.
- 2.2.5.1.10 The unit shall operate on 24VDC power with current consumption not to exceed 260 milliamper. The system shall receive mains power and emergency power (batteries) from the main fire detection system on site.
- 2.2.5.1.11 The operating temperature of the system shall be (-) 40 up to (+)750C, maximum relative humidity 95% according to Standard DIN 40040.

2.2.5.2 Passive Smoke Detector Suction System

- 2.2.5.2.1 The system shall be designed for early detection of smoke in closed spaces or ventilated spaces with forced air cooling.
- 2.2.5.2.2 The system shall be installed at the forced air exit of the protected equipment.
- 2.2.5.2.3 The principle of operation is based on forcing the air that exits the protected equipment to pass through a detector or two detectors for cross zoning. When the concentration of the smoke particles in the air exceeds a certain level, the detector shall produce and transmit an alarm message. An alarm indicator lamps on the unit shall be illuminated in this case.
- 2.2.5.2.4 The detectors installed in the suction system shall be of analog or interactive type according to the nature of the system. the unit shall provide for very early detection, within seconds, of smoke produced as a result of warming of fire of the protected equipment elements.

2.3 FM-200 Gas Extinguishing Systems

- 2.3.1 Automatic extinguishing system designed to extinguish as quick as possible, at initial stages fire in the building. The system in operation emits FM-200 gas designed to extinguish organic based electric or other flames

The system is independent (each space is equipped with a separate system) and associated with extinguishing systems installed in other spaces.

The extinguishing function is accomplished through chemical and physical actions.

The system is based on the Total Flooding of the compartment space, gas discharge, rapid diffusion within 5 – 15 seconds through the space or board. The fire is arrested since the material is heavier than air and does not allow oxygen to continue the fire process. All accessories shall be UL/FM approved.

The control system shall carry out the following activities:

- 2.3.1.1 Operating the extinguishing system and gas discharge. The automatic action of gas discharge shall take place after a 30 second delay (or other timer period determined by the COR) in each system.
 - 2.3.1.2 Manual discharge using a mechanical device installed close to the gas cylinders.
 - 2.3.1.3 Continuous control of the system wiring circuits.
 - 2.3.1.4 Operating visual and audible alarm system operation according to the alarm management programs.
 - 2.3.1.5 Transmitting operation signals and failure signals to the central control system.
- 2.3.2 An additional cylinder shall be installed on each system location for backup. A check valve shall be installed on each cylinder exit while the change over between cylinders shall be provided by means of a selector.
 - 2.3.3 The cylinders shall be installed out of the rooms in special boxes equipped with sliding louvered door at the top section of the box.
 - 2.3.4 The entrance door to the rooms protected by extinguishing gas shall be marked by means of a clear legible sign stating:

This room is protected by gas automatic fire extinguishing system.
After gas discharge do not enter the room unless it is ventilated properly.

2.4 Alarm and Extinguishing Pushbutton

- 2.4.1 The pushbuttons shall comply with UL requirements, last edition in effect.
- 2.4.2 In addition to the detector automatic alarm, additional alarm and fire extinguishing pushbuttons shall be installed to allow personnel on place notify the control center and their close vicinity on the break of fire, its location and fire extinguishing actions as necessary.
- 2.4.3 The pushbuttons shall be installed at locations specified on the drawings at heights of 150-160 cm above floor.

- 2.4.4 Pressing a pushbutton shall indicate the location of fire or fire extinguishing activity.
- 2.4.5 The extinguishing pushbuttons shall be of dual action – glass protection removal and pressing to avoid incidental operation or pulling.
- 2.4.6 The pushbuttons shall be accompanied by engraved sign with operation instructions.
- 2.4.7 Outdoor pushbuttons shall be protected at IP-65 level.

2.5 Indicator Lights

- 2.5.1 Whenever detectors are installed in closed spaces such as cabinet or electric board, an external indicator light shall be installed.
- 2.5.2 The indicator light shall be operating in parallel with the lamps in the detector mounting.
- 2.5.3 The light shall flash/illuminate when its associated detector is operating.
- 2.5.4 The light shall operate on low current with no external power supply and include magnifying lens that will allow its light visibility at wide angle and distance.
- 2.5.5 The light manufacturer shall be the same as that of the Panel and the detectors and shall be approved by the detector manufacturer for installation on detectors.
- 2.5.6 Each light shall be installed with a sign indicating the location of the detector.
- 2.5.7 Alarm indicator lamps shall be installed on both ends above the structure top surface indicating that the zone is in distress (detection/extinguishing).
- 2.5.8 A light stating “Extinguishing Operated – No Entrance” shall be installed at the entrance. This light shall flash throughout the room fire extinguishing operations.
- 2.5.9 Outdoor lamps shall be protected at IP-65 level.

2.6 Alarm Horns

- 2.6.1 The horns shall comply with UL requirements, last edition in effect.
- 2.6.2 The horns shall be electronic horns, in compliance with the requirements of the command and control system.
- 2.6.3 The horns shall incorporate a speaker driver unit, speaker horn and a separate oscillator for each horn.
- 2.6.4 The horn intensity shall be 105 dBA minimum at a distance of 5 meters from the horn.
- 2.6.5 The horn operating power shall be that of the control panel. Current consumption shall be small.
- 2.6.6 Horn operation may be interrupted by means of setting a switch on the control panel to Alarm Off position.
- 2.6.7 Evacuation horn shall have 90 dBA minimum intensity at a distance of 1 meter. The horn shall be operating in combination with a white flashing lamp and they shall have appropriate sign (Extinguishing On) during room fire extinguishing.
- 2.6.8 Outdoor horns shall be protected at IP-65 level.

2.7 Central Control System and Graphic Control (Synoptic Map)

- 2.7.1 The system shall collect and handle events announced by safety and security systems on site.
- 2.7.2 The system consists of a PC station or several stations, connected through communication buffers to secondary Panels on site, receive and display the event data graphically and alpha numeric and provide for handling the events directly from the computer station.
- 2.7.3 The communication between the secondary Panels and the computer stations shall be full duplex, so that in addition to receiving event indication at the computer station, commands may be transmitted to the Panel direction. Detectors and/or detection zones may be neutralized directly from the computer station as well as sending “Horn Silencing” and “Initialization” commands to all secondary Panels.

- 2.7.4 All communication lines, hardware and buffers shall continuously be controlled by the system. In case of failure or fault in one of the communication elements, including communication lines, the computer station shall display an appropriate failure message.
- 2.7.5 The system shall provide for maximal flexibility in selecting types of communication, so that it shall support when necessary system expansion up to national deployment through point to point lines with various communication types.
- 2.7.6 The system shall synchronize the operator functions, so that when more than one operator station is installed, no conflicts between two or more operator functions shall be encountered while each operator shall be informed on the functions carried out at other stations.
- 2.7.7 The system shall support the automatic execution of various functions, such as reminders to the operators at predetermined time periods.
- 2.7.8 The system shall be equipped with FIFO type event memory.

The event memory may be backed up on diskettes or other magnetic media for long term follow-up.

The system shall provide reports according to various cross-sections such as date, hour, operator name, type of secondary Panel, logic distribution, and geographic distribution.

During handling of the history module and report production, the system shall continue to work in the background and inform the operator on new events.

2.8 Wiring and Electrical Piping System

- 2.8.1 The electric piping system shall be of rigid or flexible 23 mm diameter fire resistant red Meriron or flexible 23 mm red "Merihaf" type. Each turn and/or branching shall be made by means of appropriate elbows and/or junction boxes.
- 2.8.2 Dual wire drop type conductors shall be threaded through the electric piping system. Wires shall have 0.8 mm² cross-section for fire detection and 1 mm² for fire extinguishing.
- 2.8.3 The wiring and piping system installation shall include passages, supports and connections of all types as necessary.

- 2.8.4 The sub-contractor is assumed responsible to the entire wiring and for the sealing of all openings and passages made for and during the installation.
- 2.8.5 The wiring shall comply with the requirements of Israel Standard 108.
- 2.8.6 All connections in detectors, pushbutton, horns, extinguishing system and control board shall be carried out by means of standard cable shoes. No connections shall be made in passage boxes but rather in the system elements only.
- 2.8.7 Outdoor installations shall be protected at IP-65 level.
- 2.8.8 Whenever wiring is installed outdoors or on ladders, it shall be accomplished with NYBY-FR cable with 1.5 mm² wire cross-section.
- 2.8.9 Exposed cables shall be marked at 3 meter intervals by means of resistant materials, such as metal or dual laminated rigid plastics.

2.9 Smoke Discharge Shutter

2.9.1 Data

2.9.1.1 Size: (should be checked according to the specific requirements for each shutter). The number of slats according to the size of the opening. The smoke shutter shall close totally the opening.

2.9.2 Operation

By means of a detector, installed close to the fire shutter. The fire shutter motor shall be equipped with reaction spring, with limit switch, installed in NO position and shall close the shutter as long as it is under power. The spring shall be made of stainless steel. Motor closing time period – approximately 90 seconds.

The operation shall be by melting arm operation. The arm is made of nickel/copper or equivalent. Responding to temperature rise in the ceiling space above predetermined value. In presence of smoke and if the melting arm is not functioning, the ionization detector (smoke) shall operate and close the palm by means of electronic thermostat, easily and rapidly adjustable.

The shutter shall be fit for automatic closing and shall normally be retained closed and sealed.

The shutter shall be closed upon power failure.

2.9.3 Structure

- 2.9.3.1 The shutter shall be made of 2 mm thick galvanized sheet metal.
- 2.9.3.2 The palms shall be made of 0.7 mm nominal thick sheet metal.
- 2.9.3.3 The fire shutter shall be made of corrosion resistant material and resist fire for 1½ hour minimum.

2.9.4 Access to the shelf

- 2.9.4.1 The shutter closing shall be accomplished in the wall where the inlet air louver is installed. A crankshaft handle operating a worm screw shall overcomes the melting arm, operate the motor and release the spring, that closes the smoke shutter.

2.9.5 Control Panel

- 2.9.5.1 The control panel shall not be operated when the distance from the smoke shutter exceeds 100 meter.
- 2.9.5.2 The control panel shall activate the fire palms (melting arm) and receive also commands from the fire detection board that will result in motor operation.
- 2.9.5.3 The control panel shall have installed dry batteries that In case of power failure will operate for 48 hours.

2.10 Piping Works Specification

The sub-contractor shall produce piping systems in plant/shop and./or on site. All works associated with welding of various accessories shall be executed in the shop, as possible. The contractor shall assemble as large units as possible so that during installation on site cuts, fixing and welding shall be kept to minimum as well as execution time.

2.11 Accessories Installation

- 2.11.1 Each valve shall be cleaned prior to installation by means of compressed air and clean lint-free cloth. The sealing surfaces in flanged valves shall be cleaned as well. Any defect detected shall be repaired prior to installation. The valves shall be installed at the appropriate angle or according to the COR instructions.
- 2.11.2 Joints of threaded accessories shall be made with red lead paint and flax only.

2.12 Sealing and coating materials

2.12.1 Cable Passage Opening Sealing

- 2.12.1.1 Cleaning the opening and cables and arranging the cables in the opening area.
- 2.12.1.2 The cable free area in the opening shall be sealed with rock wool, 1 cm larger than the width and length dimensions of the opening and the rock wool panels shall be installed under pressure.
- 2.12.1.3 Prior to entering the panel into the opening, the panel edges, the opening interior surfaces and the cables through the entire contact area with the rock wool panels shall be coated with the liquid sealing material.
- 2.12.1.4 The area where the cables pass, shall be sealed around, including cable spaces by means of rock wool panel parts filling all slots and holes.
- 2.12.1.5 On the edges of the panel, at the contact points between the panel and the opening walls as well as around the cables the openings shall be filled with the liquid sealing material.
- 2.12.1.6 When the opening is wider than 60 cm or it is made in the ceiling, the panel shall be supported by means of stainless steel supports, 3 mm thick.

2.12.2 Cable Coating

- 2.12.2.1 Cables shall be separated as necessary to allow penetrate of the sealing material and improve its application. At appropriate locations cables shall be arranged in harnesses prior to coating.
- 2.12.2.2 The specified thickness of the coating shall be reached by applying more than a single coat, after the previous one is properly cured.
- 2.12.2.3 The wall shall protect against expansion and disturbing the cables 120 minutes minimum.
- 2.12.2.4 A length of 1 meter shall be coated at entry/exit to electric boards.

2.12.3 Coating and Sealing Properties

- 2.12.3.1 The coating shall be of a type appropriate for indoor and outdoor applications. It shall resist the environmental conditions and sun radiation.
- 2.12.3.2 The coating shall not change its properties after contact with chemicals and water.
- 2.12.3.3 The coating shall not dissolve in water in dry conditions and long term contact.
- 2.12.3.4 The coating shall not be toxic, shall not contain asbestos and when under fire shall not emit poisonous gas. The toxicity level according to Israel Standard 755 shall be between 0 and 1 in compliance with toxicity level 4.
- 2.12.3.5 The coating shall be of thermal and electric isolation type and shall not affect the conductor conductivity.
- 2.12.3.6 The coating shall be appropriate to coat all types of cables.
- 2.12.3.7 The coating shall be of technical strength and flexibility that prevents cracks.
- 2.12.3.8 The sealing shall resist water jets.
- 2.12.3.9 The sealing shall be light weight and easy to apply.
- 2.12.3.10 Threading additional cables shall be accomplished easily.

CHAPTER 6

SCADA System

1.0 **INTRODUCTION**

- 1.1 This chapter covers the minimum requirements for design engineering, manufacturing, testing and commissioning of the internal SCADA system in the Manara Pumped Storage switchyard
- 1.2 The SCADA system hardware, software and I/O list shall receive IECo approval.

2.0 **SCOPE OF WORK**

Design, engineering, manufacturing, supply, installation, testing and commissioning of the internal SCADA System.

3.0 **SCADA SYSTEM**

Scada system shall include (not limited to):

1. Industrial SCADA computer/server with all needed hardware as 21" screen, keyboard, mouse, communication modules etc. installed in a cubicle as defined hereafter.

Server shall have two hot-pluggable redundant power supply modules and two hot-plug hard drives (500 Gbyte minimum). Server type is subjected to Owner approval.

2. All needed software: Operating System, SCADA software, communications etc. all with licenses.

SCADA licenses shall include all needed I/O points ,configuration, reprogramming and application modifications/expansions.

3. Complete In-station communication network including all cables (Fiber Optic &Cu), communication cubicle, optic switches, power supplies, converters, connectors etc. and including all wiring and connections to protection relays (IED's), measurement devices, RTU's etc.

4. GPS time synchronization.

5. SCADA software application dedicated to the switchyard including users licenses for local operation and for minimum two users from remote central SCADA.

6. Software & hardware to connect the station SCADA to and remote control SCADA (remote site) via redundant double connection standard protocol such as IEC 61850 for monitoring & control.
7. SCADA system shall be designed with transmit/receive commands thus to allow switching of devices and switchgears HV & MV system.
8. One color laser printer, for A4 pages, with 1200x1200 dpi. Printer shall be HP make or equal.
9. One operator desk

4.0 **SYSTEM DESCRIPTION**

SCADA shall control and monitor the followings (not limited to):

170kV AIS 7 bays switchgear: Two power transformer 161kV incoming cable bays via IED's/RTUs/Protection relays (protection and control) and microprocessor based measuring devices, statuses of all 7 bays electrical equipment via dry-contacts (CBs, Disconnectors, etc).

Aux and general station services (Alarms). Service transformers 22/0.23kV, AC and DC system, batteries and chargers, UPSs, DC/DC converters, diesel generator, Air-Conditioning and Ventilation systems, fire detection etc.

The SCADA application shall include as a minimum.

- 4.1 Dynamic color graphic displays/pictures, which display the switchyard electrical system. Pictures shall be separate and shall be divided into:
 1. Station HV/MV single line diagram with objects status and with main measurement values.
 2. Same for 170kV AIS – but with full information.
 3. Same for power transformers.
 4. Same for auxiliary systems.

All pictures shall include graphic displays of the electrical elements/objects as CBs, isolators, transformers, battery chargers, UPSs, Diesel generator, IEDs, protection relays, fire detection etc.

Displays shall show the status of all objects as: on/off, alarms, fault/ok, local/remote.

Measurements data from IEDs and other measurement devices (incl. transducers) shall be displayed at the proper location/picture.

- 4.2 Dynamic display of schematic communication diagram of the SCADA communication system showing each object (as IED or RTU or protection relays) self-supervision status and communication status (healthy/fault). It shall also include the SCADA server and the communication links.

System should monitor continuously the protection and control devices.

- 4.3 For control and for detailed information, system shall provide the selection of main objects from single line diagram as circuit breaker, transformer, IED etc.

Each object shall have separate picture/window from which user can:

1. View detailed status (position, alarms).
2. View measurements.
3. Make control operations as open/close of C.B- access limited to authorized user by software.
4. View only of IED setting parameters, data collection etc.
5. IED configuring and setting - access limited to authorized user by software.

- 4.4 Event and alarm handling with time tag resolution of 1 msec displayed in chronological order with tools for acknowledgement, filtering etc.

- 4.5 Uploading disturbance fault record file stored in IEDs and displaying it. Disturbance analysis tools shall be also supplied.

Files shall be stored and archived on the hard disk.

5.0 **TECHNICAL REQUIREMENTS**

5.1 **General**

1. The SCADA server shall run on WINDOWS operating system and shall contain all necessary hardware and software required for communication and integration of all IED's, Rtu's, microprocessor based protection & measurement devices etc. installed in switchyard. It shall be able to support wide range of standard communication protocols as: IEC 61850, 103,104 Modbus etc. for existing and future third party relays/IEDs.
2. The SCADA server shall contain data acquisition, supervision and controlling function as specifically used in HV switchyards.
3. Additional features required:
 - a. Alarm and event handling recorder with time resolution of 1 msec.
 - b. Time synchronization (SCADA and all IED's).
 - c. Data exchange through common interfaces/protocols.
 - d. Multi user support.
 - e. Enable to define user authority levels as: view level, control/operation level, and engineering level system management level.
 - f. Self-supervision and display the status information of system components as server, communication links. IED's, protection relays etc.
It shall be shown on dedicated screen.
 - g. Support print out of all displayed screens.
 - h. Supports remote SCADA access to data and control functions through station SCADA using standard protocols.
 - i. Display tools shall support zooming, panning and de-cluttering for efficient and clear visualization of the data.
 - j. Busbar coloring feature according to voltage level and switching/earthing devices position.

4. SCADA shall provide remote IEDs parameter setting and reading. The stored parameters in control and/or protection devices may be displayed on the HMI station. change of preset parameters from SCADA shall be enabled to authorize users.
5. SCADA shall have tools to display and analyze all disturbance/fault record data. Uploading the data from IED'S shall be in manual or in automatic mode (selectable).
6. SCADA shall be protected and secured by passwords hierarchy according to users list from customer.
7. The system architecture should be based on modular characteristic and ensures that new modules can be added for future modifications and switchyard expansion.

5.2 Monitoring Functions

System functions

1. System shall provide on-line engineering, reprogramming of the actual application, downloading of the databases, etc. while the main tasks are running in the background without having to shutdown the system.
2. Server, communication switches, IEDs and protection relays should be synchronized by common master clock from the GPS antenna. The time synchronization clock should simultaneously broadcast to all nodes connected to the Station bus, for a very accurate time synchronization of all devices connected to it.
3. The SCADA should have a user authorization function, which enables at least different user authorization levels to be defined to each picture object. It shall include:
 - a. View level - allowing to view the switchyard status (without control or programming).
 - b. Control level - allowing to make also control operations.
 - c. Engineering level - allowing to make control operations and configuration.
 - d. System Management level - The user is granted all rights including the rights to add and remove users.

For each individual object (circuit breaker, isolator, disconnectors, measurement, transformer, etc.) a specific user group with different access authorities shall be defined.

5.2.1 Monitoring Functions

Monitoring functions shall include (not limited to):

1. Object status- position indication, alarms, etc.
2. System component self-supervision - SCADA should allow the supervision of each system component. The system should display the status information of the station monitoring equipment e.g. station computer, communication links, IEDs, RTUs, protection relays and control modules. The status information of hardware and software should also be shown and listed in the event/alarm list and stored in the historical lists.
3. Event list and event handling.
4. Alarm list and alarms handling (acknowledgment, filtering etc.)
5. The alarms should be shown in chronological order. The color of alarm type shall be selectable from a predefined set of colors.

5.2.2 Measurement reports

This function shall be used for building statistical measurement reports, such as active and reactive energy reports, overload and short circuit report etc.

1. Remote Parameter Setting and Reading from IEDs and Protection relays.
2. Uploading Disturbance Fault Record Files
3. All disturbance records stored in the relays should be read out via the inter-bay bus and stored onto the station computers hard disk.
4. For further analysis the disturbance file should either be locally inspected or transferred to a separate workstation equipped with a disturbance analysis tool.

5. For uploading the disturbance records there should be a manually and automatic upload mode.
6. In automatic upload mode, after successful upload, the files are stored should be archived on the hard disk. After storage, the corresponding disturbance record in the relays should be automatically deleted. In the manual mode the operator should manually delete the disturbance record.

5.3 Control Functions

Control functions (as close/open of CB) shall be performed in a certain procedure as:

1. Selection of object from single line diagram.
2. Check the authorization level of the user/operator.
3. Selection of the operation required i.e. close/open.
4. Confirmation of the required operation.

Control function shall be selected each time on a single object only; double object selection and double commands shall be blocked.

5.4 Communication Cubicle

1. The SCADA main system will be located in a 19" panel.
2. The cubicle shall completely engineered and wired and tested and shall include the server, power supplies, communication panel/s, communication elements, cables, terminals, etc.
3. Enclosure shall be 19" rack with hinged frame. Front door shall be with transparent window (as RITAL make or equal approved by client and IECO).
4. Grounding bar shall be included.
5. Protection degree – IP43
6. Cable entry from the bottom.
7. It shall include also lighting fixture controlled by door operated limit switch, heating element, MCB's, terminals, cable glands etc.
8. Cubicle shall be earthquake-proof. Class shall be per switchyard classification and Israeli standard.
9. All work and wiring shall be executed according to IEC recommendations.

5.5 Time Synchronization

The system shall include an interface for time synchronization by GPS.

GPS receiver including antenna shall be supplied.

It shall synchronize the SCADA, the IDEs, RTUs etc.

It shall be possible to synchronize the whole system from one source.

Accuracy of 1 ms for all time tags in the switchyard shall be guaranteed.

6.0 DOCUMENTATION

6.1 Documentation to be provided with the Proposal:

1. Screen pictures:
 - a. Sample for SCADA detailed single line.
 - b. Sample scheme of window picture for object control operation.
 - c. Sample of alarms and event list.
 - d. Sample of a disturbance data and graphs.
2. Technical specification

6.2 Complete documentation shall include the following:

1. SCADA pictures (screens).
2. SCADA reports
3. Database per typical feeder.
4. List of main equipment's.
5. Detailed technical data for each element.
6. SCADA description.
7. Station communication overview.

The documentation shall be submitted as part of the Proposal, and as instructed in the Instructions to Participants.

7.0 **COMMISIONING**

7.1 Contractor shall make the commissioning and putting into operation of the whole system.

Putting into operation shall include also checking all reports and all screens due to each I/O in each relay/ IED/RTU.

7.2 Contractor shall include in his SCOPE separate course for client personnel.

8.0 **TRAINING**

8.1 The training course shall be of 4 full days.

8.2 Contractor shall provide course program and course material (documents) for total 12 people. [Materials in English]

8.3 Training will be in Israel and shall be performed in Hebrew or English language, as shall be agreed with the O&M Contractor.

CHAPTER 7

LV Equipment installation work

1.0 **INTRODUCTION**

This chapter covers the minimum requirements for Low Voltage systems installed in the switchyard control building and switchyard area. All electrical works shall be in accordance to IECo internal document- Technical specification for substations and IECo remarks during the detail design stage. The Contractor is responsible to execute all works in the best possible manner as stipulated in the EPC Contract and to receive IECo's approval for the works, equipment types and installations

2.0 **SCOPE OF WORK**

Design, engineering, material and miscellaneous equipment supply and installation.

3.0 **CABLES**

3.1 All Low voltage Cable supplied and installed shall be N2XY or N2XCY

- UV resistant
- Flame retardant according to IEC60332-1,2
- Round conductors
- 0.6/1kV rated
- Cables shall be from the following manufactures: GENERAL CABLES, PRYSMIAN, and SYNARGY.

3.2 Communication cables shall be:

- Flexible, shielded UV resistant
- Suitable for underground installation
- 0.6kV rated
- Cables shall be from the following manufactures: Teldor or IECo approved manufacturer.

3.3 Cable sheath color – As per Israeli electrical law and IECo requirements

- 3.4 Cable installation shall include (but not limited) to the following requirements
- Low voltage shrink cable breakouts
 - Cable lugs ,Cable ends
 - Cable and wire permanent plastic marking
- 3.5 Cable installations- Cables shall be installed in conduits, cable trays etc. All cable installations shall be in accordance to the "General inter-office specification" (The "Blue book") chapter 08 or according to IECo requirements.

4.0 **CABLE SYSTEMS**

All cable systems shall be according to IEC 61537 standard .all cable systems shall have galvanized steel support structures and original manufacturer accessories .All cable systems shall be of easy connection type .No welding or sawing at site will be allowed .

- 4.1 Cable ladders shall be of hot dip galvanized type
- 4.1.1 Cable ladders shall be "heavy" type 3mm thick with minimal side wall height of 93mm
- 4.2 Cable trays shall be of hot dip galvanized type
- 4.2.1 Cable trays shall be perforated 1.5mm thick with minimal side wall height 85mm
- 4.3 Cable mesh tray shall be of hot dip galvanized or 304 stainless steel 4mm wire diameter.
- 4.3.1 Cable mesh tray side wall shall be minimal 85mm high.

5.0 **ELECTRICAL INSTALLATION**

All installation for utility outlets, light fixtures security systems and communication outlets shall be according in accordance to the "General inter-office specification" (The "Blue book") chapter 08 or according to IECo requirements.

- 5.1 Utility outlets shall be industrial types suitable for 3X2.5mm or 5X2.5 mm wire connections manufactured by GEWISS or approved equal.
- 5.2 Security and communication sockets shall be of IEco approved manufacturers and types
- 5.3 Light fixtures shall be LED type- REGENT SPLASH 1X39w ,4000K or approved equal.
- 5.4 Light fixtures for battery rooms shall be Zone 1 EEX classification COOPER or Appleton fluorescent light. 2X36W and1X8w emergency light.
- 5.5 Emergency Led light shall be according to I.S20.2 .22 3W independent light fixture XYLUX LD4 manufactured by ENELTEC or approved equal
- 5.6 Emergency Led Exit light shall be according to I.S20.2.22 2X1W independent light fixture XY-VEX manufactured by ENELTEC or approved equal
- 5.7 Outdoor lights shall be IP65 LED type Filippi LINDA LED or approved equal
- 5.8 Outdoor light fixtures installed on 6m, 10 m masts shall be LED type TECEO Schreder or approved equal . Masts shall be hot dip galvanized steel. P.E.L.E or approved equal.

6.0 **HYDROGEN DETECTOR**

In all Battery rooms hydrogen detector shall be installed. The unit consist of an internal hydrogen detector and an external control unit located adjacent to battery room.

Unit shall be MSA ultima XIR or approved IECo system.

7.0 **GROUNDING RINGS AND GROUNDING BUS BARS**

- 7.1 All electrical rooms, battery rooms, control rooms and transformer rooms shall have a grounding ring. The grounding ring shall be:
- Galvanized steel 5X50mm bar
 - Installed on 1kV insulation supports every 1m .
- 7.2 Copper bus bars shall be installed for main grounding connections. Copper bus bars shall in be :
- Minimal 60 X10mm length according to requirements.
 - Installed on 1kV insulation supports

8.0 **SRG GROUNDING**

In all IECo control and protection rooms under the raised floor a SRG (Signal reference grid) grounding system shall be installed .. The SRG grounding system shall be made from copper wires minimum 35 Sqmm. The SRG grid shall be designed according to IECo requirements

9.0 **Main LV PANEL**

Main LV panel shall be according to section VI –GENERAL EM,HM specification

The panel shall be:

- IP42
- Form 4A
- Main circuit breakers –withdrawable

10.0 **Fire SUPPRESSION SYSTEM**

All electrical rooms shall be equipped with inert gas fire suppression system .The fire suppression system shall be designed for full coverage of the room and for fire suppression under raise floors. Fire suppression gas tank size, system design shall be in accordance to I.S regulations an IEC, NFPA requirements. The gas suppression system shall be connected to the fire detection system and shall be an integral part of it.