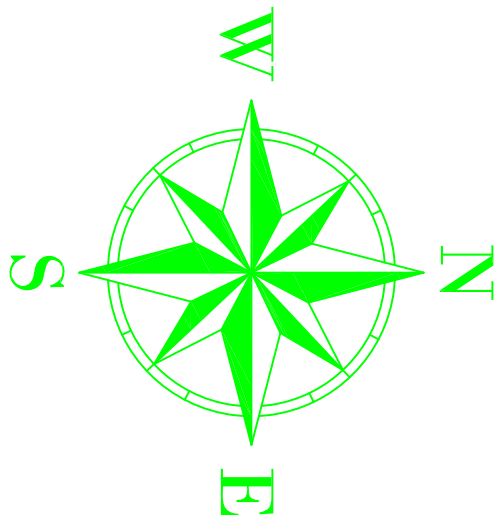




KEY PLAN

THIS DRAWING IS A COPYRIGHT. DO NOT SCALE FROM THE DRAWING.
THE CONTRACTOR AND HIS SUB-CONTRACTORS ARE TO VERIFY ALL DIMENSIONS ON SITE BEFORE MAKING SHOP DRAWINGS OR COMMENCING MANUFACTURE.

United Nation Development Programme
UNDP Lebanon
Social and Local Development Programme
P.O. Box: 11-3216 Beirut, Lebanon
Telephone: 961 1 962491

PROGRAMME:
Lebanese Host Communities Support Programme
Support to Integrated Service Provision at the Local Level

PROJECT NAME:
MHAMMRA - AKKAR

LEGEND:

NOTES:

REV	BY	Date	Description
0	---	---	---
PROJECT NBR. ---			
PROJECT PHASE TENDER			
DISCIPLINE ELECTRICAL ENGINEERING			
SECTOR			
BUILDING ELIE JARROUCHE			
DESIGNED			
DRAWN ---			
CHECKED ELIE JARROUCHE			
APPROVED			
DATE 01/02/2017			
SCALE 1/100			
SHEET SIZE A1			
Title			
GROUND FLOOR PLAN			
ELECTRICAL SYSTEMS LAYOUT			



POWER EQUIPMENT LAYOUT

LOW CURRENT LAYOUT

POWER LOW VOLTAGE LAYOUT

FIRE DETECTION LAYOUT

LIGHTING LAYOUT

MHAMMARA PROJECT

Training Center

ELECTRICAL SPECIFICATIONS

ELECTRICAL CONSULTING ENGINEER: ELIE JARROUCHE

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SECTION 16010
DESCRIPTION OF THE ELECTRICAL WORKS

1.0 GENERAL

- 1.1 These Specifications are considered as general specifications describing the lighting, power installations and civil works to be supplied and installed as required by the project Drawings and Contract Bill of Quantities.
- 1.2 The electrical work shall be carried out in accordance with the Drawings, Specification and Regulations, ensuring compliance with design performance requirements, to provide safe and protected systems with equipment readily accessible for operation, maintenance and repair.
- 1.3 Installations are to be complete, ready for operation and fully integrated and coordinated with all other work and to be carried out by qualified personnel.
- 1.4 Provide accessories necessary to complete the installations, of the types specified or recommended for the purpose by the manufacturer of the equipment or accessories.
- 1.5 The dimensions, structure, ventilating and cooling arrangements and other provisions in equipment spaces and rooms shall be checked by the Contractor to ensure they are suitable for installation, operation and maintenance of proposed equipment. Note any discrepancies on the shop and construction drawings. Inform the Engineer of such discrepancies with proposed solutions for approval.

2.0 SCOPE OF WORK

- 2.1 The scope of work outlined in these sections shall cover the complete supply, installation, testing, commissioning of electrical material and equipment as described under these sections of the Specification as required and/or shown on the Drawings, including all other associated work such as supporting structure, building, ancillary work, attendance, etc.
- 2.2 Unless otherwise specifically indicated, the work shall include the supply of electrical power to all electrically operated equipment, as shown on the Drawings.
- 2.3 Incoming Power Supply and Connection will be provided by the Local Power Authority at 380/220 V to the location shown on the Drawings.

- 2.4 Telephone Public Exchange Lines will be brought into the premises by the Local Telephone Authority to the location shown on the Drawings and/or to be agreed with the Authority.
- 2.5 All electrical work from and including motor control centers/panels to and including motors and other electrically operated equipment, which is included in the Specification for Mechanical Work or other work, does not form part of the Electrical Work
- 2.6 Power supply to motors and other electrically operated equipment, which are not connected to a motor control center/panel, is included in the Electrical Work and comprises power supply to terminal box on equipment or nearby disconnecting or starting device, and includes the disconnecting device, if individually provided, but not the starting device or combination starter.

3.0 WORK UNDER THIS CONTRACT

- 3.1 Without restricting the generality of the foregoing, the electrical installation covered under these sections of the Specification shall include the supply and installation of the following:

- Conduits and fittings
- Electrical raceways
- Electrical wiring accessories
- Main and secondary panelboards
- Power factor correction
- Earthing systems
- Telephone system
- Emergency generators
- Lighting systems
- Fire alarm detection system

SECTION 16020

GENERAL TECHNICAL REQUIREMENTS

1.0 GENERAL

- 1.1 All electrical works shall be carried out in a neat, workmanlike and efficient manner, in accordance with the Drawings and the requirements of the Specification, and so that their true meaning and intent are fulfilled.
- 1.2 It shall be clearly understood that the Specification, the Bill of Quantities and the design Drawings are complementary documents, intended for the selection of equipment having the general and specific characteristics as detailed in the Drawings.
- 1.3 Minor deviations from the drawings may be made to accomplish this, but no changes are to be made without the written approval of the Engineer.
- 1.4 Unless otherwise specifically stated, the electrical installation shall be complete, ready for operation and fully integrated and coordinated with all other building items.

2.0 REGULATIONS AND STANDARDS

- 2.1 All electrical work shall be carried out in accordance with the current issue of the local codes of practice, local power authority regulations and Regulations (if any), with the latest issue of the French Norms NFC15-100, and the International European Electro-technical Commission IEC, hereinafter referred to collectively as Regulations.
- 2.2 Unless otherwise specified, equipment and materials are to be manufactured and installed in compliance with the relevant recommendations of the following:

IEC : The International Electro-technical Commission

ISO : The International Standardization Organization

CCITT: The International Telephone and Telegraph Consultative Committee

CCIR : The International Radio Consultative Committee

CISPR: The International Special Committee on Radio Interference

or other equal and approved standards, herein referred to as the Standards. Local standards, where enforced and relevant, are to have precedence over the Standards.

3.0 MATERIAL AND EQUIPMENT

- 3.1 Equipment shall be the latest standard product of the manufacturer. Component parts are to be the product of a single manufacturer, unless otherwise approved and provided that components made by other manufacturers are of a standard design and are interchangeable.
- 3.2 Listing of approved manufacturers in the Specification does not necessarily constitute approval of their standard products as equal to those specified. Ascertain that listed manufacturers are able to supply equipment and material in conformity with the Specification.
- 3.3 Equipment generally is to be supplied in complete factory assembled units ready for installation on site. De-assembly necessary for transportation or other purposes is to be arranged to limit site work to simple re-assembly and inter-wiring of control and power cabling.
- 3.4 Equipment and materials are to be stored in an approved location, under cover, free from humidity, dust, debris and rodents. Equipment sensitive to heat and humidity is to be kept in climatically conditioned areas until installed and handed over.
- 3.5 The Employer reserves the right to operate operable defective equipment during the Defects Liability Period until it can be removed from service for repair or replacement.
- 3.6 Where required by the Specification, provide a warranty, signed by the manufacturer (including his agreement to replace promptly, defective equipment or parts thereof, as instructed by the Engineer) covering materials and workmanship for the period stated in the Specification, starting at substantial completion. The Contractor is to assign the benefits of such warranty to the Employer.
- 3.7 Confirm that proposed equipment and material characteristics where required are compatible with the requirements of the Local Power Authority or other authorities having jurisdiction and are acceptable to them. Inform the Engineer of any modifications necessary to comply with the Local Power Authority requirements.
- 3.8 Confirm availability of equipment and materials proposed for use in the work prior to submission for approval. If, after approval, equipment or materials cease to be available, submit alternative items of equal quality and type for approval.
- 3.9 Label And Identify all equipment, instruments, control and electrical devices etc. to indicate duty, service or function, to the satisfaction of the Engineer. Labels are to be laminated plastic or anodized aluminum discs with black surface and white core with incised lettering in English and/or Arabic (as required). Alternative methods of labeling may be submitted for approval. Fix labels with non-corrodible screws to equipment, or to adjacent permanent surfaces or as approved by the Engineer.

4.0 BASIC DESIGN CONDITIONS

4.1 Nominal Characteristics of Power Supply And Distribution are as follows:

Low voltage : 380 V, 3 phases, 4 wire, solidly earthed neutral
Frequency : 50 Hz

4.2 Equipment is to be designed for the system voltage and frequency previously described, unless otherwise specified. Special provisions are to be made for equipment sensitive to power supply frequency and voltage variations and for equipment operated at other voltages/frequencies or by direct current sources.

4.3 Climatic Conditions equipment, including transformers, switchgear, cables, relays, lighting fixtures, motors etc., is to be designed and de-rated for continuous and trouble free service under the following climatic conditions:

Altitude : 0 - 600 m above sea level
Maximum ambient temperature : 30 deg. C (in the shade)
Minimum ambient temperature : 4 deg. C
Maximum relative humidity : 85 percent

Where design and operating conditions, different from the above are required for particular equipment, they are described in the specification of the equipment concerned.

5.0 APPROVAL OF EQUIPMENT

5.1 Submittals for approval shall include manufacturers technical literature, shop and construction drawings and other information required by the Specification, before ordering equipment or materials and before executing any related work on site.

5.2 The technical literature is to include detailed manufacturers specifications and original catalogues or catalogue cuts, characteristics, model number, application and operating criteria of all equipment and materials, together with other information necessary to satisfy the Engineer that proposed equipment and systems are suitable and adequate.

5.3 List of proposed manufacturers of all equipment and materials, including all items for which choice of manufacturer is at the discretion of the Contractor, is to be submitted for approval.

5.4 Prior to installation, a schedule of all equipment and devices which are to be labeled is to be submitted with the suggested details, lettering, position and fixing methods of each label indicating its application.

5.5 Samples of all equipment and materials shall be submitted for approval. Major items of equipment for which samples cannot be submitted are to be demonstrated in existing installations or by manufacturer information, test certificates and reports.

6.0 CONTRACTOR DRAWINGS

- 6.1 The design drawings issued with the Specification indicate the approximate location of all electrical apparatus. The exact and final location shall be indicated by the Contractor construction drawings and shall be subject to the prior approval of the Engineer.
- 6.2 The wiring layout as shown on the design drawings shall be only used as a guideline defining the desired loading and switching arrangement. Actual routing of all circuits shall be as per the construction drawings to be submitted by the Contractor and approved by the Engineer.
- 6.3 Wiring Layouts shown on the Drawings for work not included in the Electrical Work, such as motor control panels, cables to motors and other similar electrically operated equipment are shown for convenience and reference only.
- 6.4 Shop And Construction Drawings are to demonstrate to the Engineer that the design requirements are understood by indicating all equipment and material proposed to be supplied and installed and by detailing fabrication and installation methods proposed to be used.
- 6.5 The Contractor shall coordinate his shop drawings with works with other trades, and shall revise his drawings accurately to record the work and submit them to the Engineer at the completion of the work and prior to final hand over.
- 6.6 Prior to the final acceptance of the installation the Contractor shall submit to the Engineer three sets of manuals for all equipment supplied under the Contract. The manuals shall include single line diagrams, control circuit diagrams, operating instructions, trouble-shooting procedures, and maintenance instructions including schedules for preventative maintenance.

SECTION 16130
ELECTRICAL WIRING DEVICES AND ACCESSORIES

1.0 GENERAL

- 1.1 Electrical work generally is to be in accordance with the requirements of the sections of this Book of Specification.
- 1.2 Works are to include wiring devices, lighting switches, socket outlets, cord outlets, automatic and manual lighting control equipment, outlet boxes and plates, disconnect switches etc.
- 1.3 Components are to be standard manufactured items, uniform and modular, complying with one set of approved Standards.
- 1.4 Data shall be submitted for approval, including catalogues, detailed literature, manufacturer name, catalogue number, rating, specification, overall dimensions and special features, as applicable for each item.
- 1.5 Drawings submitted for approval shall include, but not to be limited to, the exact indication of position of each item and outlet box and fitting on layout drawings, with box and equipment types and sizes, the installation details of special items including isolating switches, fans etc. and the wiring diagrams of special items.
- 1.6 Samples of each type of device shall be submitted for approval, unless otherwise agreed in writing by the Engineer.

2.0 OUTLET BOXES

- 2.1 Surface or recessed boxes are to be suitable for type of related conduit or cable system. Shapes and sizes of boxes are to be of compatible standards as switches, socket outlets and lighting fixtures selected and of various types and mounting methods required.
- 2.2 Unused openings in outlet boxes are to be closed with knock-out closers manufactured for the purpose.
- 2.3 Blank plates are to be installed on outlet boxes on which no apparatus is installed or where apparatus installed does not have suitable cover for box. Blank plates for wall outlets are to be attached by a bridge with slots for horizontal and vertical adjustment.
- 2.4 Floor outlets and plates are to be watertight and impact resistant.
- 2.5 Moulded plastic boxes used with pliable PVC and polyethylene conduits for recessed and concealed installation systems in concrete shall be made of shockproof self-extinguishing resin with knockouts for conduit entry.

- 2.6 Moulded plastic boxes and covers used with PVC conduit systems for exposed installation are to be heavy gauge pressure moulded plastic, minimum 2 mm thick, self extinguishing, with softening point not less than 85 deg. C. Boxes are to have provision for securely terminating conduits and are to be manufacturer's standard for required application.
- 2.7 Moulded plastic boxes are to have brass inset threads to receive cover screws and for mounting devices or accessories, push-fit brass earth terminals, and steel insert clips to provide additional support for pendants or for heat conduction. Neoprene gaskets are to be provided for weatherproof installations.
- 2.8 Recessed and concealed metallic boxes are to be galvanized pressed steel, with knockouts for easy field installation. Special boxes are to be punched as required on Site.
- 2.9 Use one type of boxes from the same manufacturer throughout the project.
- 2.10 Arrangements (vertical, horizontal, double, triple, etc.) and shapes of boxes (square, rectangular, etc.), depending on the type of wiring devices, shall be standardized throughout the project and shall be coordinated with the Engineer.

3.0 COVER PLATES

- 3.1 Design to be square, rectangular or round, designed to cover outlet box and to closely fit electrical device, and with polished chromium plated recessed head fixing screws. Combination plates are to be used for grouped outlets and devices.
- 3.2 Plastic plates are to be heavy gauge, break resistant, pressure moulded plastic, color to match surroundings, for general use in offices, hotel areas.
- 3.3 Metal plates are to be heavy gauge, minimum 1 mm thick, for use metallic boxes.
- 3.4 Plates for different types of devices (switches, socket outlets, telephone and TV outlets, etc.) shall be of the same range and manufacturer.
- 3.5 Weatherproof type devices shall be IP54 equipped with shutter type plates with waterproof sealing gasket.

4.0 SWITCHES AND PUSH BUTTONS

- 4.1 Switches are to be quick-make, quick-break type with silver alloy contacts in arc resisting moulded base, with toggle, rocker or push-button, rated 10A 250V AC, as specified, for inductive or resistive loads up to full rated capacity, and arranged for side and/or back connection.
- 4.2 Switches shall be single, two way or intermediate, as indicated on the Drawings, and shall be mounted with the long dimension vertical and with the operating handle in upward position when in the ON position

- 4.3 Push buttons for time-lag switch, latching relay, dimmer, and bell call system control shall be of the rocker push to make type, 6A-250V AC.
- 4.4 Pull-cord type push buttons shall be installed in bathrooms as shown on Drawings at 150cm from finished floor level, and shall be 6A-250V AC
- 4.5 Push buttons for emergency lamp test shall be normally closed type or two-way, enabling continuous feeding of emergency kit.

5.0 SOCKET OUTLETS

- 5.1 Sockets are to have injection moulded plastic base with self-adjusting, non-expanding contacts to prevent permanent distortion, arranged for side and/or back connection and with screw terminals accepting at least three parallel branch-circuit wires, rated at 16A - 250V AC, and shuttered for child safety, similar to Mosaic-Legrand cat. No. 74130
- 5.2 Weatherproof socket outlets are to be any of the types indicated, enclosed in surface mounted cast metal box and with cover comprising spring-retained gasketed hinged flap. Enclosure is to be pre-designed box and cover for type of socket outlet specified.
- 5.3 Socket outlets for UPS shall be similar to normal socket outlets in shape and rating but different in color, with tamperproof insert, similar to Mosaic-Legrand cat. No. 74132. The tamperproof insert shall be supplied with the socket.

6.0 JUNCTION AND FLOOR BOXES

- 6.1 Junction boxes shall be located where indicated on the Drawings or required to facilitate pulling and splicing wires and cables, but as hidden as possible.
- 6.2 Boxes of ample capacity shall be provided at every junction of the conduit system and as required by the Regulations or as indicated on the Drawings.
- 6.3 Junction boxes, if required, shall be placed at a maximum spacing of 10 meters.
- 6.4 Floor boxes shall be mounted flush with floor tiles, and equipped with cover for carpet, membrane gland entries for cables and cord grips, equivalent to Legrand cat. No. 89300.
- 6.5 Floor boxes shall be 4-gang, unless otherwise indicated, each gang equivalent to a space for 1 socket outlet Mosaic Legrand cat. No. 74130.

7.0 ROLLING SHUTTERS

- 7.1 Switches for electric rolling shutter control shall be of the 2-pole 2-way direct motor operation type, 10A-250V AC, with fixed up/down positions as indicated on Drawings and as stated in the bill of quantities, and shall be installed at the same height as for switches.

- 7.2 The centralized system, if required, shall include for each rolling shutter a control box connected to the main central control unit, enabling master control from a master up/down switch. The centralized system shall enable pre-programming of shutters to be left closed while opening the others.
- 7.3 Remote controlled shutter system, if required, shall consist of one radio receiver for up/down motor control similar to SOMFY Ref. 620090 flush mounted for every rolling shutter controlled by a remote control unit.
- 7.4 The remote control unit, if required, shall be wireless battery operated, fixed with one up/down programmable button similar to SOMFY Ref. 620089, or portable with four programmable channels similar to SOMFY Ref. 101065.

8.0 DISCONNECT SWITCHES

- 8.1 Disconnect switches are to be rated 500 V, 2, 3 or 4 pole, load break, short-circuit make, in accordance with IEC 408, utilisation category 22 for heating and lighting loads, category 23 for motor circuits, and with ampere rating shown on the Drawings.
- 8.2 Switches are to be non-fusible, air-break switch disconnecter, single throw, and safety type, housed in separate metallic enclosure with arc quenching devices on each pole.
- 8.3 Operating mechanism to be quick-make, quick-break, independent of operator, with external operating handle mechanically interlocked to prevent opening door unless switch is in open position. Position of handle is to be positive and clearly indicated on cover.
- 8.4 Enclosure to be of the robust thermoplastic IP42 for indoor use, and weather-proof IP65 for outdoor installations, unless otherwise required or shown on the Drawings. Locking of operating handle is to be possible in open and closed positions.

9.0 MODULAR LIGHTING CONTACTOR

- 9.1 Lighting contactors shall be double, triple or four pole, mechanically held, electrically operated, rated 500 V, modular to be installed inside secondary panelboards, of current ratings shown on the Drawings, and complying with IEC-158-1 category AC 2 and AC 3.
- 9.2 Contacts are to be of copper alloy, with silver cadmium alloy double break contacts designed for switching inductive ballast loads and switching of tungsten lamp loads.
- 9.3 Auxiliary contacts are to be as required to provide specified interlocks and signals as shown on the Drawings, or required by the Specification.
- 9.4 Each contactor whether part of a system or separate is to have a protective fuse for its coil and a control selector switch on-off-auto.

10.0 MODULAR LIGHTING CONTROL DEVICES

- 10.1 Modular lighting control devices shall be din-rail type mounted inside secondary panelboards beside circuit breakers, as shown on Drawings.
- 10.2 Time-lag switches shall be 20A-250V, 50Hz AC single pole, silent type, controlled via push buttons, with knob for time to switch OFF adjustment (0 to 7 minutes) and a maintained ON position.
- 10.3 Latching relays shall be 20A-250V, 50Hz AC single pole, silent type, controlled via push buttons, equipped with position switch manually adjustable.
- 10.4 24-hour timers shall be 16A-250V, 50Hz AC single pole, equipped with analog rotary adjustable clock with minimum on/off cycle 30 minutes, 100 hours of spare autonomous run and a selector switch for on-off-auto operation.
- 10.5 Push button controlled dimmer shall be rated 1000W incandescent load, equipped for master/slave operation, similar to Legrand 03670. A special capacitor shall be added for inductive loads.

11.0 INSTALLATION REQUIREMENTS

- 11.1 The Drawings generally show approximate locations of outlets and equipment. Exact locations are to be determined from interior finishing and detail drawings. Any condition that would place an outlet in an unsuitable location is to be referred to the Engineer.
- 11.2 Switches shall be located at strike sides of doors, whether shown on the Drawings or not. In locating outlets allow for overhead pipes, ducts, variations in arrangement, thickness of finishing, window trim, paneling and other architectural features.
- 11.3 Mounting heights for outlet boxes and similar equipment are to be uniform within the same or similar areas. Mounting is to be as shown on the Drawings or as approved by the Engineer. Unless otherwise shown or instructed, mount lighting switches near doors at 110cm, lighting switches near beds at 75cm, and socket outlets at 30cm from finished floor level.
- 11.4 Mount switches with long dimension vertical and operating handle, if of the toggle type, up when in the on position.
- 11.5 Single pole switches are to switch only the phase wire. Do not run neutral wire through switches having neutral shunt or bridge.
- 11.6 Exposed outlet boxes are to be securely fastened to wall with machine screws to permanent inserts or lead anchors.
- 11.7 Recessed outlet boxes are to have neat openings, to the satisfaction of the Engineer, allowing for thickness of finishing, and use extension rings if required. Repair damaged finishing to original condition before installation of fittings or plates.

- 11.8 Exposed boxes and plates plumb are to be installed square and parallel to finished wall surface. Exposed plates covering recessed boxes are to rest neatly on wall surface without gaps, and fully covering the box.
- 11.9 Grouped outlets are to be arranged neatly so that use of fittings is convenient and clear.
- 11.10 Damaged fittings or plates with damaged finish are rejected. Fittings and plates shall be protected against damage after installation and until handed over.
- 11.11 Fittings and equipment are to be inspected visually for good fixing and workmanship.
- 11.12 Devices are to be tested for operation and are to perform as intended at full load without any signs of heating.

12.0 MANUFACTURERS

- 12.1 Electrical wiring devices:
Legrand (France)
Ticino Light (Italy)
Vimar Idea (Italy)
or approved equal.
- 12.2 Disconnect Switches:
ABB (Sweeden)
Siemens (Germany)
Gewiss(Italy)
or approved equal.
- 12.3 Modular lighting contactors and control devices
Legrand (France)
Merlin-Gerin (France)
ABB (Italy)
Moeller (Italy)
or approved equal.

SECTION 16210
MAIN DISTRIBUTION Panels.

1.0 GENERAL

- 1.1 Electrical work generally is to be in accordance with the requirements of the sections of this Book of Specification.
- 1.2 The types of panelboards include the following:
- | | |
|---------|--------------------------------|
| UD-GF: | UPS distribution board/panel |
| LP- GF: | Main distribution board/ panel |
| . | |
- 1.3 The sections containing requirements that relate to this Section include the Low Voltage Circuit Breakers, Low Voltage Wires and Cables, Earthing, and Identification.

2.0 SUBMITTALS

- 2.1 The Contractor shall submit for approval detailed description of main distribution boards and major components supported by manufacturer catalogues, indicating compliance with the Standards, equipment characteristics, details of construction, operating data, dimensions and weights etc. The description shall also include miscellaneous items such as incoming and outgoing feeder terminal arrangement, connections at busbars, isolating, earthing, interlocks, control devices, indicating and metering instruments etc.
- 2.2 Submittals shall include complete certified manufacturer type and routine test records, in accordance with the Standards.
- 2.3 Shop Drawings

The Contractor shall submit shop drawings for approval including, but not limited to, the following:

- Plans and elevations with exact dimensions and weights
- Arrangement of boards inside rooms with required spaces and clearances
- Arrangement of equipment inside board
- Single-line diagram of power system with current ratings of equipment
- Locations of protective gear (relays, instruments, CTs, VTs etc.)
- Schematic and elementary diagrams of control circuits
- Arrangement of incoming and outgoing feeders, and busbar connections

2.4 Technical Literature

The Contractor shall submit the following for approval prior to placing orders for equipment manufacture:

- Schedule of circuit breaker, indicating type and range, and characteristics
- Setting of protective devices for overload, short-circuit and earth-fault currents as coordinated with upstream and downstream systems based on specific coordination curves of protective devices used and specific calculated prospective short-circuit currents at various points
- Test methods on site and references.

3.0 MATERIAL AND CONSTRUCTION

- 3.1 Main distribution boards and panels are to be dead-front type, metal enclosed, multi-cubicle, floor mounted free standing or wall mounted, according to size, 600 V class of service switchboards, with fixed or draw-out switchgear, manually or manually and electrically operated, as shown on the Drawings, with matching vertical sections to form a continuous integral and rigid structure.
- 3.2 Enclosures shall be rigidly framed and bolted, with electro-galvanized sheet steel enclosures, minimum thickness 1.5 mm, phosphatized, primed with rust inhibiting primer and finished with thermal polymerized polyester epoxy powder coating, gray color. Switchgear is to be vermin, dust and rodent proof, IP51 protection to IEC 947-1 for indoor installations, with adequate lifting means and base-frames and capable of being moved into position and directly bolted to floor without additional sills.
- 3.3 Enclosure shall be equipped with lockable hinged and gasketed doors, and with inner protective shrouds made of reinforced glass-fiber 3mm thick or galvanized sheet steel 1.5mm thick with openings for operating handles and control accessories.
- 3.4 Compartments are to be ventilated, where required, by approved methods complying with the Standards.
- 3.5 Structural members are to be bolted and fastened rigidly together. The structure and busbars shall allow the possibility of extension at either end of switchboard.
- 3.6 The arrangement is to permit incoming and outgoing busbars and cables to enter the enclosure as indicated on the Drawings and to connect at respective terminals without inconvenience to installation or maintenance.
- 3.7 Busbars shall be rated for normal current as shown on the Drawings or at least rated to same rating as main circuit breaker frame size, and braced for a symmetrical rms short-circuit duty equal to or higher than main circuit breaker interrupting duty, for minimum of one second unless otherwise specified or shown on the Drawings.
- 3.8 Busbars are to be copper, of sufficient size to limit temperature rise to allowable insulation or equipment temperature ratings, and to maximum 40 deg. C above average ambient temperature of 50 deg. C outside enclosure.

- 3.9 Connections and buswork are to be bolted with copper alloy hardware and are to be accessible for inspection and maintenance. Contact surfaces are to be electro-silver plated.
- 3.10 Connections from busbar to switchgear are to be rated to carry full continuous current rating of switchgear frame and are to be insulated.
- 3.11 Full size neutral is to be continuous through all sections. Neutral bus is to be insulated and separate from earth bus and connected to it with removable links.
- 3.12 Earth Bus is to extend full length of board, firmly fixed to each section in accordance with the Regulations and Standards, complete with two main earthing lugs (one at each end), and required number of feeder protective earth connectors.
- 3.13 Switchboard are to be front accessible, wall (rear) aligned, with fixed or withdrawable main circuit breaker sections (type and rating as shown in Schedules) and fixed group mounted outgoing MCCB distribution section(s)

4.0 EQUIPMENT AND DEVICES

- 4.1 Except as otherwise indicated, circuit breakers, contactors and ancillary components, of types, sizes, ratings and electrical characteristics shall be provided as shown on drawings.
- 4.2 Circuit breakers, contactors and ancillary components shall comply with manufacturer standard design, materials, components, and construction in accordance with published product information, and as required for a complete installation and as approved by the Engineer.
- 4.3 Analog metering instruments are to be housed in enameled, square, metal cases for flush installation. Scales and markings are to be protected and sealed. Accuracy of instruments is to be within 2 percent unless otherwise specified.
- 4.4 Current transformers shall be indoor dry type, rated secondary current 5 A. Rated primary current, core size and accuracy are to be determined in accordance with nominal current of plant protected, short-circuit level and burden.
- 4.5 Wiring inside panel is to be modularly and neatly arranged on master terminal boards with suitable numbering strips and appropriate cartridge type fuses where required. Metal Cases of instruments, control switches, relays etc. are to be connected, by bare copper conductors not less than 2.5 mm² section, to nearest earthing bar.
- 4.6 Control wiring is to be copper, PVC insulated, 85 deg. C, 600 V grade, and PVC sheathed for multi-core cables. Finely stranded copper conductor, silicon rubber insulated cables are to be used in proximity to higher temperature components and as flexible cable.

5.0 INSTALLATION

- 5.1 Switchboards shall be assembled and installed as indicated, in accordance with manufacturer written instructions, and with recognized industry practices; complying with applicable requirements of applicable standards or codes approved. Cubicles shall be completely plumbed and leveled, before grouting in holding-down bolts.
- 5.2 Concrete bases, cable trenches with covers, and foundations are to be provided for installation of equipment are constructed in accordance with approved shop and construction drawings and equipment manufacturers drawings and that holes for fixing bolts and provisions for passage of cables etc.
- 5.3 Damaged surfaces shall be painted, by first cleaning and applying rust-inhibiting prime coat and then applying two finishing coats of approved enamel upon delivery of equipment to site, or as required by the Engineer.
- 5.4 Connectors and terminals shall be tightened, including screws and bolts, in accordance with equipment manufacturer published torque tightening values for equipment connectors.
- 5.5 After installation and before handover, all tests required by the codes or by the Engineer shall be carried out to check compliance of installation with the Specification, including insulation resistance tests and operational tests.
- 5.6 Equipment earthing connections shall be provided for switchboards as indicated. Tighten connections to comply with tightening torques specified in applicable standards to assure permanent and effective earthing.

6.0 MANUFACTURERS

- 6.1 Enclosures for main and distribution boards and panels:
ABB (Germany)
Himel (Italy)
Eldon (G.B.)
or approved equal.
- 6.2 Circuit Breakers and accessories:
Merlin Gerin (France)
ABB (Italy)
Muller (Germany)
or approved equal.
- 6.3 Contactors and accessories:
Telemecanique (France)
ABB (Italy)
or approved equal.

SECTION 16230
CIRCUIT BREAKERS AND MODULAR DEVICES

1.0 GENERAL

- 1.1 This section includes circuit breakers and accessories for main distribution boards and panels, secondary panelboards, and motor control panels.
- 1.2 The sections containing requirements that relate to this Section include the Main Distribution Boards and Panels, Secondary Panelboards, Low Voltage Wires and Cables, Earthing, and Identification.
- 1.3 Except as otherwise indicated, circuit breakers and ancillary components are to be of types, sizes, ratings and electrical characteristics indicated, which comply with manufacturer standard design, materials, components, and construction in accordance with published product information, and as required for a complete installation which shall be subject to approval or rejection of the Engineer.
- 1.4 Types of circuit breakers and accessories in this section include the following:
- Molded case circuit breakers (MCCB)
 - Miniature Circuit Breakers (MCB)
 - Molded Case Switch
 - Modular contactors, latching relays, time-lag switches, and 14-hour timers

2.0 SUBMITTALS

- 2.1 The Contractor shall submit manufacturer product data including frame size (continuous current rating), short circuit interrupting ratings, special and regular features of mounting, trip rating and illustrated relay features etc. as required by the Engineer and installation instructions for each type of circuit breaker.
- 2.2 Submittals are to include single-line diagrams of circuits showing connections between circuit breakers, and connections to electrical power feeders and associated equipment. Differentiate between portions of wiring which are manufacturer-installed and portions which are field-installed.
- 2.3 Manufacturer certificate of compliance to the referenced standards and tested short-circuit closing and withstand ratings applicable to the protective devices and current ratings used in this Project, as indicated and as specified in the related Sections.

3.0 MOULDED CASE CIRCUIT BREAKERS (MCCB)

- 3.1 MCCB shall be totally enclosed, moulded case, constructed from high quality, high temperature resistant, tropicalized, moulded insulating materials designed for normal operation at maximum temperature within enclosure at point of application, and provided with front operated single toggle type handle mechanism for manual operation of main contacts in addition to automatic operation under overcurrent conditions.
- 3.2 Tripping on the MCCB is to be indicated by handle automatically assuming a middle position between manual on and off positions. Multi-pole breakers are to have common integral trip bar for simultaneous operation of all poles. Ampere rating is to be clearly visible. All terminals are to be box lug or clamp type with screws, suitable for copper or aluminum conductors.
- 3.3 Unless otherwise specified or shown on the Drawings, MCCB trip units of circuit breakers up to and including 400A frame size, are to be non-current limiting thermal-magnetic type, having bi-metallic inverse time delay overcurrent element for small overloads and instantaneous magnetic overcurrent trip element for operation under short-circuit conditions on each pole. Breakers rated 630A and higher shall have solid-state electronic trip units.
- 3.4 Switching mechanism for MCCB is to be quick-break type, with positive trip-free operation so that contacts cannot be held closed against excess currents under manual or automatic operation. Contacts are to be non-welding silver alloy with approved arc-quenching devices of metallic grid construction.
- 3.5 Thermal overcurrent trip units are to be compensating type to allow for ambient temperature higher at breaker than at protected circuit or device. Compensation is to be applicable between 25 and 50 deg. C.
- 3.6 When tripped automatically by overcurrent condition, operating mechanism of MCCB is to assume an intermediate position clearly indicated by the handle between on and off positions.
- 3.7 MCCB 250A frame size and higher are to accept either thermal or electronic interchangeable trip units.
- 3.8 Electronic trip units are to be solid state with long time delay settings between 0.5 and 1.0 times maximum trip rating, short time delay range of 3 to 10 times maximum trip rating with a maximum clearing time of 0.2 seconds, and instantaneous protection adjustable from 5 to 10 times continuous rating. Earth fault protection is to be built into trip unit where specified, adjustable between 0.2 and 0.6 of normal phase current pick-up with maximum time-delay of 0.2 seconds, with integral current transformers. Push-to-trip button is to be provided on cover for testing the trip unit.

4.0 MINIATURE CIRCUIT BREAKERS (MCB)

- 4.1 Miniature circuit breaker MCB shall be thermal magnetic non-adjustable type, tested in accordance with IEC898 or BS 3871, Part 1.
- 4.2 The minimum short-circuit breaking capacity is to be as 6KA, 10KA or 16KA for MCB with rating 6 up to 125 A at 240/415 V a.c.
- 4.3 MCB are to be tropicalized for operation at ambient temperatures up to 70 deg. C within panelboard enclosure and humidities up to 95 percent, and are to be constructed from high quality, high temperature, moulded insulating materials. MCB and combinational devices are to be modular, of unified profile and mounted to a standard DIN rail.
- 4.4 Under overload conditions, thermal tripping is to provide close protection of insulated conductors. Under short-circuit conditions, magnetic trip is to operate at 7 - 10 times normal rated current. Magnetic operation is to be in the current limiting region and opening time is not to exceed 5 milli-seconds.
- 4.5 MCB rated currents are to be 6, 10, 16, 20, 25, 32, 40, 50, 63, 80, 100 and 125A, calibrated at 40 deg. C, available as 1, 2, 3 and 4-pole, 1 pole + neutral (1P+N) circuit breakers. De-rating above 40 deg. C is not to exceed 1 percent per deg. C, and loading is not to exceed 70 percent of circuit breaker rating.
- 4.6 Residual current devices for earth leakage protective circuit breakers may be add-on devices, or built-in and integral with the standard miniature circuit breaker. Non-adjustable sensitivities of 30mA and 300mA are to be available for all ratings of 2-pole and 4-pole circuit breakers.
- 4.7 Where required or shown on the Drawings, are to include alarm switch, auxiliary switch, shunt trip, under voltage trip and similar units which are to be modular additions to the circuit breakers.

5.0 INSTALLATION

- 5.1 Circuit breakers and accessories shall be installed as indicated, in accordance with manufacturer written instructions and with recognized industry practices to ensure that protective devices comply with requirements.
- 5.2 Installation shall include coordinate with other work, including electrical wiring work, switchboards, panelboards as necessary to interface installation of circuit breaker work with other work.
- 5.3 Fastening circuit breakers shall be executed without causing mechanical stresses, twisting or misalignment being exerted by clamps, supports, or cabling.

- 5.4 Adjustable circuit breakers shall be set for trip settings as indicated in accordance with an approved system coordination scheme, subsequent to installation of units.
- 5.5 Electrical connectors and terminals shall be tightened , including screws and bolts, in accordance with equipment manufacturer published torque tightening values for equipment connectors.
- 5.6 Equipment earthing connections are to be provided for circuit breakers as indicated. Tightening connectors is to comply with tightening torques specified in manufacturers standards or compatible international standards to assure permanent and effective earthing.

6.0 TESTING

- 6.1 Tests are to be carried out in accordance with the requirements of the Regulations and Standards
- 6.2 Tests are to include operation of every circuit breaker manually.
- 6.3 Automatic operation of selected circuit breakers shall be checked, as required by the Engineer, by applying necessary short-circuit, overload and earth leakage current for tripping circuit breaker as applicable and compare with manufacturer characteristic curves.

7.0 MANUFATCURERS

- 7.1 Low voltage circuit breakers:
 - ABB (Italy)
 - Merlin Gerin (France)
 - Legrand (France)
 - Ticino (Italy)
 - Moeller (Germany)
 - or approved equal.

SECTION 16260
UNINTERRUPTABLE POWER SUPPLY

GENERAL

SUMMARY

- The Contractor shall furnish and install a single phase continuous duty, on-line, double conversion, solid-state uninterruptible power system, hereafter referred to as the UPS. The UPS shall operate in conjunction with the existing floor electrical system to provide power conditioning, backup and distribution for critical electrical loads. The UPS shall consist of, as required by the project, the UPS module, battery racks, accessory, and distribution applications, and other features as described in this specification.

RELATED SECTIONS

- SYSTEM DESCRIPTION

Standard UPS system will include :

- Rectifier
- Inverter
- Sealed Lead Acid Batteries
- Battery Charger
- Automatic Bypass
- User Interface Panel
- Serial (RS-232)/USB Communication Interface
- Communication Card Slots (2)
- Remote Emergency Power Off Contacts
- Environmental (Building Alarm) Inputs (3)
- Hardwired Input, Output
- External Battery racks
- Communications Options

- Modes of Operation: The UPS shall operate as an online, double-conversion UPS with the following modes:
 - Normal: During the Normal or Double-conversion Mode the rectifier shall derive power as needed from the commercial AC utility or generator source and supply filtered and regulated DC power to the online inverter. The inverter shall convert the DC power to highly regulated and filtered AC power for the critical loads.
 - Battery: Upon failure of the AC input source, the critical load must continue to be supplied by the inverter without switching. The inverter must obtain its power from the battery. There must be no interruption in power to the critical load upon failure or restoration of the AC input source.
 - Recharge: Upon restoration of the AC input source, the rectifier/battery charger must recharge the battery. The inverter shall, without interruption of power, regulate the power to the critical load.
 - High Efficiency: The static bypass switch will conduct, and the UPS rectifier and inverter will be operated in a “suspended” mode, unless incoming power conditions require conventional double conversion operation.
 - Bypass: The static bypass switch must be used for transferring the critical load to the AC utility supply without interruption, and shall be rated for continuous operation. Automatic re-transfer to normal operation must also be accomplished without interruption of power to the critical load. The static bypass switch must be capable of manual operation via the front panel controls. An integrated bypass back feed protection contactor, in series with the static switch, shall prevent system voltages from bleeding backwards through the static switch and rectifier snubbed components to the utility source in the event of a utility failure and shall also open upon detection of a short circuit static bypass SCR.

REFERENCES

- The UPS and all components shall be designed, manufactured and tested in accordance with the latest applicable standards as follows. Where a conflict arises between these documents and statements made herein, the statements in this specification shall govern.

Safety

- IEC 62040 or EN 62040
- EN 60950

Emission and Immunity:

- IEC62040-2-C3 (conducted and radiated)
- EN61000-4,-5, level 4 – 4 kV L-PE, 2kV L- Electrostatic discharge (ESD): 8 kV air discharge, 4 kV contact discharge (IEC 61000-4-2, level 4) - Electromagnetic field: IEC 61000-4-8 level 3.

SUBMITTALS – FOR REVIEW/APPROVAL

- Submit one copy of a concise operation and maintenance manual.

QUALIFICATIONS

- The manufacturer of the unit shall have a minimum experience in the design, manufacture and testing of Uninterruptible Power Supplies.
- The UPS shall be CE marked.

DELIVERY, STORAGE AND HANDLING

- Equipment shall be handled and stored in accordance with manufacturer's instructions. The UPS and accessory cabinets meet structural requirements of ASTM D4169. One (1) copy of these instructions shall be included with the equipment at time of shipment.

OPERATION AND MAINTENANCE MANUALS

- Equipment operation and maintenance manuals shall be provided with each assembly shipped and shall include instruction leaflets, instruction bulletins and renewal parts lists where applicable, for the complete assembly and each major component products.

PRODUCTS

MANUFACTURERS

- Eaton Corporation
 - APC Schneider
 - Emerson
- Or equivalent

RATINGS

System Input

- Input Voltage Operation Range
 - Nominal 400/230 (or 380/220 or 415/240 adjustable) VAC, 4-wire plus ground
 - +20% to –15% from nominal at 100% load
 - +20% to –50% from nominal at 50% load

Input Frequency

- a. 42 to 70 Hz
- b. auto-sensing
- c. Input Power Factor: 0.99 typical
- d. Input Current Distortion: 5% THD maximum at full rated linear load

System Output, Normal Mode -Nominal Output Voltage, UPS on Utility

- 400/230, or 380/230 or 415/240VAC, Selectable through front panel or through serial port connection with power management software
- Output power factor rating: 0.7 lagging to 0.9 leading without de-rating.
- Voltage regulation: +/-1% of selected output voltage in steady state
- 2% Total Harmonic Distortion (THD) maximum phase to neutral into a maximum rated linear load (5% phase to phase)
- 5% THD maximum phase to neutral and phase to phase into a non-linear load
- Short Circuit conditions: current limit at 2.5x nominal FL current for 300 ms.
- Unit shall be able to detect bypass module failure.
- Efficiency:
 - In Normal Mode, 100% linear load, with nominal line condition: $\geq 94\%$
 - In Normal Mode, 50% linear load, with nominal line condition: $\geq 92,5\%$ to $\geq 93\%$
 - In High Efficiency mode: $\geq 98\%$ at 100% linear load; 97% at 50% linear load

CONSTRUCTION

- The UPS system is initially provided as a single-module, non-redundant system.

BATTERIES

- Battery Type: Valve Regulated Lead Acid (VRLA), minimum one-year warranted float service life at 25 degrees C
- Holdover Time (Runtime): Each UPS system shall have the capability for sufficient battery autonomy to holdover time at 80% power factor. Refer to the BOQ for required autonomy per UPS.
- Battery Recharge Time:
UPS system will have a typical recharge time of 10 times the length of the outage 90% usable capacity @ nominal line.
- Battery Protection:
 - Short Circuit Protection: Over-current protection shall protect the batteries from all short circuit fault conditions
 - Battery Module Protection: Internal battery contactor shall be provided
 - Under-voltage Protection:
 - Inverter cut-off voltage: Battery operation shall be terminated when the battery voltage drops to the 1.67 VPC set point
 - Over-voltage Protection: If the UPS system's battery bus voltage exceeds the predetermined set point then the UPS will disable the charger and alarm a "check battery" condition

NAMEPLATES

- Provide a printed nameplate for UPS.

- ENVIRONMENTAL CONDITIONS
 - The UPS shall meet IEC 61000-4-6 Level 3, and IEC 62040-2 C3, and FCC A15J for Emissions
 - Ambient Temperature
 - Operating: UPS: 0 °C to +40 °C,
 - Storage: UPS -15 °C to +55 °C.
 - Transportation: -25 °C to +60 °C
 - Relative Humidity
 - Operating: 5 to 95% non-condensing.
 - Storage: 5 to 95% non-condensing.
 - Transportation: 5 to 95% non-condensing
 - Altitude
 - Operating: To 1000 metres, de-rating or reducing operating temperature range may be required for higher altitudes
 - Transit: To 10,000 metres
 - Electrostatic Discharge: The UPS shall be able to withstand a minimum 8 kV without damage and without affecting the critical load

EXECUTION

- FACTORY TESTING
 - The following standard factory tests shall be performed on the equipment provided under this section. All tests shall be in accordance with the latest version of NEMA and UL standards.
 - Standard Computer-automated UPS system test
 - Hipot test
- INSTALLATION
 - The Contractors shall install all equipment per the manufacturer's recommendations.

WARRANTY

- All components of the UPS system (UPS module, batteries, and optional accessories, if any) shall be covered by a standard 1-year warranty.
- Manufacturer shall also offer, as an option, 7x24 on-site service support with guaranteed response times. Additional preventive maintenance visits shall be available as an option for both UPS and battery components.

Manufacturer shall also include Start-up services of UPS and batteries, On-site user training, Site Audit, installation and commissioning of monitoring service.

SECTION 16410

INDOOR LIGHTING FIXTURES

1.0 GENERAL

- 1.1 This section includes complete indoor lighting fixtures, emergency lighting units, control gear, mounting provisions, accessories and connection to circuit wiring and to corresponding lighting control equipment.
- 1.2 Location and details of lighting fixture work are indicated on drawings and in schedules.
- 1.3 The sections containing requirements that relate to this Section include the Low Voltage Wires and Cables, and Electrical Wiring Devices.
- 1.4 Lighting fixtures has been determined from photometric data of specified fixtures to achieve desired level and uniformity of illumination. Reflected ceiling plans are to be checked to ensure exact positions of fixtures with respect to structural members, ducts, pipes, other installations and ceiling panels/tiles, where required, so that illumination is as intended by the design.
- 1.5 Types of indoor lighting fixtures in this section include the following:
 - Metal halide
 - Fluorescent
 - Incandescent
 - Emergency
- 1.6 Lighting fixtures or luminaries shall include lamps, parts required to distribute the light, position and protect lamps, and connect lamps to the power supply. Internal battery powered exit signs and emergency lighting units also include a battery and the means for controlling and recharging the battery.

2.0 SUBMITTALS

- 2.1 The Contractor shall submit product data and installation instructions on each type of indoor lighting fixture and component, any modification made necessary, catalog number, serial number, operating characteristics and photometric data.
- 2.2 Submittals will include one complete operating unit for each type of light fixture specified, together with color and texture samples where required.

3.0 LIGHTING FIXTURE CONSTRUCTION - GENERAL

- 3.1 Lighting fixture construction and wiring are to comply with the Regulations and Standards. Fixtures are to be fabricated, assembled and wired entirely at factory. Manufacturer name, factory inspection stamp and official quality label are to be fixed to each fixture supplied.
- 3.2 Sheet steel housings are to be not less than 0.6 mm thick, and thicker when required by the Specification or the Standards. Sheet steel reflectors are to be not less than 0.5 mm thick.
- 3.3 Aluminum reflectors are to be not less than 0.7 mm thick, unless otherwise approved.
- 3.4 Metalwork is to be mitered, welded and ground smooth without tool marks or burrs. Flat metal parts are to be stiffened by forming grooves and edges during fabrication. Metal parts are to have finish free from irregularities
- 3.5 Finish for non-reflecting metal surfaces are to be approved baked enamel paint. Paint color on fixture frames and trims is to be as specified or as selected by the Engineer.
- 3.6 Finishes, wires and components inside fixtures are to be certified materials to resist the temperatures or other conditions encountered in the fixtures.
- 3.7 Wiring inside fixtures are to be not less than 1.5 mm², and insulated for 240V application. Insulation is to have acceptable characteristics to resist maximum temperatures inside fixtures. Wiring is to be terminated on screw type fixed insulating terminal blocks.
- 3.8 Recessed fixtures are to be constructed to fit into suspended ceilings without distorting fixture or ceiling. Removal of parts for maintenance is to be possible without removing fixture housing.

4.0 DISCHARGE LAMP FIXTURES

- 4.1 Discharge lamp lighting fixtures shall include mercury vapour, high and low pressure sodium, and metal halide lamp type fixtures.
- 4.2 Discharge lamp luminaires are to be complete units including integral ballasts and lamps of required number and type, and are to have lighting distribution characteristics equivalent to model and manufacturer indicated in the fixture description.
- 4.3 Ballasts and ignition devices are to be power factor compensated to at least 0.9 lagging, and type specially selected for lamp type and size used.
- 4.4 Lamp is to be able to start with at least +/-10 percent variation from nominal line voltage and continue in normal operation with dips attaining 20 percent for four seconds. RF suppression circuit is to be provided.

5.0 FLUORESCENT FIXTURES

- 5.1 Lamp holders generally are to be heavy-duty type, moulded white plastic with non-corroding spring contacts, to comply with IEC 400.
- 5.2 Only single or two-lamp ballasts are to be used in any one fixture. Two-lamp ballasts are to be lead-lag, series type. Equipment is to be enclosed in sheet steel casing with corrosion resistant finish. Ballasts are to comply with IEC 82.
- 5.3 Ballasts shall be switch start, rapid start or dimming type, as stated in fixture description and as shown on the Drawings, power factor corrected to above 0.9, having manufacturer lowest case temperature. Sound rating is not to exceed level given in the Standards.
- 5.4 Electronic ballasts, where required or specified, are to be used in conjunction with electronic dimming controls. Dimming is to be possible down to 5 percent of normal output equal and approved, with service life in excess of 10000 hours.
- 5.5 The ballast is to be manufactured and certified for the specific lamp it controls and for operation from nominal power supply, with voltage and frequency equal to nominal voltage and frequency of distribution network.
- 5.6 Capacitors shall be of snap-type with connectors and fastening, bolt type M8, for fixing to fixture, to comply with IEC 566.
- 5.7 Starters, if required, are to comply with IEC 155, and are to be selected in conjunction with respective ballast and lamp.

6.0 INCANDESCENT FIXTURES

- 6.1 Incandescent lamp sockets shall be to IEC 61 and IEC 238, high grade porcelain, E27 screw or B22 spring type sockets for lamps not exceeding 200W.

7.0 EMERGENCY EXIT LIGHTING

- 7.1 Emergency exit signs lights shall be fluorescent provided with integral automatic high/low trickle charger in a self-contained power pack with sealed, maintenance-free, nickel cadmium battery.
- 7.2 Emergency exit lights shall be equipped with test switch and LED indicator visible and accessible without opening fixture or entering ceiling space.
- 7.3 Battery shall be sealed, maintenance-free, minimum 3-hours running time (autonomy) nickel-cadmium type, with a minimum nominal 10-year life.
- 7.4 The charger is to be fully automatic, solid-state, constant-current type.

8.0 LAMPS

- 8.1 Rated voltage of all lamps is to be equal to nominal voltage of distribution network. Lamps with different rated voltages are not acceptable.
- 8.2 Incandescent lamps for general lighting are to have screw type or spring type base. Inside frosted lamps are to be used unless otherwise specified. Guaranteed rated life is to be above 800 hours and luminous output above 1350 lumens for 100 W lamps.
- 8.3 Tungsten halogen lamps shall be tubular, quartz, resistant to high temperatures. Guaranteed rated life is to be above 2000 hours and luminous output above 9500 lumens for 500 W lamps and 22000 lumens for 1000 W lamps.
- 8.4 Straight tubular fluorescent lamps are to be low energy type with tube diameter 26 mm, switch start type, bi-pin, rated as indicated in the fixture description and with improved fluorescent internal coating. Color of light is to be Daylight, unless otherwise specified. Lamps are to be. Guaranteed rated life is to be above 8000 hours and luminous output above 1300 lumens for 18 W lamps, 3200 lumens for 36 W lamps, and 5200 lumens for 58 W lamps.
- 8.5 PL-C Compact fluorescent lamps are to be single ended, compact-miniature lamp, consisting of four narrow fluorescent tubes welded together, with integral instant starter and capacitor and with special two-pin plug-in base and socket. Guaranteed rated life is to be above 5000 hours and luminous output above 600 lumens for 9 W lamps, 900 lumens for 13 W lamps, 1200 lumens for 18 W lamps, and 1800 lumens for 26 W lamps.
- 8.6 Metal halide lamps are to have quartz discharge tube enclosed in clear tubular hard-glass outer bulb, operating on same principle as all gas discharge tubes with iodide additives indium, thallium and sodium in the mercury discharge, to increase intensity in three spectral bands; blue, green and yellow-red with high color rendering. Lamps are to be to IEC 188 with E40 base. Guaranteed average life is not to be less than 10000 hours and luminous outputs, after 100 hours burning, are to be above 32500 lumens for 400W lamps and 90000 lumens for 1000W lamps.

9.0 INSTALLATION

- 9.1 Lighting fixtures shall be installed aligned and parallel or square to building lines and at uniform heights as shown on the Drawings or as approved by the Engineer.
- 9.2 Lighting fixture shall be equipped with hangers, brackets and flanged bolted fittings, as necessary, to support weight of fixture. Fixtures shall be rigidly secure mounted on outlet boxes to fixture studs.
- 9.3 Two stem hangers are to be provided for individually mounted pendant fixtures. Stems are to have suspension aligners and are to be of suitable length for suspending fixtures at required height.

- 9.4 If suspended ceiling construction is unable to support weight of fixtures without strain or deformation, suspend fixtures directly from building structure.
- 9.5 Fixtures installed in a continuous row shall be arranged so that individual fixtures can be removed without dismantling remaining fixtures with minimum spacing between fixtures.
- 9.6 Metal frames of fixtures shall be connected to earth as described in related Sections of this Specifications.

10.0 MANUFACTURERS

- 10.1 For lighting fixture type and manufacturer, refer to Drawings. Final decision regarding shape, color, lamp color and location of lighting fixtures shall be coordinated with the Architect.
- 10.2 Lamps for lighting fixtures:
 - Osram (Germany)
 - Philips (Germany)
 - or approved equal
- 10.3 Ballast and starters:
 - Osram (Germany)
 - Philips (Germany)
 - or approved equal

SECTION 16710
TELEPHONE DISTRIBUTION SYSTEM

1.0 GENERAL

- 1.1 Electrical work generally is to be in accordance with the requirements of the sections of this Book of Specification.
- 1.2 The location of service entrance arrangement of public telephone exchange lines into the premises shall be coordinated with the Local Telephone Authority (PTT).

2.0 SUBMITTALS

- 2.1 The data submitted for approval shall include complete technical data and manufacturer catalogues for all equipment and materials.
- 2.2 Drawings submitted for approval shall include, but not to be limited to, with box and equipment types and sizes, detailed system schematic diagram, exact routing and layout of all cabling and race-ways, exact composition of terminal boxes and other distribution boxes, typical installation details of cabinets, boxes, and other equipment.
- 2.3 Samples of each type of device shall be submitted for approval, unless otherwise agreed in writing by the Engineer.

3.0 TELEPHONE DISTRIBUTION CABINET

- 3.1 Telephone distribution cabinets and boxes to be PVC or steel, general purpose enclosures, for surface or concealed mounting, of size and at location shown on the Drawings, dust-proof, IP 42 protection for indoor mounting and IP 55 for outdoor mounting, to IEC 144, with door and lock for sizes over 10-pair capacity, and with tamper-proof screwed covers for up to 10-pair capacity.
- 3.2 Terminal blocks to be screw or plug-in quick connect type in moulded high insulation resistance phenol base, fixed by two captive screws, with double-ended nickel-plated brass connectors, and self-stripping or set-screw terminals for connection of conductors with diameters between 0.5 and 1 mm
- 3.3 Telephone distribution boxes shall have number of pairs as indicated on Drawings, with openings for incoming and outgoing telephone cables.

4.0 TELEPHONE CABLES

- 4.1 Telephone cables are to be two-pair and multi-pair cables for indoor, polyethylene insulated, tinned solid copper conductors, twisted into pairs, color coded, with wrapping of aluminum polyester tape and gray PVC sheath. Minimum diameter of conductor is to be 0.5 mm. Drain wire is to be provided in each cable, 0.4 mm diameter for 1 to 10-pair cables and 0.6 mm diameter for cables with more than 10-pairs. If data cables are required refer to related section.
- 4.2 Multi-pair cables for installation in duct banks, outdoors or directly buried are to be non-hygroscopic, waterproof, polyethylene insulated, tinned solid copper conductors, minimum 0.6 mm diameter, twisted into pairs, color coded, with wrapping of aluminized polyester tape, PVC tape, aluminum or copper sheath and PVC over-sheath.
- 4.3 Cables are to be rated for maximum operating voltage of 150 V, with insulation resistance of 10,000 Mega ohm/km, and tested at 500 V d.c., applied core to core and core to earth.

5.0 TELEPHONE OUTLETS

- 5.1 Telephone outlets are to have modular grid box and cover plates similar to other socket outlets and switches described in related section of the Specification, with cord-grip cover and fixed mounting set-screw terminal block inside box.
- 5.2 Unless otherwise indicated, telephone outlet shall be 2-pair RJ-11 category 3 or 4-pair RJ-45 category 5, as indicated on the Drawings.
- 5.3 Unless otherwise specifically indicated, each telephone outlet shall be connected by a 2-pair telephone cable to the corresponding telephone cabinet or by an unshielded twisted 4p category 5 cable, as shown on Drawings.

6.0 INSTALLATION

- 6.1 Conduits and raceways are to be provided in accordance with the related section of this Specification.
- 6.2 Telephone cables shall be pulled inside conduits and boxes, concealed or surface mounted or directly laid and fixed on cable trays.
- 6.3 Telephone installations shall be completely segregated and separated from any other electrical installations, with minimum 15cm clearance, including conduits, boxes

- 6.4 The contractor shall co-ordinate between the installations of the telephone system and those of all other systems. The layout shop-drawings shall reveal the measures taken therein, and every fixation principle, and detail, shall be subject to the approval of the Engineer.
- 6.5 Telephone cables shall run in dedicated raceways apart from those where power cables are laid.
- 6.6 Jumper wires are to extend neatly between connection modules, moderately stretched, and guided by the specialized rings and hooks. No jumper shall be left loose or imperfectly guided. The final arrangement of jumper wires within any cubicle shall allow for an easy trace of any telephone line.
- 6.7 All equipment shall be earthed. Earthing system shall ensure safety conditions and shall eliminate the relevant noise effects. Earthing cables shall be characterized by their green/yellow color.

7.0 TESTING

- 7.1 Tests shall be cover every aspect related to the specification of the material and their operation, including but not limited to, visual inspections, insulation tests, measurements, and operation.
- 7.2 Equipment shall be tested to ensure that they are not damaged, correctly assembled and connected, properly powered, and operating as specified.
- 7.3 The contractor shall undertake to train the client operation and maintenance staff. This training course shall be carried on according to a detailed program to be submitted by the contractor and approved by the Engineer.

8.0 MANUFACTURERS

- 8.1 Multi-pair telephone cables:
Liban Cables (Lebanon)
Med Cables (Lebanon)
Saudi Cables (KSA)
or approved equal.

SECTION 16780
DIGITAL CLOSED CIRCUIT TELEVISION SYSTEM

PART 1 - GENERAL

- This section includes the security system, whereas the location of the security equipment and devices is indicated on the related drawings.
- The required security systems are as follows:
 1. Security operator console
 2. Closed circuit television system (CCTV)
- Before the start of the construction of the project, the system supplier shall meet the electrical installation contractor to develop the shop drawings. Shop drawings submitted for approval shall include point-to-point wiring diagrams for each component.
- Shop drawings shall include riser diagrams and system data.
- Equipment design consideration for future expansion shall be considered.
- Drawings submitted shall reflect only security system related equipment and peripherals.
- Together with the shop drawings, separate drawings of control panels with details of wiring within each control panel shall be submitted.
- Shop drawings shall include an overall security riser diagram, detailing exact equipment and wiring at each equipment location.
- All system riser diagrams provided shall contain detailed exact equipment and wiring at each location and shall as well include all cabling and all components proposed for centralized security control.
- Product data
 - Complete manufacturer's technical data sheets of systems and components shall be submitted, including block diagrams with regard to the inter-relation chips, power calculations and specifications.
 - Description of system operations
 - Operations and maintenance manuals in English and Arabic
 - Part numbers of all replaceable components

- Guarantee and preventive maintenance procedure
- GUARANTEE
 - Written guarantee of two years, covering all systems and components.
 - Preventive maintenance and on-call basis shall be provided

PART 2 - PRODUCTS

2.1 CLOSED CIRCUIT TELEVISION SYSTEM (CCTV)

- The CCTV system consists of numerous cameras with digital recording in the central station in the Security Operations Room.
- Cameras shall be of fixed type or programmable motorized dome cameras as shown on drawings and single line diagram.

2.2 MATERIAL

- Digital Video Recorder (DVR)
 - High performance recording using MPEG-4 technology

The latest MPEG-4 compression method supported by the processes 480fps live displaying and 480fps/120fps high quality video recording shall be used.
 - Supports high resolution image

The DVR should support 720 x 480 and other various high resolution images making monitoring of DVD-like high-definition images under any environment possible.
 - Multiple recording settings

The DVR can be set for general, event, and / or scheduled recording simultaneously, so it is ready to handle any operating environment. Additionally, the image quality can be set to four different levels for more effective control of recording quality.
 - Various controllers including mouse, remote control and controller

The DVR should come with an infrared wireless remote control, and offer simple GUI and a mouse for experienced PC users. The graphic menu of the SVR-1650 shall have Hot Function icons to aid mouse users and provide a better working environment. Additionally, a system controller could be used to control PTZ dome cameras connected to a DVR plus multiple DVRs simultaneously.
 - Easy-to-use and convenient GUI

Pop-up style menu and GUI shall make it very easy to operate the DVR.

- Front USB port and AV output port
2 front USB ports shall be accessible for connecting mouse or back-up devices like DVD+RW or USB memory sticks. Video / Audio ports shall also be located on the front.
- Optimal network speed
The DVR should recognize line status automatically and configure the optimal network according to its environment.
- Stable network speed
480fps Image processing chip for networking shall be used in the DVR to prevent interference from the main system's surveillance, record, play, and other settings during data transmissions.
- Manages up to 5 DVR simultaneously
A standard application provided, can be connected to five DVR and manage all of them simultaneously. This Network Viewer shall support live video monitoring of DVR, replay, menu setting modification, PTZ camera control, and other functions through a network.
- Large data back up using DVD+RW
The DVR shall come with a DVD+RW to support high capacity, high resolution record data back-ups. The front USB port can also be used for easy data back-up to a USB memory stick.
- Built-in 250GB HDD, expandable up to 2TB
The DVR shall be equipped with large 250GB internal HDD and support up to four internal HDD making it ideal for long-term data storage. (Up to 2TB with 4 x 500GB HDD)
- Supports scalability of DVR/PTZ Dome using system controller
The system controller SCC-3100A, shall allow control of up to 255 DVR and PTZ dome cameras. The DVR shall provide multi-protocol to support connecting and controlling a variety of peripherals making it easy to build medium to large security systems.
- Supports text recording of ATM/POS transaction
The SVR-1650 can process text inputs and save, replay, or display them on a monitor.
- Audio port : 4 in / 2 out, Sensor port : 16 in / 4 out
The DVR shall support 4-channel audio input line, and the inputted audio data shall be saved simultaneously with the video data and be searchable. Multiple

system configurations can be built by using the DVR 16 channel sensor input and 4- channel relay output.

- Day and Night programmable speed dome camera
 - Implementation of Low Light 0.003 Lux

Built-in DSP system of the SPD shall ensure clear recognition and visualization of an object under dark or extremely poor light conditions. With unrivalled low light 0.003 Lux @ F1.6, the SPD-3300 detects and captures an object under any low light condition. Incorporated SSNR technology shall eliminate noise and ghost effectively and save DVR recording capacity up to 70 %.
 - 30X Optical Zoom
(Focusing Distance : 3.3 ~ 99mm)

The SPD should implement powerful 240X zoom capability with 8X digital zoom. With the increased focusing distance of 3.3 ~ 99mm, the SPD shall capture an object from a far distance quicker and clearer.
 - 24-hour Complete Monitoring, Day & Night (ICR Type)

The SPD shall implement 520TV high-resolution colour video by using filter switching (ICR) Day & Night feature, and clearer 570TV B/W video during night time by automatically removing the filters.
 - Wide Dynamic Range (WDR) Enhanced by 126X

Based on unique sophisticated pixel-level histogram analysis technology provided by the DSP system, the SPD shall provide 52dB of wide dynamic range (WDR).
 - 128 Preset Settings

The SPD-3300 shall allow specifying up to 128 settings of monitoring area, time and method for automatic monitoring. In particular, the image hold feature to maintain an image while moving in the preset area, for increased monitoring convenience. - PTZ Tracing, Auto Swing, Group (Max. 6), Tour (Max. 6)
 - Motion Detection

The SPD shall provide the motion detection feature that automatically recognizes a subject being monitored and generates a warning message or alarm. Up to 4 detection areas can be specified.
 - Digital Flip

Shall enable automatic tracking and monitoring through controller operation right below the camera of an object in motion.
 - Wide Range White Balance

The automatic white balancing range shall be 1,800°K ~10,500°K, enabling balanced implementation of original colours under sodium lights.

- Convenient OSD Menu

Using the OSD menu that displays camera functions in characters on the screen, you can specify each camera function easily and conveniently.
- CCTV monitors
 1. CCTV monitors 19" TFT-LCD colored screen, similar to STM-19LV:
 - 1280 x 1024 @ 75Hz Resolution
 - 700: 1 High Contrast Ratio
 - 300cd/m2 High Brightness
 - 8ms Response Time
 - BNC Loop Through, S-Video, RGB Inputs
 - Built-in Speakers
 - Protecting Glass
- Day and Night fixed cameras
 - High Resolution of 530TV lines
 - Day & Night Capability with High Sensitivity of 0.002Lux
 - Disk Saving with Unique SSNR Technology
 - Intelligent Motion Detection

This professional camera is also equipped with the Internal ability to detect motion in the scene they are viewing.
- Privacy Masking

When the SDC-415 is observing a wide area , the captured images can be "masked" for privacy purposes. Users can easily configure the size and position of up to 4 required privacy zones.
- Powerful Automatic White Balance

The camera with automatic white balance technology allows true color images without tending to be red or blue , which covers extensive color temperature of 1,800°K to 10,500°K.
- Camera ID Setting

Users can use the camera identification (CAMERA ID) to assign a name to the camera. The camera ID consists of up to 15 alphanumeric characters.
- High resolution Day & Night 3-Axis dome cameras
 - Mountable to any places with 3-axis rotating structure

- Built-in auto iris 3X varifocal lens (f=3~9mm)
- High resolution of 530TV lines, High sensitivity of 0.002Lux
- Day & Night, Unique SSNR, noise reduction technology (SID-450)
- System keyboard controller
 - Capable of Controlling of Both Speed Dome Cameras & DVRs
 - Centralized Control of up to 255 Units from a Single Controller
 - Configurable to Connect Multiple System controllers up to 16 Units
 - Ergonomic Design and Easy-to-Use Keypad
 - 3D Joystick LCD Display (20 x 4 lines)
 - Multi-Protocol Support Control of PTZ Functions
 - Large Character (SCC-3100A)
- Varifocal Lenses

1. Lens format	1/3"
2. Iris control	Auto DC control
3. Focal length	3.5-8 mm
4. Focus control	Manual
5. Zoom control	Manual
- CCTV Power wiring and video coaxial cable
 - The power wiring running from low voltage power supplies to CCTV-camera equipment shall be sized by such method that voltage drop will not exceed the CCTV equipment manufacturers written requirements.
 - Separate runs from low voltage camera power supplies to each camera location shall be provided. The use of one pair of wires to power more than one camera will not be accepted.
 -
 - Coaxial cable connectors to be used for all CCTV equipment shall be crimp type BNC. The use of twist type BNC connectors and "F" type connectors will not be accepted.
 - Coaxial cable shall be of solid copper center conductor and 95% minimum coverage copper braid.
 - The maximum dc resistance of the center conductor shall be a 65 Ohms per 1000 feet and maximum attenuation 0.45 db/100 FT at 10MHz.
 - Temperature range shall be as from minus 30 degree to plus 75 degree Celsius.

- Video amplifier to be installed in the Security Operations Room if needed; field equipment will not be approved.

2.3 MANUFACTURERS

1. SAMSUNG (Korea)
or approved equal

PART 3 - EXECUTION

- Install, test and commission the security system as in these specifications and in line with the approved drawing.
- Where required derive 240V, 50 Hz, single phase power supply to the system device through the electrical sockets. Location of such outlets shall be identified on the drawings well in advance and approved by the Engineer and shall be executed by the main contractor.
- All the central system components and devices shall be fully tested and demonstrated as a system to the Client
- After installation and before termination, all wiring and cabling shall be checked and tested prior to starting any commissioning activity. Provide grommets and strain relief material where necessary, to avoid abrasion of wire and excess tension.
- Provide terminal blocks, labels, tags and other permanent markings to clearly indicate the function, source and destination of all cabling. All cables and wires shall be identified, utilizing heat shrink, preprinted, polyolefin wire markers.
- Competent start up personnel shall be provided by the Contractor until the system is fully functional. If, in Client's judgment the Contractor is not demonstrating progress in solving any technical problems, the Contractor shall supply manufacturer's representative and diagnostic equipment at no extra cost, until the problems are resolved.
- All electronic equipment should be grounded prior to applying power.
- Before the final acceptance the Contractor shall deliver 2 (two) copies of System Operation and Maintenance Manuals in ring binders.
- A statement of guarantee including date of termination and the name and phone number of the person to be called in the event of equipment failure.
- Individual factory issued manuals, containing all technical information on each piece of equipment installed. Advertising brochures or operational instructions shall not be

used in lieu of the required technical manuals and information. All manuals shall be printed to ensure their performance.

- Activate all alarm or other output devices that are in the system for proper operation, including supervisory and trouble circuit tests.
- A check out report for each piece of equipment shall be prepared by the Contractor and submitted to the Client, one copy of which shall be registered with equipment manufacturers.

SECTION 16820
FIRE ALARM DETECTION SYSTEM

1.0 GENERAL

- 1.1 Electrical work generally is to be in accordance with the requirements of the sections of this Book of Specification.
- 1.2 The fire alarm panel shall be conventional system with manual and automatic alarm initiation, equipped for automatic sensitivity control of detectors and multiplexed signal transmission dedicated to fire alarm service.
- 1.3 The system shall include all components and accessories deemed necessary for a safe, reliable and satisfactory system shall conform to the relevant and applicable requirements and recommendations of BS 5839, BS 5445 and BS5446.

2.0 SUBMITTALS

- 2.1 The Contractor shall submit product data on each type of fire alarm equipment and component, catalog number, serial number, operating characteristics.
- 2.2 Drawings submitted for approval shall include, but not to be limited to, with equipment types and sizes, detailed wiring and system schematic diagram, exact location of detection points and routing and layout of all cabling and race-ways and other equipment.
- 2.3 Samples of each type of device shall be submitted for approval, unless otherwise agreed in writing by the Engineer.

3.0 SYSTEM REQUIREMENTS

- 3.1 The fire detection system shall include a main fire alarm control panel, here on referred to as FACP, optical smoke sensors, heat sensors, manual call points, sounders, repeater panels, interface modules, each with its own short circuit built-in isolators, as shown on Drawings.
- 3.2 Fire alarm system shall be of the conventional type and to be un-attendant, self-contained, audibly and visually supervised two-wire, zoned, non-coded, pre-signal system.
- 3.3 Manual alarm stations and automatic fire detector and sensor circuits are to be grouped in zones as shown on the Drawings, each zone having control and annunciator module on main fire alarm control and annunciator panel
- 3.4 The system shall automatically detect and report open circuits, shorts, and grounds of wiring for initiating device, signaling line, and notification appliance circuits.

- 3.5 The system shall be fully programmed to accommodate fire alarms as indicated on the drawings and schematics. The system shall be configured to allow on site modifications with the minimum of disruption
- 3.6 Faults are not to prevent fire alarm being sounded and are to automatically indicate alarm by audible and visual warning. Audible warning is to remain on until silenced by respective cut-off switch whilst red illuminated LED remains on to indicate defective zone.
- 3.7 When respective circuit is restored to normal, trouble bell is to sound again until cut-off switch is back to normal, thereby turning off the illuminated LED.
- 3.8 Upon actuation of any automatic detector or manual station, the system is to operate as follows:
- Alarm initiating device is to illuminate a LED for the respective zone, and cause only the pre-signal alarm to sound continuously at the fire alarm control panel and repeater panel (if required), alerting only authorized personnel of actuated zone.
 - Authorized personnel are then to evaluate danger and sound alarms by inserting key into any fire alarm station. Alarm bells shall partly or fully activated, as required.
 - If no action by personnel has been taken after a preset period, general alarm is to be activated automatically
 - General alarm sounders are to be silenced either by operating a reset button on main control unit or when station from which alarm was originated is restored to normal.
 - Fans and other air-handling equipment serving zone when alarm are to be shut-off or run for smoke evacuation, as required

4.0 FIRE ALARM CONTROL PANEL FACP

- 4.1 The fire alarm control panel FACP shall be of latest technology type use for conventional fire alarm systems. The number of zones shall be as shown on Drawings.
- 4.2 The FACP shall have modular design to facilitate phasing of work, expansion and servicing, and containing all components of the system including solid-state electronic components, audible and visual units, relays and interface components, batteries and charger and other components required for operation of system.
- 4.3 The FACP is to give visual and audible warning of alarm condition or trouble condition from any detector or zone. Each detector or zone is to be represented by one indication on the fire alarm control panel display for circuit trouble and another indication for alarm condition, grouped under one zone module.

- 4.4 Means for activating zone alarm and total evacuation alarm are to be provided, as well as reset buttons for silencing alarm sounders and cut-off switches etc. as necessary to supervise and control the system as described
- 4.5 The FACP shall be equipped with the necessary auxiliaries and outputs for transmitting necessary signals to other systems, as shown on the Drawings.
- 4.6 The FACP is to provide 24V dc to all zone alarm initiating and alarm signaling devices. Battery back up power is to exceed 48 hours normal load, followed by full alarm load capability of 5 minutes. Voltage is to be 24V dc. The battery is to be nickel cadmium type, float charged, with automatic rapid charge at maximum allowable rate for type used.

5.0 FIRE ALARM REPEATER PANEL

- 5.1 The fire alarm repeater panel FARP shall duplicate annunciator functions of the FACP for alarm, supervisory, and trouble indications. It shall also duplicate manual switching functions of the FACP, including acknowledging, silencing, reset, and test.
- 5.2 The FARP display shall be alphanumeric display same as the FACP. Controls with associated LEDs are to permit acknowledging, silencing, resetting, and testing functions for alarm, supervisory, and trouble signals identical to those in the FACP.

6.0 MANUAL FIRE ALARM STATION

- 6.1 Manual alarm stations shall be pre-signal break glass type, reset to normal position only by replacement of break glass. Operation of station is to cause the wig-wag signs to operate and the siren to operate. A test key is to be provided to enable testing without removal of the glass unit.
- 6.2 Construction is to be tamper-proof, surface or semi-recessed mounting, in suitably designed metal box. Exposed parts are to be bright red. Glass is to break under firm pressure or moderated impact, no hammer is to be necessary.
- 6.3 Inscription is to read BREAK GLASS FOR FIRE ALARM in raised white characters. Dimensions of inscription are to be conforming to the Regulations. Other instructions on use of station are to be boldly inscribed.

7.0 OPTICAL SMOKE DETECTOR

- 7.1 The optical smoke detector shall be designed for two wire operation, photo-electric type, utilizing light scattering principle, with high quality solid state electronic components, completely shielded, protected against false alarms from EMI and RFI, and obtaining operating power from supervisory current in detection zone.

- 7.2 Mounting is to be surface or semi-recessed ceiling mounted type, located as shown on the Drawings, and comprising mounting base and twist-lock detector head. Removal of detector head is to interrupt supervisory circuit and cause trouble signal at control panel.
- 7.3 The detector is to be factory set to detect smoke at nominal sensitivity (2 percent light obstruction per foot) regardless of rate of combustion, distance between detector and fire source, combustible material, temperature or velocity of smoke and whether fire is in confined or open area. Sensitivity is to be monitored without removal of detector head by use of metering test points accessible on exterior of detector head.
- 7.4 Detector is to have status indicating LED, flashing under normal operation for visual supervision. When detector is actuated, LED is to latch-on steady and at full brilliance until reset from control panel.
- 7.5 Detector is to have nominal operating voltage 24 V d.c., normal flat surface coverage is to be over 100 m² at mounting height of 6 m, alarm current less than 70 mA, quiescent current less than 60 micro Amp, ambient temperature from 0 to +60 deg. C, relative humidity 10 percent to 90 percent, and smoke entry characteristics 360 degrees in all directions.

8.0 RATE-OF-RISE AND FIXED HEAT DETECTOR

- 8.1 Detector shall be of type to operate on differential bi-metallic principle for rate-of-rise in temperature, with fixed temperature element and plug-in, twist-lock type base, hermetically sealed against dust and moisture, mounted in recessed or surface mounted box compatible with type of installation.
- 8.2 Detector is to operate on temperature gradient not less than 10 deg. C per minute with maximum delay of four minutes. It is also to operate with delay of one minute at fixed ambient temperature of 57 deg. C or 70 deg. C as selected. Detector is to have coverage greater than 80 m² and is to operate at 24 V d.c. nominal voltage.
- 8.3 Detector is to have automatic regulation to varying supply voltage (18 V - 32 V d.c.), reverse voltage protection, spike and surge suppression.
- 8.4 Detector is to have status indicating LED, flashing under normal operation for visual supervision. When detector is actuated, LED is to latch-on steady and at full brilliance until reset from control panel.
- 8.5 Detector is to be sensitive, compact and simple to install, reliable in operation and is to reset automatically after actuation by rate-of-rise element.
- 8.6 Detector is to automatically actuate its signaling zone in case of fire or fault.

9.0 FIXED TEMPERATURE HEAT DETECTOR

- 9.1 Heat detector of fixed temperature type shall be actuated by temperature that exceeds a fixed temperature of 88 deg C with normal flat surface coverage is to be over 50 m²
- 9.2 The detector shall have a plug-in base, interchangeable with smoke detector bases, surface or semi-recessed ceiling mounted type, located as shown on the Drawings, with head removable from fixed twist-lock base.
- 9.3 Removal of detector head is to interrupt supervisory circuit and cause trouble signal at control panel.
- 9.4 Detector is to automatically actuate its signaling zone in case of fire or fault.

10.0 FIRE ALARM BELLS AND SOUNDERS

- 10.1 Fire alarm bells shall be vibrating under dome standard 6 inches type (150 mm) with heavy type contact mechanism, finished bright red, for operation at 24 v d.c. with minimum 95dB sound level at 1m.
- 10.2 Fire alarm electronic sounder shall be programmable with 3 signals (continuous, intermittent or warble), with minimum 100dB sound level at 1m.
- 10.3 The fire alarm bells installed on a separate bell circuit shall be terminated with an end-of-line device of appropriate value, supplied and installed as required.
- 10.4 Bells and sounders shall be colored red and shall operate without manual adjustment and without faults or false alarms.

11.0 REMOTE INDICATOR

- 11.1 Remote indicators are generally to be located above doors as shown on the Drawings.
- 11.2 Indicator is to have built- in lamp unit with solid state lamp flasher enclosed in red enameled steel back box with matching red moulded phenolic front panel and lens.
- 11.3 All units are to have the word FIRE in white lettering and are to give clear visual indication, flashing under normal conditions and steady at full brilliance when corresponding automatic detectors are actuated

12.0 FIRE ALARM CABLES

- 12.1 Fire alarm detectors and sounders shall be connected with fire rated cables up to FACP, unless otherwise indicated.
- 12.2 Fire rated cables shall be high temperature type FP 200 with solid or stranded plain annealed copper conductors to BS 6360 (in sizes up to 4 mm²), extruded silicon rubber insulation to BS 6889 (0.6 mm radial thickness), aluminum/PVC laminate and PVC composite sheath with tinned earth continuity conductor/drain wire.
- 12.3 Fire rated cable is to be rated 300/500 V, capable of accepting voltage surges up to 5 kV, to operate continuously at 150 deg. C and for short durations at 200 deg. C.

13.0 INSTALLATION

- 13.1 The FACP and FARP are to be surface mount with tops of cabinets not more than 1800 mm above the finished floor.
- 13.2 Ceiling mounted smoke detectors shall not be less than 100 mm from a side wall to the near edge.
- 13.3 Wall mounted smoke detectors shall be at least 100 mm, but not more than 300 mm, below the ceiling.
- 13.4 Smoke detectors shall be closer than 1520 mm from air-conditioning air supplies and audible alarm indicating devices shall not be installed less than 150 mm below the ceiling.
- 13.5 Boxes, wiring and cabling shall be installed according to related Section in this book of specification.
- 13.6 Wires and cables shall be pulled inside recessed conduits embedded in concrete structure or inside exposed rigid PVC flame retardant conduits, up to fire alarm control panel, as shown on Drawings.

14.0 TESTING

- 14.1 Tests shall be cover every aspect related to the specification of the material and their operation, including but not limited to, visual inspections, insulation tests, measurements, and operation.
- 14.2 Equipment shall be tested to ensure that they are not damaged, correctly assembled and connected, properly powered, and operating as specified.
- 14.3 The minimum required tests are as follows
- Testing of all conductors for short circuits using an insulation-testing device.
 - Testing of initiating and indicating circuits for proper signal transmission under open circuit conditions.
 - Each initiating and indicating device shall be tested for alarm operation and proper response at the control unit. Smoke detectors shall be tested with actual products of combustion.
 - Making all possible alarm and monitoring initiations and using all communications options.

15.0 MANUFACTURERS

- 15.1 Fire alarm system:
- | | |
|-------------------|-------|
| Simplex | (GB) |
| Gent | (GB) |
| Thorn Security | (USA) |
| or approved equal | |
- 15.2 Fire rated cables and wires:
- | | |
|--------------------|---------|
| Pirelli | (Italy) |
| West pen wire | (USA) |
| Firecell | (USA) |
| Belden | (Italy) |
| or approved equal. | |