

**PARTICULAR TECHNICAL SPECIFICATIONS ELECTRICAL**

**1.1 ABBREVIATIONS, CODES, REGULATIONS AND STANDARDS**

The following abbreviations are common to all Electrical Trades and are used in the specifications and drawings:

- BS : BRITISH STANDARDS
- IEE : THE INSTITUTION OF ELECTRICAL ENGINEERS (U.K.)
- VDE : VERBAND DEUTSCHER ELECTROTEHNIKER
- NEMA : NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (USA)
- IEC : INTERNATIONAL ELECTROTECHNICAL COMMISSION

The latest editions of the following codes, regulations and standards relating to the particular subjects covered by the specifications shall form part of this section.

GENERAL	IEE WIRING REGULATIONS FOR ELECTRICAL INSTALLATIONS MOULDED CASE CIRCUIT BREAKERS, PANEL BOARDS, L.V. SWITCHGEAR, MOTORS,
AND CONTROL	BS, NEMA AND VDE
FIRE PROTECTION	NATIONAL FIRE CODES (U.S.A) FIRE OFFICES COMMITTEE (FOREIGN) U.K.
TELEPHONE SYSTEM	BS, IEE, POST OFFICE REGULATIONS (U.K.) GERMAN POST OFFICE TELEPHONE REGULATIONS
LIGHTING PROTECTION SYSTEM	BRITISH STANDARD BS 6651

## **1.2 CONDUIT**

### **1.2.1 GALVANIZED STEEL CONDUIT:**

For exposed installation above false ceilings or other places shown on drawings, galvanized steel conduit and conduit fittings shall be used complying with BS 4568.

The Contractor shall supply all necessary hangers, traps, couplings, unions, fittings or other material to install and support the conduit, and boxes in a permanent and rigid manner on the type of surface provided, coincident with the Architectural treatment in the location. Meddled in the masonry walls shall be used for exposed metal conduit systems. Concealed or exposed conduits shall be supported by metal brackets or hangers embedded in the walls, by "RAWLPLUGS", expansion bolts, toggle bolts, of explosive charge studs to masonry, and by machine screws of welded threaded studs on steel. "U" Bolts may be used to secure conduit to truss rods or round steel structural components.

The use of wooden plugs or dowels inserted in cavities or holes, as a supporting means will not be permitted. Wooden anchor blocks embedded in the walls may be used to support concealed metal conduit only for special conditions and if approved by the Engineer.

Each piece of exposed conduit on walls, ceiling or hung- ceiling regardless of length shall have at least one supporting clamp or strap and as many additional clamps as may be required to support the conduit in a manner approved by the Engineer. In any case of extended runs of conduit the maximum spacing of supports should be 1.50m. Pipe straps used shall be factory fabricated for this purpose and shall be zinc coated or have other non-corrosive surface finish. Fastening of conduit, boxes or other equipment with plastic clips, field made straps or nails will not be permitted.

All runs of exposed conduits shall be parallel and symmetrically spaced. The same spacing shall be maintained on curved sections by increasing the radius of each concentric bend. Conduits in hung ceiling shall be installed parallel to walls, structural members or intersections of vertical planers and ceilings. Conduits shall be installed in such a manner as to avoid the collection of trapped condensation. Conduits in slabs shall be installed above the reinforcement and not below or through.

The Contractor shall take all necessary precautions to prevent the lodgment of mortar, dirt, plaster or other foreign matter in conduits, fittings and boxes during construction. Conduits which have become clogged shall have their ends reamed and burs removed to prevent damage to cables during installation.

The conduits shall either be screwed into threaded metal hubs or boxes or inserted into holes of proper size and secured tightly with locknuts and bushings to provide a rigid connection and firm electric bond for ground continuity. Double lock nuts shall be used where bushings cannot be brought into firm contact with the box or where insulating bushings are used. In open conduits, risers and underground component on the system, the open end of the conduit shall be fitted with a conductor protecting bushing of proper size.

### **1.2.2 PVC CONDUITS:**

All PVC conduit and accessories shall be 'Heavy gauge' super high impact type HP complying with BS 4607 and BS 6099 and the materials shall be UPVC.

The PVC conduits shall be terminated on the loop in adaptable boxes using a female socket adapter and jointed using an adhesive recommended by the manufacturer.

PVC conduits inserted into the loop-in boxes or adaptable boxes without the proper accessories will not be accepted.

The minimum conduit size shall be 20mm (3/4") in all cases the maximum number of cables permitted in a conduit shall not exceed the provisions of the IEE Regulations for the capacities of conduits.

All conduit systems shall be installed concealed except where indicated on drawings that they are exposed. Conduits shall be installed in such a manner that cables can be easily drawn in them or removed and replaced at any time without damage to the wiring.

No heating shall be applied for bending and no sectional distortion of the conduit shall result from bending. The radius of all bends in conduits shall be at least 6 times the internal diameter of the conduit.

All conduits shall be kept at least 20cm from parallel runs of flues, hot water pipes or surfaces of hot water reservoirs, boilers burners or other equipment. Penetrations through walls, ceilings or floors shall be made through neatly opened holes of no larger than necessary diameters. Where conduits pass through foundations or concrete members, they shall be installed before the concrete is poured or tubular sleeve may be located in the form to provide an access for future installation. The sleeve shall not have a diameter greater 1 1/2 times the outside diameter of the conduit. All conduit and sleeves extending through waterproof floor shall be provided with flashing collars.

All conduits and boxes shall be installed prior to plastering. Where necessary the masonry walls shall be chased to provide at least 1cm of plaster over the conduit or as required by the Main Contractor. Where parallel runs of conduit are installed the space between the tubes shall be a minimum of twice outside diameter of the largest tube.

#### 1.2.3 **OUTLET AND JUNCTION BOXES:**

Outlet and junction boxes shall be provided in the wiring or raceway systems wherever required for pulling of wires, making connections, and mounting of devices and fixtures. Boxes for raceways shall be of the watertight gasketed type when located in normally wet or damp locations, in mechanical and electrical rooms, in machinery rooms and when installed exposed up to 3.00m above floors and Walkways. Boxes in other locations shall be sheet steel or plastic as required. Each box shall have the volume required by BS32, for the number of cables enclosed in the box. Boxes for mounting lighting fixtures shall be not less than 10cm except that smaller boxes may be installed as required by fixture configuration as approved by the Engineer. Boxes installed for concealed wiring shall be provided with suitable extension rings, or plaster covers as required. Boxes for use in masonry, block or tile walls shall be square cornered tile-type, or standard boxes having square-cornered tile-type covers.

Separate boxes shall be provided for flush or recessed fixtures when required by the fixture terminal operating temperature, and fixtures shall be readily removable for access to the boxes unless ceiling access panels are provided. In suspended ceilings, for those fixtures for which the ceiling suspension system does not have sufficient strength to prevent visible deflection of the ceiling surfaces, fixture housings shall be supported by structural members.

Boxes and supports shall be fastened with bolts and expansion shields on concrete, with toggle bolts on hollow masonry units and clay tiles and with machine screws welded studs on steel work. Treated studs driven in by power charge and provided with either lockwashers and nuts or nail-type nylon anchors are acceptable in lieu of good screws, expansion shields or machine screws.

In open overhead spaces metal boxes threaded to raceways need not be separately supported except where used for fixture support. Cast metal boxes having threadless connectors and sheet metal boxes or plastic boxes shall be supported directly from the building structure or by bar hangers. Where bar hangers

are used, the bar shall be supported with an approved type fastener not more than 100cm from the box. Junction boxes shall be kept to a minimum.

Full boxes of not less than the minimum size required by BS31 shall be constructed of galvanized No.12 gauge sheet steel, except where cast metal boxes are required in locations specified above. Boxes shall be furnished with screwfastened covers. Where several feeders pass through a common pull box the feeders shall be tagged to indicate clearly the electrical characteristics, circuit number, and panel designation.

All boxes used for cable systems shall be equipped with isolating glands, sized as required to match the cable diameter. Conduits stubbed through concrete floors connections to free standing equipment shall be provided with an elbow extended in rigid threaded conduit to equipment, except that, where required, flexible conduit may be used above 25cm from the floor.

### **1.3 LOW VOLTAGE CABLES AND WIRES**

#### **1.3.1 PVC. INSULATED CABLE:**

PVC insulated unsheathed cables shall fully comply with BS 6004 1975 with high conductivity copper conductors protected throughout their length by conduit or trunking.

All cables being 450/700 volt grade C.M.A. reference No.649IX and conforming to the 'Cable insulation Colors' clause.

No cable smaller than 1.5mm<sup>2</sup> shall be used unless otherwise specified. Stranded conductors only are permitted.

#### **1.3.2 CABLE AND FLEXIBLE CORDS:**

Cables shall be of the manufacturer specified. All cable drums or coils shall bear the makers seals, labels and B.S. numbers which are to be retained for inspection by the Engineer/Supervising Officer or his representative. Any cables not thus marked are not to be delivered to the site or used in any part of the work.

All flexible cables shall be heat resisting PVC unless otherwise specified.

#### **1.3.3 HEAT RESISTING CABLES:**

Heat resisting PVC insulated cables (or Elastomeric Rubber H.O.F.R. sheathed cables if specified) single or multicore as required shall be used for all final connections to cookers, water heaters, boilers etc.

Heat Resisting PVC insulated as described above, is to be used where a service temperature of 45°C - 60°C exists. Where service temperatures of greater than 60°C exist, Silicone Rubber insulated Cables shall be used.

All light fittings other than Fluorescent shall be connected by:

- 1) For fittings up to 100W heat resisting PVC insulated cables to BS 6500, 1969 Table 12, CMA, Ref. Nos. 3092 & 3093Y or 3094Y as required.
- 2) For fittings over 100W by silicone rubber insulated cables. Heat Resisting Cables

Fluorescent fittings will normally be wired in PVC insulated copper cables to BS6004 where unusual or extreme temperature conditions exist connections will be by heat Resisting PVC or Silicone Rubber as conditions dictate.

No cables smaller than 2.5mm<sup>2</sup> shall be used unless specified otherwise.

Cables to conform with 'Cable Insulation Colors' clause.

#### **1.3.4 PVC INSULATED P.V.C SHEATHED CABLES:**

PVC insulated, PVC Sheathed cables shall fully comply with BS 6004, 1975 with high conductivity copper conductors being 300/500 volt grade Specification. No cables smaller than 1.5mm<sup>2</sup> shall be used.

The use of PVC insulated PVC sheathed single core with C.P.C. cables not covered by BS 6004 is permitted.

The cables shall be concealed as far as possible within the fabric of the building by being run in ceiling spaces, between the leaves of partitions and in wall chases etc.

The cables shall be supported with plastic cable clips, fixed with brass pins at regular intervals, adequate to prevent ANY strain on the cables.

Clips shall be provided immediately adjacent to each ceiling rose, switch or socket box etc., and when entering boxes the cable sheath shall be protected by the PVC grommets or bushes (grommets and bushes must not be cut and be of the correct size for the hole it is fixed to).

Cable rising to or from cubicle panels, fuse boards etc., shall be concealed where possible within the walls, partitions etc., and shall enter the rear of the fuseboard protected by vertical conduits or trunking, which shall project into the ceiling space.

The ends of steel conduits shall be fitted with BS 31 or (BS 4568) hexagon smooth bore entry brass bushes and the ends of trunking shall be drilled to receive grommets for the entry of cable.

#### PVC Insulated PVC Sheathed Cables

No cables shall run diagonally across any wall, or ceiling without the written permission of the Engineer/Supervising officer or his Representative

No cables shall be installed within a distance of 200mm from uninsulated pipes carrying hot fluids.

No cable shall be installed within a distance of 50mm from insulated pipes carrying hot fluids - distance measured from outer surface of insulation not pipe.

#### 1.3.5 **CABLE INSULATION COLOURS:**

All sleeve markers to be 'Hellerman' slip on type or equal and approved.

Any control circuit wiring for diverting valves, burners, etc., shall be:-

NEUTRAL	-	BLACK, BLUE
LIVE	-	RED, BROWN
CONTROL WIRE	-	RED with numbered sleeves

A circuit diagram indicating the numbering of all cables or cores in any control circuit shall be produced by the Electrical Services Contractor and copies sent in duplicate to the Engineer/Supervising Officer or his Representative for approval.

All identification sleeves shall comply with BS 3858 where applicable.

All bus-bars shall be painted with colors corresponding to the phase and boxes shall have the respective phase colors painted neatly on the box exteriors.

Phase colors shall also be indicated on ALL switchfuse and isolators by means of colored discs, diameter 9mm fixed to the front covers.

Any system or point not covered by this Clause should be referred to the Engineer/Supervising Officer or his representative prior to tendering as the Engineer/Supervising Officer or his Representative's interpretation of this clause after tendering will be binding and final.

#### 1.3.6 **FLEXIBLE CABLE GLANDS:**

Where flexible cables pass through holes in equipment, without protection by conduits, compression glands of a suitable type shall be supplied and fixed by the Electrical Services Contractor to prevent chaffing and hold such cables firm.

#### 1.3.7 **CABLE SOCKETS:**

All cables of 16mm or larger shall be terminated in tinned copper cable sockets by means of compression tools recommended by and in accordance with the cable manufacturers instructions.

#### 1.3.8 **MAINS CABLE TESTING:**

As soon as possible and after the completion of installation all cables shall be subjected to the following tests:

- i) An insulation resistance test, shall be applied at 500 volts to measure the insulation resistance between conductors and between each conductor and earth.

- ii) An earth continuity test to verify that the cable armoring has been adequately bonded to earth.
- iii) Phase rotation test to prove that the cable have connected correctly.

**1.3.9 POLYVINYL CHLORIDE INSULATED SINGLE WIRE ARMoured PVC SHEATHED CABLES (PVC/SWA/PVC) :**  
Cables

Cables shall be of 600/1000 volt grade complying with BS6346 and shall consist of plain copper stranded conductors, circular or sector shaped, PVC insulated with an extruded inner sheath of PVC any necessary fillers or wormings shall be extruded PVC. Cables shall be single steel wire armored and served with extruded PVC over sheath. Single core cables shall be unarmored unless otherwise specified and shall have an extruded oversheath of black PVC applied directly over the inner sheath. Stranded copper conductors complying with BS6360. Cable sizes and number of cores shall be as shown on the drawings.

Terminations

Cable ends shall terminate in compression type glands comprising cone grip armor clamp and outer seal complying with BS 4121 type BW. All cables shall be supported below the gland to ensure that the gland is relieved of the weight of the cable.

Installation

All cables shall run from point to point without joints and where they change direction the radius of the bend shall not be less than the minimum stated in the IEE Regulations.

However, cables pass through walls, ceilings, partitions and the like the ELECTRICAL-contractor shall provide and fix in position a heavy gauge PVC sleeve having an internal diameter greater by at least 12mm but not more than 25mm, than the diameter of the cable.

Identification of cables

Each cable shall be provided with a means of identification fixed adjation at each end, providing details of the cable size and cable reference numbers.

The cores of all mains cables shall be individually identified at terminations by means of colors in accordance with the IEE Regulations. Where the core insulation is not itself colored, bands of self-adhesive PVC tape in the appropriate color shall be affixed to each core over the insulation.

**1.4 LOW VOLTAGE DISTRIBUTION EQUIPMENT**

**1.4.1 DISTRIBUTION PANEL BOARDS:**

The Distribution boards shall be constructed from minimum 16 s.w.g. sheet steel folded and braced as necessary to form rigid enclosures. Front panels shall also be removable for ease of wiring and lockable hinged doors fitted to each distribution board on each panel.

Each board shall be equipped with the number of miniature circuit breakers (MCB's) indicated on the drawings and shall be of the ratings specified.

Bus bars shall consist of four high conductivity copper conductors of equal cross section, mounted on insulated pillars and rated in accordance with the details given on the drawings.

MCB banks shall be identified with their respective phase colors. Each MCB shall have a corresponding number on the circuit list. Each distribution panel shall have an approved circuit list fixed to the inside of the door. Labels shall be supplied for each distribution board screwed to the front giving board reference. Neutral bus bars shall have an out-going terminal for each MCB. An earth bar shall be fitted within the panel.

**1.4.2 ISOLATORS AND ISOLATING SWITCHES:**

Isolators and isolating switches shall be to BS 5419. They shall be suitable for the rating of the equipment served and have fault capacities compatible with the remainder of the switchgear.

Isolating switches shall comply with BS 3185 and includes facilities for locking them in the "OFF" position. Solid copper links shall be fitted in place of fuses. Switches shall be selected for the ratings suitable for the equipment served and with fault capacities compatible with the corresponding switchboard.

**1.4.3 MINIATURE AND MOULDED CASE CIRCUIT BREAKERS :**

Circuit Breakers shall be of the miniature (MCB) or moulded case (MCCB) pattern as appropriate. MCB's shall be fitted with thermal and magnetic overload tripping devices and comply with BS 3871 Part 1. They shall provide close excess current protection and be suitable for carrying their rated current continuously at 45C.

MCB's with magnetic Trip only (M.T.O.) shall be used for the Lift Control Panels.

Automatic MCCB's shall be fitted with thermal and magnetic overload tripping devices and comply with BS 4752. They shall be suitable for carrying their rated current continuously at 40C.

Non-automatic MCCB shall be of identical construction to automatic MCCB's but without tripping devices fitted.

**1.5 WIRING ACCESSORIES**

**1.5.1 LIGHTING SWITCHES:**

Lighting switches shall be manufactured in accordance with BS 3676.

All lighting switches shall be minimum of 15A rating with a 50% derating factor applied for fluorescent lighting loads, unless specifically designed for fluorescent loads.

All lighting switches shall be compatible with the type of installation (for example, flush switches for flush conduit installation).

Plaster depth boxes shall not be used for conduit installation. Where more than one phase, or dissimilar voltages are present then these shall be permanently separated by earthen metal barriers within the switch box.

Where wall mounted switches are installed on special wall finishes, for example, tiles, timber cladding, fair faced brickwork, then special care must be taken to ensure that the final positions of all switch plates are set symmetrically with the pattern of the wall finish as required by the Engineer.

Where more than one switch is indicated in a position then these shall be ganged in the same box and a multi-gang switch plate used.

Pull cord ceiling switches shall be mounted on a standard circular conduit box with a matching 'plaster break' ring between.

The pull cords shall be of nylon cord and of adequate length.

MSP (master switch panel) comprised of a recess stainless steel box onto the door will be installed the grit switches with the indicating let lights.

**1.5.2 OUTDOOR SWITCHES:**

Outdoor switches shall be of the weatherproof type in weatherproof boxes, and they shall be as manufactured by "WALSALL" (or approved equal), with substantial cast iron enclosures and gasketed with weatherproofing seals.

**1.5.3 WATER HEATING SWITCHES AND SMALL EQUIPMENT ISOLATORS:**

Water Heater switches or 1ph equipment isolators shall be double pole lined to disconnect both poles of the supply simultaneously. The units shall conform to BS 3676. The wiring between the water heater switch and the equipment shall be BUTYL Rubber insulated three core flexible cord with 2.5 sq. mm copper conductors. They shall be 20 Amps rated with Pilot lights.

**1.5.4 PUSH BUTTON SWITCHES:**

Push button switches shall comply to B.S. 3676 and their plate shall match the plate of other switches in that area.

**1.5.5 SOCKET OUTLETS:**

Single or duplex sockets shall be rated 13Amps, 250 volts except where otherwise specified, shall be of the three rectangular pin type (two pole and earth) with shutters and switch in accordance with the latest edition of BS 1363. Bodies shall be of phenolic compound supported by a mounting yoke. Contact arrangement shall be such that contact is made on two sides of the rectangular pin plug. The sockets shall be of ivory color or as approved by the Engineer. Notes on drawings, if any, regarding finish of sockets supersede specifications.

Socket outlets shown on drawings are for estimating purposes. Exact location shall be coordinated with the furniture and equipment layout and shall be shown on the Contractors working drawings.

All socket outlets and spur units shall be set square to the vertical and horizontal axes.

A protective conductor terminal shall be provided within the box at every socket outlet, lighting switch or adjustable grid and a 'fly lead' of PVC sheathed cable in yellow/green, used to connect from the box to the accessory.

Where metal plates are specified, the heads of fixing screws shall be of identical finish.

Where PVC/PVC covered cables are used grommets shall be fixed to the cable entry of the box.

Boxes shall be cleaned out and free from all debris and dust prior to wiring. The knocknuts shall not be used as method of grouting boxes into walls etc.

Where equipment supplied by means of a socket outlet rated at 32 amp or less, or cord/flexible cable having a similar current carrying capacity, and specifically intended for use outside the main equipotential bonded zone, protection shall be afforded by a residual current device having a rated residual operating current not exceeding 30mA. On or near every such socket a notice shall be provided in durable and lasting material which reads "For Equipment Outdoors".

**1.5.6 WEATHERPROOF SOCKETS:**

Shall consist of single or duplex sockets as specified in 4.1 with a gasket weatherproof spring hinged cover. Instead of a duplex socket two single ones may be used. Each weatherproof socket shall be furnished with a matching plug.

**1.5.7 FUSED CONNECTION UNITS:**

Fused connection units shall be DP switches rated 13A and fitted with pilot lamp. Fuse shall be rated in such a way to provide overcurrent protection to the appliance or equipment connected on it. Where necessary these shall be with flex outlet.

**1.6 EARTHING**

**1.6.1 EARTHING:**

The metallic conduit systems, metallic equipment enclosures, metallic lighting fixtures, cable trays, all non-current carrying metal parts of electrical systems, and any other equipment of system components required by the regulations shall be earthen. The earth connection shall be made at the main low voltage switchgear earth bus.

The earthing system of the building shall be an independent system connected to the earth bus on the main low voltage switchgear panel. The neutral shall not be grounded. The conduit system shall be considered as continuous for earthing purposes if the conduit is rigid heavy gauge steel with threaded



connections and lock nuts at all boxes. In all cases however, separate earthing conductor shall be insulated and installed in the same conduit or cable with the phase(s) and neutral conductors. Its size shall be according to the regulations.

Where flexible connections are made to equipment an earth conductor shall be provided even if the conduit system for the system is heavy gauge steel.

All electrical equipment in the low voltage room shall be earthen to the earth bus and the earth bus shall be connected to the earthing system. The earth system shall be of high conductivity copper.

All panelboards shall be provided with an earth bus. All cable trays shall be provided with an earth conductor according to the regulations.

Earth leakage protection of the whole installation may be afforded, subject to the approval of the Engineer, by means of fuses, and excess - current circuit breaker, a current operated earth leakage circuit breaker. In every case the earthing terminal of the installation shall be connected to a suitable electrode, in the latter case through the operating coil of the circuit - breaker and in all others directly. The resistance of the earth electrodes system shall be according to the regulations. If the required resistance cannot be obtained with one earth rod, then additional rods shall be used to obtain the require resistance at no extra cost to the owner. Measurements of earth resistance shall be made when the whole of the installation is completed.

All metallic water services of the buildings shall be grounded according to the Local Authorities Requirements.

All earth rods shall be copper-weld rods, manufactured by fusionweld process resulting in an electrolytic copper sheath welded homogeneously to an inner steel core. Copper thickness shall be about 110% of the overall rod diameter. The connection between earth conductors and earth rods shall be made by means of safety type pressure connectors made of high copper alloy cast metal permitting the entire connection to be buried into the earth without danger of corrosion. The top of the rods shall be 0.3m below finished grade ad shall be enclosed in concrete or brick lined pit fitted with an inspection cover and in a location approved by the Engineer.

At the completion of the installation, it shall be tested to ensure that the earth impedance of the system is less than 1.0hm.

#### 1.6.2 **MAIN EQUIPOTENTIAL BONDING:**

Main equipotential bonding conductors shall be installed to connect the main earthing terminal the following extraneous conductive parts:-

- a) Main water pipes at the point of entry into the building.
- b) Main gas pipes at the point of entry into the building, if applicable.
- c) Other service pipes and ducting.
- d) Risers for central heating and air conditioning.
- e) Exposed metallic parts of the building structure.

The main equipotential bonding conductors shall be copper and not less than half the cross sectional area of the earthing conductor of the installation subject to a minimum 6mm<sup>2</sup>.

#### 1.6.3 **SUPPLEMENTARY BONDING:**

In addition to main equipotential bonding, local supplementary bonding shall be carried out to metal parts to maintain the equipotential zone where those parts are:-

- a) Extraneous conductive parts, and
- b) simultaneously accessible with exposed conductive parts or other extraneous conductive parts and
- c) not electrically connected to the main equipotential bonding by permanent and reliable means.

This supplementary bonding shall include baths and exposed metal pipes, sinks, taps, tanks, radiators, and where practical accessible structural metalwork.

Supplementary bonding conductors shall be copper of cross-sectional area not less than that of the associated protective conductor, subject to a minimum of 2.5mm<sup>2</sup> if mechanically protected and 4.0mm<sup>2</sup> if not mechanically protected.

Circuit protective conductors shall be connected to the main earthing terminal and either calculated in accordance with IEE Regulation 543-2 or selected in accordance with table 54F (Regulation 543-3) where the size is not specified in the particular clauses of the specification or on the drawings.

The earthing conductor shall be selected in the same manner as the circuit protective conductor and in addition comply with table 54A (Regulation 542-16) where buried in soil.

All earthing and bonding conductors shall have permanently fixed at or near the point of connection to an earth electrode or extraneous conductive parts a permanent label durably marked with the words "safety electrical earth - do not remove" in legible type not less than 4.75mm high.

## **1.7 RESISTANCE OF ELECTRICAL INSTALLATIONS**

### **1.7.1 EARTHQUAKE RESISTANCE OF ELECTRICAL INSTALLATIONS:**

The building shall be structured in accordance to high level earthquake motion standards. Therefore all services including the electrical services shall be installed to withstand and not fail in these earthquake motions.

It must be emphasized that detailed working drawings indicating installation or supporting methods for all electrical equipment should be submitted for approval by the Architect prior any building work commences on site.

Special care should be taken by the electrical contractor on the following:-

Installation on UPVC, steel, or any kind of conduits in slabs shall not be allowed. Wherever installation of conduits in slabs can not be avoided, intuits should be clearly shown on working drawings and the Architects approval should be granted. In this case conduits shall be installed in straight runs and a good distance should be kept between two parallel runs of conduits.

PVC conduits shall always be installed concealed in floor screeds. For exposed installation in car parks, plant rooms, vertical risers or other places, galvanized steel conduits and conduit fittings shall be used.

Freestanding switchboards should be fasten on concrete box and concrete walls with bolts and nuts.

Wall mounted distribution boards should be installed surface on concrete walls and fasten with minimum 4 Nos. bolts and nuts.

Free standing heavy electrical equipment should be isolated from floor using rubber or neoprene pad.

Lighting fittings recessed in false ceilings should be supported from the slabs. Pendant lighting fittings should be strongly supported from the slab in one or two places with threaded rods or using any other method the Architect would suggest.

Surface mounted lighting fittings should be supported from the slab with still-wire. Clip supports are not permissible.

Chandeliers should be supported from slab in more than one places.

Cables trays should be installed on concrete walls or concrete slabs in such a way to eliminate movement during an earthquake. Cables should be supported on cable trays with purpose made clips.

## **1.8 INSPECTION, TESTING & COMMISSIONING**

### **1.8.1 TESTING OF INSTALLATION:**

Upon completion of the installation, the Electrical Contractor is to carry out all inspections and tests to the installations in accordance with the current Edition of the Regulations for Electrical Installations issued by the Institution of Electrical Engineers.

The completion Certificate and Inspection Certificate shall be in the form set out in the current Edition of the Regulations for Electrical installations. It shall be signed by the Electrical Contractor and handed to the Engineer.

### **1.8.2 LOAD TEST:**

The Electrical Contractor shall carry out a full load test on the whole or part installation at the conclusion of the work as required by the Engineer. The load is to be maintained for a minimum period of one hour to ensure that all fuses or circuit breakers are correctly rated.

**1.8.3 COMMISSIONING:**

The Electrical Contractor shall provide, install, test and put into commission, the complete system described in this Specification and shall leave it in satisfactory working order to the satisfaction of the Engineer and maintain to substantial Completion, at which time the Defects Liability will commence.

**1.9 DRAWINGS, OPERATION & MAINTENANCE INSTRUCTIONS**

**1.9.1 AS FIXED DRAWINGS:**

A set of plastic film negatives and three complete sets of prints shall be submitted by the Electrical Contractor at practical completion of the works to the Engineer/Supervising Officer or his representative for approval. These shall show the installation as actually installed i.e. conduit runs, cable runs, circuit number and the final positions of all installed points, together with the positions and the sizes etc., of all distribution boards.

The drawings provided shall also include a Schematic Wiring Diagram showing the sizes of all main distribution cables and circuit diagrams of all control circuits indicating the number or coloring of all cables or cores.

The Engineer/Supervising Officer or his representative will reject any 'As Fixed' drawings which are considered incomplete, or unsatisfactory because of their general quality and/or appearance and the sub contractor shall re-submit such drawings to the Engineer/Supervising Officer or his representative for approval as necessary.

**1.9.2 OPERATION AND MAINTENANCE INSTRUCTIONS:**

The Electrical Services Contractor shall provide the person nominated to take charge of the installation with 3 copies of a typewritten full operating and maintenance instruction manual in properly bound covers for the whole of the Electrical Services Installation. On completion of the installation the Electrical Contractor shall give to the person nominated to take charge of the installation, detailed verbal instructions on its operation, control and maintenance.

**1.9.3 MAINTENANCE PERIOD. DEFECTS LIABILITY:**

The Electrical Contractor shall maintain in complete repair and full perfect working order to the satisfaction of the Engineer/Supervising Officer or his representative, the works carried out under this Section of the Contract for a period of 12 months after the date of practical completion of the main contract in accordance with the contract documents.

**2.**

## **2. PARTICULAR SPECIFICATIONS**

### **2.1 GENERAL**

#### **2.1.1 INTRODUCTION:**

This part of the specification describes the specific requirements of the Electrical Services to be installed at **APOSTOLOS ANDREAS MONASTERY PHASE 2.**

#### **2.1.2 SCOPE OF WORKS:**

The Electrical Contractor shall include for the whole of the Electrical Services and auxiliary services as described in the specifications and associated drawings and share stricting the generality of the foregoing, include the supply, installation, testing and putting into operation and maintenance for twelve months to the approval of the Engineer, the following:

- a) Main MCCB
- b) Main and sub-main distribution boards
- c) Power Cables and the necessary conduits
- d) Light and power distribution, including the light and power conduits, boxes and branch circuits, for lighting.
- e) Installation and connection of lighting fittings complete in perfect condition ready for use.
- f) External Lighting System
- g) Complete Earthing System TT
- h) The supply and installation of TV System
- i) The supply and installation of the Security System and fire alarm system
- j) The supply and installation of the Door Entry System (Videophone) **NOT APPLICABLE**
- k) The supply and installation of the Telephone Distribution System
- l) Wiring for the mechanical services
- m) Supply and installation Lightning protection system. **NOT APPLICABLE**
- n) Testing and commissioning.

#### **IMPORTANT NOTE:**

Within Electrical Contractor's obligations is to locate existing underground cables near the building with special instrument (Cable Locator).

#### **2.1.3 DRAWINGS :**

A schedule of the drawings forming part of this specifications is mentioned below.

These drawings are diagrammatic only. The exact position of equipment, sockets, switches etc is to be determined on site by the Architect / Consulting Engineer.

The general routes of engineering services and approximate positions of plant as indicated on the Tender drawings have been arranged to allow for the inter-relationship between the various services. The Electrical Services Contractor shall liaise with the Contractor, other Services Contractors and the Architects/Site officer to produce such installation drawings to ensure that the services can be installed to meet the requirements of this Specification.

The Electrical Services Contractor may use the tender drawings for construction purposes subject to satisfying himself that the information meets the requirements. Should the Electrical Services Contractor decide to use the drawings then he shall take full responsibility for any errors or discrepancies found. Any errors or difficulties are to be referred to the Consultants or Architect.

The Electrical Services Contractor shall be responsible for coordinating the works of all of his own Sub Contractors.

## **2.2 POWER SERVICES**

**2.2.1 INCOMING SUPPLY: Has to be modified to get from the grid and generator connection only if power cut.**  
The Electricity supply is provided by the DBM P SITUATED IN GEN-SET ROOM 415/240 Volts, 3 phase 4 wire, 50 Hz and is terminated at the position indicated on the drawing.

### **2.2.2 TYPE OF SYSTEM AND PROTECTION AGAINST DIRECT & INDIRECT CONTACT:**

a) Type of System

The electrical system for the building shall be TT. TT is the earthing system

b) Protection against Direct Contact

The installation shall afford protection against Direct Contact by the following means:-

- i) Protection by insulation of live parts
- ii) Protection by enclosures

c) Protection against indirect contact

The new installation shall afford Protection against indirect contact by the following means:-

- i) By Design and Specification Requirements  
Earthen equipotential bonding and automatic disconnection of supply
- ii) Where specifically detailed  
Use of Class II equipment

The protection against overcurrent and short circuit shall be as detailed in later clauses in the schedule at the rear of this specification.

### **2.2.3 MAIN FUSED SWITCH :**

At the position indicated on the drawing the Electrical Contractor shall supply and install the main fused switch. The switch shall be factory purpose made and shall be front access, designed for bottom entry and shall be complete with all necessary labels to indicate device being controlled.

### **2.2.4 MAINS AND SUB MAIN CABLES :**

The Electrical Contractor shall supply and install the main and sub mains cables from the Main switchgear panels to the distribution boards and isolators. The cables shall be as indicated on the Main's single line schematic drawing.

The cables shall be installed as shown on drawings either through conduit or tray or fixed on structure by brackets, or in cable trench in false ceiling and or underground.

Unless expressly stated in the Specification to the contrary, all cables, accessories and equipment used in the installations shall be suitable for a working pressure of 600-1000 volt and shall be capable of withstanding this pressure under test.

### **2.2.5 DISTRIBUTION BOARDS :**

The Electrical Contractor shall supply and install the distribution board at the position indicated on the drawings.

The distribution board shall be complete with an integral isolator, and all necessary circuit breakers and blanking off plates as indicated on the drawings. The circuit breakers are to be of the quick fitting type into the bus bars to BS3871 and are to be Type C.

The MCB sections shall be fitted with neutral and earth bars having as many ways as circuit breaker ways, together with all the necessary insulating shields and barriers to conceal all live metal and to shroud between phases and poles.

All distribution boards shall be complete with a lockable hinged cover which is to cover the MCB ways.

The integral isolator shall be complete with a padlocking device so that the isolator may be padlocked in the OFF position.

To facilitate remote switching of the lighting and permanent live apply to emergency luminaries a purpose made enclosure housing an isolator, a conductor, a 'mains' DB and an emergency DB shall be installed wherever is needed.

Each distribution board is to be labeled in the following manner:-

- 1) Typed final circuit chart to be provided.
- 2) Each fuseway or MCB way to be numbered (typed) on adjacent numbering strip - also phase to which fuseway is connected to be stated - this to correspond to the typed final circuit chart.

## 2.2.6 LABELLING OF NEW SWITCHGEAR AND DISTRIBUTION BOARDS :

The Main switchgear panels and distribution boards shall be fitted with ivory labels with black letters on a white background and fixed by means of 4BA (or metric equivalent 3.5mm) nuts and screws. Self tapping screws will not be allowed. Minimum letter size 4mm high, lower case lettering.

The engraved ivory label shall be fixed to each board and shall state the following:

- a) Distribution board identity
- b) Voltage and Phase
- c) Size and type of incoming cable
- d) Origin of supply
- e) Protection by earthed equipotential bonding and automatic disconnection of supply
- f) Type of system
- g) 3 phase fault level at Dist. Board = ----- KA  
Single phase ((L-N) fault level at Dist. Board = ----- KA
- h) Earth loop impedance at board = ----- ohms

## 2.2.7 CABLE SIZE AND MCB RATINGS:

All cable sizes and MCB ratings for each individual circuit are given in the Distribution Board Circuit Schedules at the rear of the Specifications.

## 2.3 SMALL POWER SERVICES

### 2.3.1 SMALL POWER INSTALLATION:

The Electrical Contractor shall supply and install complete the small power installation as shown on the drawings.

The wiring to switch sockets shall comprise PVC insulated cables enclosed in conduits. Each circuit shall be installed with a separate circuit protective conductor the same size as the phase conductor.

Generally, switched socket outlets shall be wired on the ring main principle with circuits protected at 32 amps unless otherwise stated. Circuit protective conductors shall also be wired in a ring. Minimum conductor size shall be 2.5mm<sup>2</sup>.

### 2.3.2 SWITCH SOCKET OUTLETS:

All 13A switch socket outlets, spur units etc., shall be as manufactured by Messrs MK, Crabtree or equal approved. Cover plates shall be same as the lighting switches.

Each socket and other necessary accessory box shall be fitted with a brass earthing terminal and a 2.5mm<sup>2</sup> minimum stranded and sleeved protective conductor from the box terminal to the earth terminal the socket outlet or fused connection unit.

For ring main circuits protected by 32A MCB's and 30mA rcd no more than two circuits shall be installed in a length of or conduit at the same time.

## 2.4 LIGHTING SERVICES

### 2.4.1 LIGHTING INSTALLATION:

The Electrical Contractor shall be responsible for the supply and installation complete of the lighting installation as shown on the drawings.

The installation generally shall be carried out using single core cables enclosed in concealed PVC conduit or single core cables enclosed in galvanized conduit (above false ceilings)

All final lighting circuits installed in conduit shall be installed with individual circuit protective conductors which are to be of the same size as the phase conductors. Minimum lighting conductor size shall be 1.5mm<sup>2</sup>.

**2.4.2 LUMINAIRES:**

All luminaries shall be supplied to the Electrical Contractor, by the Client.

The Electrical Contractor shall include for the handling and installation of the lighting fittings. Any lighting fittings broken or damaged while in the possession of the Electrical Contractor shall be replaced at the Electrical Contractors expenses.

**2.4.3 FINAL CONNECTION TO LIGHTING FITTINGS:**

Final circuit cable connection to all surface lighting fittings shall be direct from the lighting conduit system via the circular conduit boxes as necessary.

The Electrical Contractor is to ensure that the circuit cables shall enter luminaries adjacent to the fittings 'input' terminal block and hence be connected to the terminal block.

The circuit cables entering all fluorescent lighting fittings shall be individually protected against temperature rise by the provision of heat resisting glass sleeving slide over each cable. For conduit systems the glass sleeving will be installed between the terminal block within each fitting and the conduit box. For trunking systems the sleeving will be installed from the fittings terminal block to a minimum of 75 mm away from the luminary.

**2.4.4 LIGHTING SWITCHES:**

Generally, all lighting switches shall be of the Plateswitch or Gridswitch and shall be flush mounted, ganged to suit requirements as manufactured by Messrs MK, Crabtree, or equal and approved. All switches shall be 10 amp rated, or otherwise as indicated on the drawings.

Cover plates shall moulded white.

Each lighting switch detailed as two way, intermediate, double pole, indicator type etc., shall be of the same manufacturer, type, finish and quality as the switches detailed above, but having the appropriate interior.

Earthing terminals shall be provided for each assembly both on boxes and grids. A 1.5mm<sup>2</sup> minimum stranded and sleeved protective conductor shall be connected between each grid and each appropriate box utilizing the earth terminals.

In certain instances multi-gang switchboxes occur for the purpose of centralized switch control. In these instances more than one phase may occur as well as circuits from several Distribution Boards and the Electrical Contractor is advised to include all requisite and necessary equipment to ensure that barrier type switching is arranged, together with adequate labeling which shall indicate within the box the nature of the supplies therein and specifically instruct which distribution boards and location of same where isolation can be carried out before working on the switch interiors.

**2.4.5 EMERGENCY LIGHTING:**

Emergency lighting luminaries will be installed as indicated on the drawings. The units shall be capable of non-maintaining light output for a period of three hours in the event of a power failure.

The units will be either of the integral or of the miniature fluorescent pattern, fully automatic and self contained non-maintained with a three hour duration.

Wiring to the luminaries shall be carried out using PVC insulated cables of the same size as the lighting circuit from which they are fed. The cables shall be installed in conduit concealed within the ceiling voids and the fabric of the building.

For testing purposes each lighting circuit with an emergency luminaries integral or self contained shall have a secret key switch incorporated in the 'mains' normal lighting switch box.

The system is to be installed in accordance with BS 5266 and all aspects of the installation shall comply with the standards contained therein.

**2.4.6 EXTERNAL LIGHTING:**

The Electrical Contractor shall supply and install the external lighting installation as indicated on the drawings.

**2.5 TELEPHONE DISTRIBUTION SYSTEM**

**2.5.1 TELEPHONE INSTALLATION:**

The works under this section include the conduit and wiring installations, the primary and secondary telephone sockets the telephone terminal cabinet PVC pipe for incoming telephone cable and manhole covers. All telephone sets are excluded from the scope of this specification.

**2.5.2 CONDUITS, DISTRIBUTION CASE:**

The size of conduits is shown on the drawings as well as the capacity and position of distribution case and wooden boxes. The conditions for conduit work specification in the section of electrical installations apply to this section as well.

The electrical contractor is responsible to make all necessary connections and relevant jumpers in the distribution cases which should be clearly shown on the schematic diagrams approved by the Engineer.

**2.5.3 GROUNDING:**

The telephone distribution grounding shall be in accordance to the latest requirements of the Telephone Company. Earth resistance should be less than 5 Ohms.

**2.5.4 TELEPHONE INCOMING LINES:**

The electrical contractor shall provide the necessary PVC pipes for the telephone incoming lines as indicated on the drawings.

**2.5.5 PRIMARY AND SECONDARY TELEPHONE SOCKETS:**

All telephone points shall be provided with primary or secondary telephone sockets of white color shuttered type suitable for fittings into flush mounted boxes. The sockets shall be in accordance with the latest requirements of the Telephone Company.

The telephone sockets shall be manufactured by MK or equal approved.

**2.6 SECURITY SYSTEM**

**2.6.1 GENERAL:**

The system shall comply to NACOSS code of practice NACP14. It shall feature addressable detection technology with Individual Detection Identification System (**IDIS**) where each detector is identified by its zone and actual position in the building for pinpointing the exact location of an alarm.

All the field devices shall be wired in star topology and programming of the detectors in zones shall be carried out at the panel by using the keypad or local P.C.

Individual field devices shall be programmed into zones as required and for each device there shall be a programmable text of at least 32 characters. This text shall be displayed in the event of alarm on the LCD keypad(s).

**2.6.2 SECURITY PANEL:**



This shall have facilities for programming the Field Devices into 48 Zones and year 2000 compliant. For each field devices there shall be a programmable text to identify it's exact location. The control panel shall be fully «downloadable». Programming of the panel shall be possible from the keypad or P.C.. The main features of the panel shall be as follows:-

ZONE ATTRIBUTES :- Each zone to be programmed as Personal Attack, normal alarm, 24hr., final exit, entry route, not used, omit, flexizone, key switch, chime omit allowed.

PANEL	:- Blank end station control panel
KEYPADS	:- Minimum four, LCD text 32 characters.
LEVEL SETTING	:- With separate A, B, C, D Buttons.
PARTITIONING	:- 4 Partitions in 8 Areas + Common Area.
INTERNAL SOUNDER	:- Up to four 16 ohms. Internal loudspeakers
OUTPUTS	:- At least four programmable. (Voltage free contacts)
MODEM	:- Building-in V21 Half duplex CCITT Modem for full system up/downloading, remote diagnosis remote programming.
COMMUNICATOR	:- BUILD-IN (module) speech+digital communicator with four telephone numbers and four individual messages + master message.
EVENT LOG	:- 500 + Printable and downloadable events date & time stamped.
CODES	:- 99,4 OR 5 Digit user access codes.

#### 2.6.3 **KEYPADS:**

This shall have a 32 character alphanumeric LCD «supertwist» display. Four level status LED'S, Four level setting ABCD keys and large area keymat illuminated rubber tactile keys.

#### 2.6.4 **INFRARED DETECTOR (QUAD ELEMENT PIR):**

This shall be of the Quad Element PIR. It shall have adjustable coverage over 15 meters range  $\alpha= 90$  degrees. The circuit design shall have high level of immunity to radio interference. Other features:-

- Low noise quad element pyroelectric sensor
- Fresnel lens array, `` Grooves in `` compensated, white light filter
- High density 3 planes, 54 zones, 90° Volumetric, 15m
- Build in NVM for address programming
- Operating temperature range – 10 to 50 degrees centigrade.

#### 2.6.5 **FLUSH DOOR MAGNETIC SWITCHES:**

This shall be a quick fit flush door contact with associate magnet of diameter no more than 20mm diameter. The magnets shall be wired in a three wired bus and shall be equipped with NVM for address programming.

#### 2.6.6 **EXTERNAL SIREN / FLASHER:**

The external sounder shall include a Bell Module for wiring in the 3 wire bus. This shall have selectable trigger input, close cct tamper input, tamper closed cct zone input and build in NVM for address programming. The sounder output level shall be 120 DB. at 1 meter and the strobe flash rate 90 per minute. The complete unit shall be housed in a fully weatherproof housing including back up battery.

#### 2.6.7 **WIRING AND DRAWINGS:**

The specialist contractor shall produce working drawings for the Engineer's approval. These shall be handed over to the Electrical Contractor who shall supply and install the conduit requirements.

The specialist contractor is responsible to supervise and advise the Electrical Contractor with regard to the conduit installation for the Security System.

Wiring of other systems such as telephone, TV sound, lighting and power shall not be run in the same conduit with the wiring of the security system. The type and size of the wiring shall be as recommended by the equipment manufacturer.

The wiring shall be install in flush mounted conduits.

#### 2.6.8 **TESTING AND COMMISSIONING:**

The specialist contractor shall be responsible for the testing and commissioning of the whole system in order that it will be demonstrated to the satisfaction of the Engineer that the system as installed is fully functional and in accordance with the contracts intend.

On completion of the works the specialist contractor shall test and commission the systems. A commissioning certificate shall then be issued to the Consulting Engineers.

### 2.7 **TV SYSTEM**

#### 2.7.1 **GENERAL:**

The system is required to provide each TV outlet socket with 6db of RF TV signal free from ghost and interference received from the following stations: CYBC1, CYBC2, ANT1, NET, SIGMA, MEGA, EXTRA, LTV / ALPHA, FM & SATELLITE STATION. The Satellite system shall include a 1,2m rotating dish with digital / analogue receiver.

Both the satellite receiver and the LTV / ALPHA Receiver A/V outputs shall be fed via RF TV Modulators into Band Input of the distribution amplifier so that these channels shall be available to all TV Outlets.

Quotes for the TV Distribution system shall include for all necessary antennas, filters, preamplifiers, amplifiers, TV Modulators, splitters, outlets, cables etc. to receive, amplify and distribute signals as per specification below.

The signal quality at any TV outlet shall be as good as the signal received from a directional antenna situated on the roof of the building and directed to the specific station under test. Each TV outlet socket shall have average signal strength of + 6db with maximum signal variation between any two TV outlets socket not more than 3 dbs. The variation of signal between any two channels at any two TV outlets shall not be more than 3db.

#### 2.7.2 **WIRING AND DRAWINGS:**

The specialist contractor shall produce working drawings for the Engineer's approval. These shall be handed over to the Electrical Contractor who shall supply and install the conduit requirements.

The specialist contractor is responsible to supervise and advise the Electrical Contractor with regard to the conduit installation for the TV System.

Wiring of other systems such as telephone, Security, sound, lighting and power shall not be run in the same conduit with the wiring of the TV system. The type and size of the wiring shall be as recommended by the equipment manufacturer.

The wiring shall be install in flush mounted conduits.

#### 2.7.3 **TESTING AND COMMISSIONING:**

The specialist contractor shall be responsible for the testing and commissioning of the whole system in order that it will be demonstrated to the satisfaction of the Engineer that the system as installed is fully functional and in accordance with the contracts intend.

On completion of the works the specialist contractor shall test and commission the systems. A commissioning certificate shall then be issued to the Consulting Engineers.

### 2.8 **LIGHTNING SYSTEM NOT APPLICABLE**

### 2.9 **FIRE ALARM SYSTEM**

### **2.9.1 General**

The fire alarm system shall include, but shall not be limited to, central processing unit, liquid crystal display, built-in printer, power supplies, fire alarm initiating and indicating devices of Analogue Addressable type, cabling and accessories to provide a complete operating system according to BS5839 part 1 1988.

The Contractor shall be responsible for the final locations of all items and the correct zoning of the system.

### **2.9.2 Materials And Equipment**

The equipment and material shall be in full conformity with the provisions of BS 5839 Part 4:1988 and of the Analogue Addressable Type.

### **2.9.3 Wiring**

Wiring shall be installed in cable trays and plastic conduits as shown on the relevant drawings. Cables installed in places without false ceiling or on the walls below the false ceilings e.g. to call points, control equipment etc., shall be installed in PVC trunking.

Cables of the fire alarm system should be segregated from cables of other systems.

#### **2.9.3.1 Cable requirements**

Cables shall be of the prolonged operation complying with BS6387, and meeting at least the requirements for categories CWZ, unless otherwise stated in the drawings.

Be in accordance with the requirement of BS5839:Part 1 1988 (17.6).

#### **2.9.3.2 Cable size**

Loop circuit cable cross sectional area shall be 2.5mm<sup>2</sup> minimum

Sounder circuit cable cross sectional area shall be 2.5mm<sup>2</sup> minimum

Control equipment such as door holder and Air conditioning controls cable cross sectional area shall be 1.5mm<sup>2</sup>.

### **2.9.4 The Fire Alarm Control Panel**

The control equipment shall be designed in full conformity with the provisions of BS 5839 Part 4 1988 and shall be of the Analogue Addressable type. With suitable protocol, all devices should be continuously polled and any abnormal condition should be first checked and verified by the software and then displayed and logged in appropriate way. A plain or thermal paper printout should be produced which gives alarm condition, device type and number, programmable text location, date and time. The Fire Alarm Panel shall be located in the reception.

The standard features should include:

- a. Capacity of eight loops
- b. 80 character display showing the exact address and location of any fire or fault.
- c. Self contained 24 volt rechargeable battery for 24 hour standby with fully loaded loop and repeater connected
- d. Full text downloading using laptop computer
- e. Self learning of detector addresses to aid commissioning
- f. Earth fault detection on all output circuits
- g. In the event of a fire or fault, display shown location text, zone, type of sensor and analogue level
- h. Printer interface
- i. Alarm out put for connection to the existing automatic telephone dialler
- j. Alarm output for connection to the alarm bells on the existing Fire Alarm Panel
- k. Soft programmable relays as required

There should also be two RS232 outputs that can be configured for REPEATERS.

## **2.9.5 Visual Indications And Controls**

### **2.9.5.1 At Least the following LED indicators should appear on the panel facial:**

1. Zonal Fire
2. Charger on
3. Fault
4. Disable
5. Test in progress
6. System fault

### **2.9.5.2 The following switch controls appear on the panel facial:**

1. Alarm Silence
2. Reset
3. Evacuate
4. Cycle Display (Scroll)

### **2.9.5.3 Marking**

The following information should appear on each panel facial:

- I. The relevant British Standards i.e BS5839 Part 4: 1988
- II. Name of the manufacturer and type of the Panel

### **2.9.5.4 Power Supply**

The control unit shall operate on a mains power of 240V, 50Hz and powered through 13A fused spur outlet which will be distinctively labeled "FIRE ALARM DO NOT SWITCH OFF".

The control unit shall be equipped with a automatic battery charger and cadmium Batteries.

The Automatic Charger shall be capable to charge the batteries after a full discharge within at least 24 hours.

The battery charger can be an integral part of the control panel or separate unit.

Cadmium Lead Acid Batteries shall be rated to maintain the system in operation in case of Mains Failure for at least 48 hours after which sufficient capacity should remain to provide operation for the alarm sounders for at least 30 min.

## **2.9.6 Analogue Addressable Fire Detectors**

The detector devices shall comply to BS 5445: Part 7 and be suitable to respond to Smoke and Heat. Each device should respond to interrogation and command from central control equipment. They should communicate to the panel information on status, command bits, type, location and other information that allows an alarm to be raised even when the device is not itself interrogated.

All detector sensor devices should be of the Plug in type and shall be provided with a alarm indicating lamp (LED).

The sensor bases should be suitable for Smoke and Heat sensors. It shall also be possible to connect a Remote Indicating Lamp where applicable.

A simple and user friendly type of Addressing method should be provided, where the address data such as a coded card inserted in the base is read by any detector device once it is plugged in. No electronic components shall be in the base.

Each detector should be marked with the following:

- a. Manufacturer trade mark
- b. Detector type and number
- c. Standard Number (BS)

### **2.9.6.1 Ionization Smoke Detector**

The Ionization Smoke Detector should be moulded in a self extinguishing white polycarbonate case with wand resistant smoke inlets. They shall consist of the dual chamber system, the inner reference chamber contained inside the outer smoke chamber.

The smoke detectors shall be of the following technical characteristics:-

Chamber Configuration	: Twin chamber, double sided radioactive source
Radioactive Isotope	: Americium 241
Maximum Activity	: 0.9 microcuries
Indication lamp	: Red LED
Supply Voltage	: 17-28V DC
Quiescent Current	: 30 micro Amps at 24V
Alarm Voltage	: 5 to 28V DC
Operating Temp.Range	: 0 to 60°C
Operating Humidity	: 0% to 95% non condensing

### 2.9.6.2 Heat Detector

The Heat Detectors shall be fixed high temperature or a combined rate of rise / fixed temperature type as indicated on the relevant drawings and in accordance with E.N 54 Part 5 and B.S 5445:1977 Part 5.

The mounting base shall be identical to that of the smoke detectors for interchangeability.

The heat detectors shall be of the following technical characteristics:-

Operating Principle	: Matched pair negative temperature coefficient thermistors
Type and Rating	: Steep rate of rise plus fixed 60°C
Maximum Normal Operating Temperature	: 45°C
Supply Voltage	: 17-28V D.C
Quiescent Current	: 50-70 micro Amps at 24V
Indication lamp	: Red LED
Operating Humidity	: 0-95%

### 2.9.7 Manual Call Point Break Glass

The Addressable Manual call point shall be water proof of the Glass type and comply with BS 5839. The call points shall be housed in sealed high impact enclosure and shall be suitable for indoor and outdoor installation. Method of operation shall be clearly indicated on the fragile Glass. The glass shall be plastic cover to protect the operator.

The call points shall be capable to be tested using special key without the need in breaking the glass and shall be provided with an integral LED to indicate activation.

### 2.9.8 Fire Alarm Sounders

Fire alarm sounders shall be water proof, of loop type, having a fire red color and be 150mm in diameter.

They shall be suitable for operation on 24V DC supply.

The current consumption should not exceed 20mA and the sounder bells should be suitable for surface wall mounting. The sound output shall be at least 94dB at 1 meter.

### 2.9.9 Short Circuit Isolator Units

The Short Circuit Isolators shall be installed along the loop circuit for short circuit protection.

These units shall be installed as indicated on the drawings and in the event of short circuit on the loop only the section between the isolators will be affected.

An LED on the Isolator should be provided to indicate operation of the unit.

The Short Circuit Isolator shall have a unique base that will not accept other detecting devices or other products.

### **2.9.10 Single Channel Input/Output Unit**

The single channel Input/Output (I/O) unit shall provide a fully floating relay changeover contact which is switchable by the control panel and a logic input for reporting the status of the field device.

These units shall be located as indicated on the drawings to control equipment such as Air conditioning unit, Fire Shutters, Escalators etc., where they are very far from the local control panel.

The I/O unit should be mounted in an IP66 grey polycarbonate box. Cable entry knockouts should be available with space for easy cable termination.

The I/O unit shall be of the following technical characteristics:

1. The Input/Output Unit shall be factory set to return a pseudo analogue of 16 at all times.
2. Two LED indicators shall be provided on the PCB to report the status of the local input and the relay output.
3. Power supply requirement for the unit to operate the changeover contacts and to provide the local input.

### **2.9.11 Spare Parts**

The Fire Alarm and Security Sub-Contractor shall provide a complete set of recommended spare parts for two years operation.

The spare parts to be provided shall be submitted to the Engineer for approval.

### **2.9.12 O+M Manuals**

The Fire Alarm and Security Sub-Contractor shall provide fully detailed Operating and Maintenance Manuals for the installed system.

The cost for providing the O+M manuals shall be included in the analytical price list.

### **2.9.13 Testing and Commissioning**

The Fire Alarm and Security Sub-Contractor shall be responsible for the testing and commissioning of the whole system in order that it will be demonstrated to the satisfaction of the Engineer that the system as installed is fully functional and in accordance with the contracts intend.

The Fire Alarm and Security Sub-Contractor shall submit, at the same time as the material/equipment submittal, details of the tests that he intends to carry out to demonstrate the functioning and compliance of the system installed to this specifications.

### **2.9.14 Warranty & Maintenance**

The Fire Alarm and Security Sub-Contractor shall provide warranty and maintenance for the complete fire alarm system for a period of one year from the date of issue of the substantial completion certificate

### **3. LIST OF DRAWINGS**

- H-01** : SITE LAYOUT EXTERNAL PITS UNDERGROUND CODUITS & CABLES
- H-02** : ELECTRICAL INSTALLATIONS - LIGHTING
- H-03** : ELECTRICAL INSTALLATIONS - SMALL POWER TV, TEL.
- H-04** : ELECTRICAL INSTALLATIONS - FIRE ALARM & SECURITY SYSTEMS
- H-05** : ELECTRICAL INSTALLATIONS - SYSTEMS SCHEMATIC DIAGRAMS & DETAILS
- H-06** : ELECTRICAL INSTALLATIONS - LIGHTING & SMALL POWER
- H-07** : ELECTRICAL INSTALLATIONS D/B SINGLE LINE DIAGRAMS