LEHDING SERVICES DESIGN LTD

GENERAL REQUIREMENTS ELECTRICAL

GENERAL SPECIFICATION FOR ELECTRICAL WORKS

1.0 LOW VOLTAGE DISTRIBUTION EQUIPMENT

1.1 General

It shall be the responsibility of the Contractor to ensure that the manufacturer is given all of the requirements of the Specification and Drawings relative to distribution equipment which shall influence the manufacturer's design and costs.

All distribution equipment shall be suitable for operation at 500 volts AC with a short circuit fault rating of not less than 25 kA or as detailed on the drawings.

All switch gear ratings shall be for AC23 duty.

Distribution equipment shall have terminals or termination extensions of a size capable of accepting the incoming and outgoing circuit cables.

All enclosures for distribution equipment shall be manufactured from electro zinc coated, phosphate and chromated heavy gauge sheet steel and shall be of a damp and dust protecting vermin proof construction.

Where corners of doors or the like are of folded construction, the corners shall be welded and smoothed off to form a neat finish.

All manufactured enclosures for distribution equipment shall comply with BS EN 60947-1 for protection of enclosures, with all metalwork being treated with a rust inhibiting primer, one coat of an acrylic stove enamel applied as an undercoat, with a final finishing coat of stove enamel paint applied, to the specified colour and finish i.e. gloss, semi-gloss or hammered.

Irrespective of the finished colour of switchboards, any switchgear connected to the 'live' side of the main control switch shall be coloured red, and a label fitted inscribed "DANGER - FED FROM LIVE SIDE OF MAIN INCOMER". In addition, any item on the switchboard which is not isolated by the main incoming switch, shall be similarly identified and labelled.

Accessory plates and bolt heads shall be nickel plated.

All distribution equipment shall be handed over in first class condition; the Contractor shall ensure that he protects, at all times during installation, the appearance of the equipment. The Contractor shall arrange for a complete re-spray of all equipment considered not acceptable. The Contractor shall include for arranging the sub-division of equipment into suitable sections for handling and erection purposes and for passing through doorways. The Contractor shall also include for the provision of all necessary labour, materials and lifting tackle for off-loading all items, setting in position, levelling, securing to floors or walls and leaving in perfect working order.

All composite switchboards, distribution assemblies, loose switch and fuse gear shall where possible be of the one manufacturer, and shall be complete with suitable cable termination boxes, spreader and extension boxes, glands and plates as required.

1.2 Fuses

Only fuses of the HRC cartridge type manufactured to BS 88: Parts l and 2 shall be used in any fuse switch, fuse or distribution board

Fuses to be of the Class Q1 range, to provide over current protection, having a fusing factor not exceeding 1.5, where used for general purpose circuits, but where required to protect a motor starting load they shall be of the dual current rated type i.e. for continuous rating, and selected for the operational characteristics of the motor. Where required for use in domestic consumer unit fuse boards, the fuses fitted shall comply with BS1361 to a maximum rating of 45 amps, and shall only be fitted within the correct fuse carrier applicable to the consumer unit supplied.

Cartridge fuses, manufactured in compliance with BS 646 and BS 1362 only shall be supplied and fitted within any fused outlet such as spur units and three flat pin plug tops to a maximum rating of 13 amps. Where a fused outlet has a rating in excess of 13 amps, then all fuses shall again be to BS 1361.

All distribution fuse boards shall be provided with 25% spare fuse links and fuse switches with 100% spare fuse links. These fuses shall be either fitted inside their respective units or handed over on completion of the contract, as instructed.

All fuse carriers shall be fitted with a fuse to match the current rating of the circuit and not necessarily the full rating of the fuse way installed.

1.3 Fuse Switches

Fuse switches shall be manufactured to BS EN 60947-3 and shall be complete with HRC cartridge fuses. Fuse switches shall be 500 volt range complete with bolted neutral link, and be contained in sheet steel enclosures with On/Off indication. Operating handles shall be of the fully interlocked such that the cover cannot be opened unless the switch is in the "Off" position. Facilities shall be provided to allow the units to be padlocked in the "Off" position.

1.4 Isolating Switches

Switches shall be manufactured to BS EN 60947-3 and shall be capable of making and breaking three times the full load current at a power factor not greater than 0.3 lagging.

Operating handles shall be fully interlocked such that the cover cannot be opened unless the switch is in the "OFF" position. Facilities shall be provided to allow the units to be padlocked in the "OFF" position.

1.5 Distribution Fuse Boards

Distribution fuse boards shall be manufactured to BS 5486: Part 11, 500 volts rating of the capacity and number of ways indicated on the relevant drawings.

Distribution fuse boards shall be of the totally enclosed pattern, complete with lock and key, gasketed hinged cover, and removable plates top and bottom, drilled to suit site requirements.

Fuse bases and carriers shall be designed to accommodate HRC cartridge fuse links. The neutral bus bar shall be fitted with pinching screw type connections corresponding to the total number of single pole fuse ways on the board.

When the hinged door of the fuse board is open, only the fuse carriers shall be visible. All terminals, cables and bus bars shall be hidden behind a Traffolyte or similar insulated cover panel.

The interior of the fuse board shall be sectionalised by means of rigidly supported insulating barriers, and all live metal so shrouded that accidental contact therewith is impossible.

Where fuse boards shall be used in conjunction with switches, or cable trunking they shall be mechanically connected by means of bolt on flanges, with a protective insert fitted around the edge of the cut-out.

Fuse boards feeding circuits wired with MICC cable shall be fitted with internal earth termination bars fitted top and bottom of the fuse boards and suitably linked.

All fuse boards shall be fitted with 25% additional equipped spare ways rated in proportion to the in service ways.

1.6 Contactors

Contactors shall be of the air break, electro magnetically operated type manufactured to BS EN 60947-4 with current rating, mechanical duty class, making and breaking capacity and number of poles as indicated on the relevant drawings. All Contactors shall have an electrical duty of AC23.

Enclosures for contactors shall be of all metal construction, suitably ventilated and arranged for wall mounting except where otherwise indicated. Cable or conduit shall be provided to suit site requirements.

Where a contactor forms part of a switchboard, it shall be of a pattern suitable for unit construction or cubicle mounting as required. All contactors coils shall be separately fused and continuously rated and supplied at 110 volts ac.

Contactors shall be equipped with self-aligning silver faced contacts, and suitable arc quenching devices. Insulating barriers shall be fitted between phases and between each phase and earth.

Time delay contactors shall have a time delay mechanism, which shall be programmable from 20-180 seconds.

Contactor enclosure shall have the same external finish as the switchgear within which they are grouped.

1.7 Time Switches

Time switches shall be operated by a self starting Quartz motor, back up battery mechanism and be suitable for operation on a 240 volts, 50 Hz supply to the independent motor connections, protected by a suitably rated cartridge type fuse.

The switch unit shall be supplied with at least 2 ‘On’ and 2 ‘Off’ levers controlling a single pole switch rated at 20 amps with a manually operated programme advance switch. The load terminals shall be clearly identified.

The clock facia shall be of the 24 hour indication type with a separate 7 day indicator, incorporating a day omitting device which shall omit either the ‘Off’ or ‘On’ actions as detailed.

Time switches shall be totally enclosed in an insulated dust proof housing, with a clear plastic protective cover, capable of being sealed against unauthorised intrusion.

Where required to control external lighting systems, the time switch shall incorporate a solar dial face and levers to automatically advance or retard the 'On' and 'Off operations throughout the year to match the sunrise and sunset times. The time switch shall also incorporate additional levers to allow a possible 'Off' and 'On' switching between the normal sunset and sunrise times.

Where time switches are incorporated with main switchboards or panels, they shall be fitted within such units behind a protective and easily accessible hinged door unit suitably identified on the outside.

Digital time switches shall be 7 day 24 hour fully programmable, be simple to operate, have a 14 day battery back-up and be capable of switching 10 amp inductive loads. Number of channels shall be as detailed on the Drawings.

1.8 Miniature Circuit Breakers

All miniature circuit breakers shall be suitable for mounting within distribution boards as described under Part 1.10 of this Specification, and shall be designed, manufactured and tested to comply with BS EN 60898, Type C (unless specified otherwise), with a minimum prospective fault current rating of M10 (10,000 amps R.M.S.).

They shall be of the over current type incorporating a fixed time/current thermal or magnetic-hydraulic tripping device for overload conditions and electromagnetic tripping mechanism, providing protection against short circuit or earth fault conditions. The disconnection times for all MCB units shall meet requirements of the IEE Wiring Regulations 17th Edition, as appropriate to the type of circuit, and the rating of the MCB installed, and the respective maximum earth fault loop impedance allowed therein.

The MCB units shall be so designed that they are easily mounted or replaced within the distribution panel, but so protected that they cannot be removed without deliberate action or removing a cover plate or shield. The units shall be constructed so that the operating mechanisms are sealed within an insulated case, designed to withstand rough usage, with no live parts exposed to touch when mounted within a panel.

The units shall clearly indicate the 'Off/On' positions of the switch dolly and be capable of being, locked 'Off' or 'On' where called for. The ratings of the breakers shall be clearly indicated. They shall also be interchangeable within the range of rating available and shall be manufactured in either single, RCD or triple pole units as required.

Triple pole MCB units shall have each pole manufacturer certified to the rating required, but they shall be mechanically interlocked to ensure that a fault on any individual pole shall simultaneously isolate all three poles of the unit.

All breakers shall have a trip free mechanism to ensure that the circuit breaker cannot be held closed under fault conditions. The switch contacts shall be of the anti-weld type, silver alloy faced and contained within suitably designed arc chutes.

1.9 Residual Current Devices

All residual current devices (RCD's) shall be suitable for mounting within distribution boards and consumer units as described under Parts 1.10 and 1.11 respectively, and shall be designed, manufactured and tested to comply with BS EN 61008-1 for RCD's and the relevant requirements of BS EN 60898, as described under Part 1.8 of this Specification.

All RCD's shall incorporate separate test and re-set buttons. The re-set button shall be so arranged as to 'eject' in the event of the device operating an earth fault, and remain 'in' if the breaker trips an over current.

Unless otherwise stated all RCD's shall have a fixed tripping current sensitivity of 30 mA and shall be fitted to all ring main socket circuits unless specified otherwise.

Each RCD shall occupy a single outgoing way in any distribution board.

1.10 Miniature Circuit Breaker Distribution Boards

Distribution boards detailed as having the outgoing circuits controlled by means of miniature circuit breakers (MCB's) shall be manufactured to comply with BS 5486: Part 12 covering both single phase Type 'A' boards and multi phase Type 'B' boards.

The Boards shall be constructed from sheet steel, suitably protected against rust and generally complete with a dust protecting gasketed, hinged door. The cases shall be constructed so as to ensure adequate strength and rigidity for direct wall mounting. Doors to be fitted with locking facilities.

The banks of miniature circuit breakers shall be arranged so that within a multi-phase board, each phase is readily identifiable as well as each MCB unit and outgoing circuit.

The interior of the board to be so arranged that there is no access to any live parts without the removal of a cover or covers surrounding the MCB units, fitted in such a manner that only the "switch dolly" and 'On/Off' indication for each MCB projects through the cover.

Generally MCB type distribution boards shall be fitted with an integral isolator of a similar pattern to the MCB units fitted, but shall be of the non-automatic type and shall be fitted with a 'Red' coloured operating handle to distinguish it from the other switches, all such isolator units to be fully tested to BS EN 60947-3.

The MCB distribution board shall also have a full capacity neutral bar arrangement as well as earthing facilities incorporated to suit the wiring system.

All fuse boards shall be fitted with 25% additional equipped spare ways rated in proportion to the in service ways.
Where an MCB distribution board is required as a single phase consumer unit, it shall be in compliance with BS 5486: Part 13 and shall incorporate double pole isolator, with a minimum rating of 100 amps.

MCB distribution boards shall include all necessary labelling, etc.

1.11 Miniature Circuit Breaker Consumer Units

Consumer units shall have all outgoing currents controlled and protected by means of 'plug-in' type miniature circuit breakers (MCB's) and shall be manufactured to comply with BS 5486: Part 13 covering single and dual tariff type, and split-load type, and the requirements as described under Part 1.10 of this Specification.

1.12 Bus bar Chambers

All bus bar units shall conform to BS EN 60439: Parts 1 and 2 manufactured from hard drawn high conductivity copper, to BS 1433 designed and supported on insulated spreaders, with allowance for expansion and contraction due to ambient temperatures or load variations.

All neutral bars shall be to the same cross section and capacity as the phase bars.

The complete bus bar system (including interconnections to switches, etc.) shall be adequately braced and supported to prevent permanent or dangerous distortion or mechanical failure under short circuit conditions to a fault level of 25KA for 3 seconds (or as specified on the drawings) at 415 Volts.

All connections within cubicle switchboards, between bus bar and switch and fuse gear terminals shall be made by means of fully rated, insulated solid copper links of ample rating to match the duty of the switchgear. Solid mechanical clamps shall be used at all connections to the bus bars.

Under no circumstances shall PVC cable interconnections be allowed within this type of switchboard.

All bus bars shall be fully shrouded along their length by means of PVC sleeving or tape with joints and take off also taped, all in accordance with BS EN 60684.

The bus bars and all main connections shall also be clearly identified with suitable coloured marking in compliance with BS 3858.

The layout of bus bars shall be such that they are capable of being extended for future use.

Bus bar chambers shall not be used as a through wiring chamber for any cables, other than for the connections of instruments.

1.13 Cubicle Switchboards

Cubicle type switchboards shall be manufactured and tested in compliance with BS EN 60439: Part1.

Switchboards shall be totally enclosed IP41, free standing units suitable for front access only and be of the multi-compartment flush fronted metal clad "Cubicle Type" constructed from heavy gauge sheet steel on a bolted or welded steel framework, and shall include suitable removable gland plates fitted either top or bottom to suit the switchboard location.

Switchboards shall incorporate an internal copper bus bar chamber with solid tinned copper interconnections including full sized neutral conductors to all outgoing units, and shall also have an external full sized solid copper earth bar to which all exposed conductive parts of the switchboard shall be bonded including the main earth terminal. The switchboards shall be rigidly constructed

and braced to meet the thermal and dynamic stresses resulting from a prospective fault level of 50 KA for one second or as specified.

All cable terminals shall be suitable for the connection of stranded copper conductors and ensure that the necessary contact pressure is maintained after initial connection.

The required incoming and outgoing functional units shall be provided with insulated barriers to prevent accidental contact with live parts and shielded to prevent objects failing from one compartment to another, with the degree of protection to BS EN 60947-1 not less than IP 31 or as specified elsewhere.

The switchboards shall be complete with all instruments, labels, name plates, doors and access panels as detailed, treated against corrosion and finished in a high quality enamel paint to a selected shade within the British Standards colour range.

1.14 Unit Construction Switchboards

Unit construction type switchboards shall be constructed, and tested, either by the Contractor or by a Specialist Manufacturer all in compliance with BS EN 60439: Part 1, with a fault withstand capability to Class 2, using the functional units detailed in the Schedule of Equipment.

These boards shall consist of a mounting structure constructed from mild steel angles and flat bar of suitable dimensions to ensure complete rigidity of the final framework.

The complete mounting structure, apart from support legs, shall be faced with mild steel sheeting at least 6mm thick secured to the framework with flat headed countersunk bolts and nuts.

The described distribution equipment shall be secured by bolts passing through the face plate and fixed to the flat bar or angles behind by locking nuts. No heavy units shall be attached solely to the face plate.

The framework shall be suitable for floor and wall fixings and the dimensions arranged that no units are less than 300 mm from the floor.

The bus bar section shall be as described in this Specification with all interconnections to incoming and outgoing functional units also complying with the requirements detailed therein.

Where required, from distribution boards, etc., sheet steel trunking shall be fitted to the front of the framework, to carry outgoing cables, other than multi-core, armoured or sheathed cables.

A full size solid copper earth bar shall be fitted to the front of the framework, to which all exposed conductive parts of the assembly shall be connected, including the provision of a main earth terminal.

The complete framework face plate, distribution units, bus bars, etc., shall be suitably painted to a pre-selected colour, all previously treated against rust, primed and undercoated as described.

1.15 Meters

Meters installed in switchboards shall be manufactured and tested to comply with BS 89 and IEC 1036 Class 2.0 and be of a rectangular pattern suitable for flush mounting.

All multi-meters shall be solid-state devices providing digital displays of the following electrical parameters for all phases:- kW, kVA, kVAR, kWh, kVARh, frequency, kW peak, kVA peak. Metering to the above standard shall be provided on the main switchboard. The generator incomer shall be fitted with a voltmeter with 4 position selector and an ammeter with a 7 position selector. Where generator changeover equipment is provided a voltmeter with 4 position selector shall be fitted to both essential and non essential busbars.

KWh consumption check meters shall be single/three phase as detailed on the Contract Drawings, manufactured from black ABS with an unbreakable flexi-glass front. kWh registering shall be by means of a continuous roller type cyclometer dials (7 no.). Each meter shall have a basic to maximum current rating of 5-6 amps and have an LED indicator lamp, which shall have a pulsed operation.

All current monitoring transformers shall be of the ring type to BS 7626.

All meters shall be complete with all required accessories including CT's, wiring and brackets etc.

1.16 Meter Boards

The meter board shall be resin bonded compressed woodchip board or other approved material, 12mm thick and rounded at the corners. It shall be treated with anti-termite solution and treated or impregnated with a flame retarding agent in order to comply with BS 476: Part 20-23 'Fire Tests on Building Materials and Structure'.

The boards shall be supplied by an approved manufacturer. For Tender purposes an allowance for 2 No. 2.5 m x 4.0 m boards shall be deemed to be included.

1.17 Mains Distribution System Schematic Drawing

An AI drawing which clearly details the building's mains distribution system schematic shall be located within a suitable glazed frame (unbreakable type) in the Electrical Switch room.

1.18 Rubber Matting

A rubber insulating mat complying with the requirements of BS 921 shall be installed in front of the main switchboard, each MCC, generator control panel and each lift control panel.

Each mat shall extend the full length of the respective panel and be a minimum of 900 mm wide.

2.0 ARMOURED CABLES

2.1 Plastic Insulated Cables

Plastic insulated cables shall have shaped, stranded conductors of high conductivity copper to BS 6360 insulated with steel wire armouring and LSF overall sleeving. They shall be XLPE/SWA/LSF.

Cables shall comply with the IEE Wiring Regulations for Electrical Installations, 17th Edition in respect of the cross sectional area of the metal armour protective conductors in relation to the phase conductors.

Cables shall be suitable for use on low voltage systems, at a frequency of 50Hz and shall be rated at 600/1000 volts. Conductor sizes shall be as given in the Drawings. No reduction in cross section shall be permitted for the neutral conductor.

Each cable shall be manufactured and installed in one length. No through joints shall be permitted on any cable without written authority.

Any cable lengths given shall have been measured from drawings only. The contractor is required to undertake accurate site measurements of cable routes before ordering cable lengths. No allowance shall be made for waste lengths.

Except where laid in the ground, cables shall be supported by all round band or specifically designed cleats at centres not less than those set in the IEE Regulations, or where the cable size and type is not specifically listed in the Regulations, at the minimum centres recommended by the cable manufacturer.

Where two or more cables follow the same route, such cables shall be separated by a distance not less than the diameter of the larger of the adjacent cables, except that the horizontal clearance need not exceed 150 mm. The vertical clearance between the cables shall not be less than 40 mm. No cable shall be handled or installed where it has been subject to temperature below 0^{o} C within the previous 24 hours,

All cables shall be neatly dressed and the contractor shall ensure that excessive bending of cable does not occur during installation and that bends shall be formed in a smooth curve with the radii of bends not less than those set out in the IEE Regulations, appropriate BS Specification, or as recommended by the manufacturer, whichever is the greater.

Where mechanical means are employed to pull cables, the pull shall be applied using a cable stocking or pulling eye sweated to the conductors and armouring, and that an adequate number of rollers are used to prevent undue strain and/or sheath damage to the cables.
The Contractor shall report immediately any corrosive or other deleterious condition revealed in the course of the installation of cables.

Certification indicating the results of the acceptance tests carried out at the manufacturer's works, in accordance with BS 6346, shall be submitted.

Immediately prior to the final connection to switchgear, equipment etc., each cable shall be subject to pressure tests. The test voltages and method of administering those voltages shall be as detailed in BS 6346. The results of the tests shall be entered on proper test sheets and submitted.

After final connection to switchgear, equipment, etc., and prior to energising, further tests shall be carried out on each cable in the following sequence:-

- Insulation resistance between all conductors and the protective conductor (armouring)

- Insulation resistance between all conductors

- Resistance of armouring (protective conductor)
- Resistance on one conductor

The contractor shall allow for provision of all labour, test instruments of certified accuracy and equipment necessary to carry out the required tests.

2.2 Plastic Insulated Cable Termination's

Cable end termination's shall be made off using moisture proof armour locking glands manufactured to BS 6121 to suit the sizes of the cables. Glands shall be complete with earth tags and top and bottom seal arrangement, to produce a moisture proof connection between the outer sheath of the cable, the gland and the apparatus. Earth tag bolts to be rust proofed mild steel hexagon with proofed spring and plate washer.

An LSF shroud shall be fitted externally over, and totally enclose the body of the gland, so that an effective seal is formed onto the overall outer sheath of the cable.

Conductor ends shall be terminated in socket type compression lugs, complying with BS 4579: 1970 to suit the cable size, terminal type and space at the connection to the apparatus. All tools and lugs used in connection with conductor end termination's shall be of the correct size for the conductor and type supplied by, or specifically approved by, the cable manufacturer for use with the cable.
Crimping devices shall be of the ratchet type such that it is not possible to partially crimp a termination. Crimping tools shall be supplied by the supplier of the terminations.

2.3 Cable Cleats

Where specified plastic insulated cables shall be fixed to the vertical structure/cable tray with LSF type cable cleats manufactured to BS 1490 or all round band. Fixings shall be spaced at centres not less than 60Omm with additional fixings at bends. Cleats shall be supported on metal back straps fixed with rawl bolts.

Plastic insulated cables shall be fixed to the horizontal cable tray with cable ties with metal inserts

2.4 Cable Tiles

Cable tiles shall be manufactured to BS 2484 and shall be interlocking type 225 x 150 x 35 mm without staples.

2.5 Cable Markers

Cable markers shall be 600 mm long x 150 mm wide x 50 mm deep with a recessed head plate engraved "DANGER - ELECTRIC CABLES".

Cable Ducting:-
Solid PVC cable ducts shall be used throughout, unless otherwise indicated, and shall have smooth internal diameters of not less than 150 mm. All solid PVC cable ducts shall be to BS 3506, installed in a trench excavated to a depth of 950 mm below finished ground level and then bedded and covered with 100 mm of lightly compacted sand to BS 1200 Table 1.

150 mm internal diameter clay pipes shall be run from the electrical switch room to an agreed location external to the building. All runs shall be straight.

Deflection from a straight line or variation in depth shall not exceed 1 in 15 horizontally nor 1 in 60 vertically and the cable duct shall pass the alignment tests.

Alignment shall be proved by drawing a mandrel through each duct. The diameter of mandrels shall be 7 mm less than the bore diameter. Mandrels shall be of wood, 250 mm long.

While cables ducts are being laid nylon draw-lines shall be threaded through each length of duct. The draw-lines shall have a breaking strength of not less than 550 N and shall be at least 4 m longer than the duct run.

Immediately after laying, and before back filling the trench, the ends of the cable ducts shall be sealed temporarily with hardwood plugs. Draw-lines shall be secured outside the plugs.
Immediately before cables are drawn-in, ducts shall be cleared with a mandrel 150 mm long and having a diameter 12 mm less than the bore diameter. The mandrel shall be followed by a circular wire brush with a diameter 12 mm more than the bore diameter.

After cables have been installed the ends of the all ducts and service conduits (including spare ways) shall be sealed.

Where ducts and service conduits enter buildings the seal shall form a barrier against gas, water, oil, fire and attack by vermin. Spare ducts and service conduits shall be similarly sealed with removable material. The method of sealing shall be submitted for the Engineer's approval before work commences.

Fire barriers at fire-resistant structural elements, such as floors and walls, shall satisfy the requirements of BS 476 Part 20-23 for insulation, stability and integrity for the period of time indicated.

Duct access chambers of suitable sizes shall be installed as indicated. Dimensions and details of all duct access chambers shall be forwarded to the engineer for approval before work commences.

Excavation of Trenches:-
Excavation of trenches shall be as directed by the Engineer. Any deviation from the defined line set out shall be approved by the Engineer before work is started.

Excavations in a wearing course shall have saw cut edges.

Trenches shall be of sufficient width to allow the cable ducts to be properly laid. The bottom of the trench shall be levelled and, where instructed by the Engineer, rammed. In rocky or stony soils, earth free from stones shall be spread over the bottom of the trench and rammed.

Where trenches are excavated in grassed verges and turfs shall be re-laid, they shall be carefully stripped and stacked. The turfs shall be used within one week of cutting during the period 1 April to 31 August or within two weeks during the remainder of the year. Turfs not used within these periods shall be regarded as topsoil. Topsoil shall be set aside for re-use.

Particular care shall be taken not to damage or dislodge any adjacent pipes or ducts and the Contractor shall satisfy himself of the ground conditions and the presence of underground service pipes, etc., for any damage to which during or in consequence of excavation he shall be held responsible.

Laying of Cable in Trenches:-
When in trenches cable ducts shall:-
(i) Be laid on a bed of lightly compacted graded sand to BS 1200 Table 1 – 100 mm deep and covered with 100 mm lightly compacted graded sand to BS 1200, Table 1 before general reinstatement of the trench. The trench shall be free of water when the sifted sand and cable are laid therein. Whenever indicated on the Contract Drawings interlocking cable tiles shall be provided and laid along the centre line of the cable.

(ii) Be laid loose in trenches.

(iii) Have an adequate length of cable left at each column, pillar and other termination point to enable connections to be made when apparatus is erected after the cable is laid.

(iv) Have any ends left temporarily exposed appropriately sealed and buried.

(v) Only be laid when the ambient temperature is above 0^{o} C and has been at or above this temperature for the previous 24 hours, or special precautions approved by the Engineer have been taken to maintain cables above this temperature to avoid risk of damage during handling.

(vi) Have a PVC or polythene marker tape laid above the line of the duct/cable, 225 mm below finished ground level at all locations.

Inspection before Re-instatement:-

Trenches shall be left open for inspection by the Engineer after the cable is laid and shall not be backfilled without his permission.

3.0 EARTHED CONTAINING SYSTEMS

3.1 General

The design of the installation requires that all conductors are insulated and are further protected by earthed containing systems, which prevent contact with the conductors without penetrating the containing systems.

The containing systems comprise of metal ladder rack, trunking, conduit, cable tray, cable basket, metal sheath of mineral insulated cables and steel wire armouring of LSF cables.

All containment systems shall be of the galvanised type.

Main and sub-main cabling within switch room shall be run on suitably sized ladder rack.

Conductors associated with telephone, closed circuit television, security and radio systems shall be segregated from 240/415 volt final sub circuit wiring and shall be enclosed within a separate containing system.

The Contractor shall supervise and test the work of his tradesman during the progress of the works to ensure that the conductivity of the containing system is effective and compatible with wiring Regulations and with the particular requirements that the resistance measured between any two points on the containing systems shall not exceed 0.5 ohms.

Where the containing systems run within 100 mm of any other piped or metal enclosed services, such as gas, water, heating, drainage, etc., or passes within 100 mm of exposed builders work metal, the containing systems shall be bonded positively to such services pipe, metal or builders work by means of a copper conductor or section not less than 6 mm^2.

Prior to the installation being offered for acceptance, the Contractor shall submit records of tests undertaken during the progress of the works to establish the efficiency of earthing of the containing systems. Where tests during progress or at acceptance, show the resistance of any section of the containing system exceed the minimum requirements of the IEE Regulations or this Specification, the Contractor shall be liable to dismantle the whole of that section and reinstate it in a competent manner, and the costs borne by the Contractor shall include those of other trades whose works are necessarily affected.

All containment systems shall be concealed behind brick, plasterwork, plasterboard, panelling or tiled finishes etc, unless otherwise specified.

Where trunking or cable tray containment systems are concealed behind building finishes of plasterboard panelling or tiled finishes etc., easy access shall be provided to the entire route length behind the aforesaid finishes.

Trunking, ladder racks and cable tray containment systems shall be fixed to the building structure using 40 x 21 mm galvanised unistrut (slotted) type back straps of suitable length.

On vertical surfaces the containment systems shall be directly fixed to the unistrut brackets by means of 2 no. (minimum) propriety spring-loaded back-nuts and sheradised bolts of 6 mm diameter. The unistrut brackets shall be fixed directly to the building's structure by means of 6 mm diameter rawl bolts.

Within ceiling voids, the containment systems shall be supported from the building's structure by means of a minimum number of 2 no. screwed rod supports, with each support having a minimum diameter of 10 mm. The screwed rod supports shall connect on to a suitable and co-ordinated length (maximum length of 1100 mm) of 40 x 21 mm galvanised unistrut (slotted) type bracket, located in an inverted position such that the nut and washer connections are located within the bracket's depth. Locking nuts and washers shall be provided at all screwed rod building structure

and bracket terminations. The containment systems shall be directly fixed to the unistrut brackets by means of 2 no. (minimum) nuts, bolts and washers assemblies, with a minimum size of 6 mm diameter.

3.2 Steel Conduit Installation

All conduits shall be new, galvanised heavy gauge, steel, welded and screwed in compliance with BS 4568: Part 1 to Class 4 standard for all internal and external works.

Under no circumstances shall conduit, which shows signs of rusting, be fixed in position, and care shall be taken to avoid damage from mechanical causes, or weather during storage on site. No conduit of size less than 20 mm diameter shall be used and the spacing factor for cables shall be no less than that stipulated within the IEE Regulations for Electrical Installations 17th Edition.

In straight conduit runs, draw-in boxes shall be fitted at not more than 7.5 metre intervals, and after not more than two right angle bends. In no circumstances shall conduit boxes be installed in positions where access cannot be obtained after completion of the building, neither shall solid or inspection pattern elbows or tees be used, other than in exceptional circumstances where prior permission in writing has been given. The routes of conduits shall be arranged to avoid traps or low level pockets or crossing of conduits.

Conduits shall be cleaned free from oil prior to installation. Conduit which is split, badly marked, poorly threaded or has rough projections internally shall be removed from site. All bends and sets shall be made cold on a bending machine and care shall be taken to ensure that the bore of the conduit is not deformed. Where surface parallel conduits are offset or bent, the radii of the bends shall be from a common point, so that the distance between the conduits is constant throughout the run, in these instances, only the smallest radii bend need to be made on a machine. All surface conduits shall be run parallel to building lines.

Where conduits are cut, and prior to jointing, the ends shall be reamed, threads shall be cleaned of enamel, etc., running couplings shall be rigidly connected using light steel milled edge locknuts on each side of the coupling joint. All exposed threads, locknuts and couplings and any portions of the conduit from which enamel or galvanising has chipped, shall be given two coats of good quality zinc based paint.

Wiring shall not be drawn into any conduit system until the system has been proved electrically and mechanically continuous.

Where conduit enters pressed steel junction boxes, cable trunking, switchgear, outlet boxes, etc., without tapped spout outlets, the connection shall be made with a coupling with a female thread throughout its length, and male brass bush with heavy gauge compression washer inserted between the head of the bush and the box, etc. Where outlet boxes with tapped spout entry are used, the conduit shall be screwed into the entry.

Bright steel milled edge locknuts, with even bearing surfaces, shall be provided on each side of running couplings.

Care shall be taken to prevent the ingress of plaster and cement, etc., into conduits during the progress of the installation. Before any wiring is drawn in, all conduits shall be swabbed dry internally.

Where conduits shall be run on the surface, they shall be held clear of walls, ceilings, beams, etc., by single saddles. Saddles shall be spaced regularly and at not more than 1300 mm centres. Each saddle shall be fixed to the mounting surface by means of a countersunk screw or equivalent. Saddles shall be provided 500 mm on each side of any outlet for a luminaire, ceiling switch, draw-in box, etc. Wherever possible, continuous lengths of conduit shall be used between accessories. Coupling joints shall be used between accessories. Coupling joints shall not be permitted within 1000 mm of switches, switch sockets, etc.

Where conduits shall be concealed in brick or similar construction walls having a plaster finish or to which a tiled or panelled finish is to be applied, the conduits shall run in chases or raggles to a depth not less than 12 mm behind the finished plaster face. In all instances, the 12 mm depth relates to the outmost projection, e.g. band saddles, couplings, locknuts, etc., with the chase or raggle widened or deepened at box and accessory position.
Concealed conduits shall be fixed securely to brickwork by means of band saddles at not more than 1000 mm centres and cement render shall cover the raggle to be flush with the standard brick face level. The cement render shall have a keyed finish suitable for plastering. Where conduits are buried in floor screeds, they shall be secured in a similar fashion. Conduit up stands from floors shall be temporarily braced to prevent the conduit being rotated before the screed is poured and set. Conduit shall be run in floor screeds only where approval has been given, and only when no alternative route is practicable. No crampet type fixings shall be permitted.

Bushes, glands, plums, etc., used with any conduit or conduit accessories shall be of brass. All male bushes shall be of the long thread pattern.

3.3 Steel Conduit Accessories

Outlet boxes at lighting points shall be galvanised, malleable iron, standard circular boxes, small pattern type with earthing terminal manufactured to BS 4568: Part 2.

Outlet boxes at switches, sockets, etc., shall, unless otherwise stated, be manufactured by the makers of the units concerned.

Junction boxes for use with 20 mm diameter conduit shall be circular pattern similar to outlet boxes. Junction boxes for use with conduits larger than 20 mm diameter shall be rectangular or square, pressed steel type. Boxes shall have metal lids secured by round head brass screws. All junction boxes shall be provided with an earthing terminal.

Conduit accessories shall be suitable for use with heavy gauge steel welded and screwed conduit to the same standard of protection i.e. Class 2 and Class 4 only.

Where luminaires or accessories are attached to concealed conduit boxes, extension rings or pieces shall be fitted to the boxes if there is a visible distance between the box and the finished plaster, tile or panel surface of the ceiling or wall.

3.4 Flexible Conduit and Accessories

All flexible conduit shall be manufactured from galvanised steel strip, spiral wound with an external LSF sheath overall to BS 731: Part 1 to form a weatherproof final connection to equipment.

The flexible conduit shall be terminated at each end with solid adaptors using an internally serrated steel locking washer between the adaptor and the conduit system and equipment terminal unit.
Earth continuity shall be maintained between the conduit system and the equipment by means of a LSF or SRI stranded copper cable coloured "Green and Yellow" to at least the cross sectional area of the phase conductors, but not less than 2.5 mm^2 connected to an earth terminal at the final conduit system layout and the earth connection on the equipment. This cable is to be run internally in the flexible conduit and under no circumstances shall it be terminated at the adaptors or to the cover plate of the outlet box or equipment terminal box.

3.5 Metal Trunking

Metal trunking shall be manufactured to BS4678: Part l Class 3 standard from 1.6 mm thick galvanised steel, of standard section length of 3000 mm, with internal flanges for lid fixing and rigidity. All bends, tees, cross pieces and other accessories shall be works fabricated by the same manufacturer and shall be specially designed for use with the trunking and be of the same construction and finish. Trunking lids shall be fitted to the body by means of mushroom or batten type head screws.

No self tapper type screws shall be permitted.

The spacing factor for cables installed into trunking, shall be no less than that stipulated within the IEE Wiring Regulations 17th Edition. The Contractor is duty bound to advise the Contract Administrator in writing of instances where the trunking provision is inadequate.

The trunking and accessories shall be neatly assembled and it is particularly emphasised that each portion of the body and lid section shall butt squarely edge to edge without leaving a gap at any coupling point or joints to accessories.

In all instances, the trunking shall run on a horizontal or vertical plane and shall not deviate from the straight, except where a change in direction accessory is used.

Unless otherwise indicated, trunking mounted on walls, ceiling floors and ceiling/floor voids etc. shall be securely fixed with 'Unistrut' brackets at not more than 1800 mm (two fixings) centres with additional brackets at bends and intersections at a distance not more than 1000 mm from bend or intersection etc.

2 no. 10 x 2 x 35 mm copper earth links shall be used to bond each length of trunking and between bends, tees, crosspieces and all other accessories and/or equipment to which the trunking is connected. The copper links shall be solidly bonded to every length or accessory (i.e. tees, bends, etc.).

On vertical runs of trunking, LSF insulated cable pin racks shall be provided at centres not exceeding 600 mm, additional pin racks shall be installed at bends. Where lids are mounted on the underside of a trunking run, cable retaining straps shall be installed at centres not exceeding 600 mm with additional straps installed at bends. Where trunking passes through a floor or fire division wall, a barrier of incombustible mineral fibre shall be fitted within the trunking after all cables have been installed, to prevent/inhibit the passage of heat and smoke.

When installing the trunking, the Contractor shall ensure that all cut edges are filed smooth, and that all steel and brass particles produced by cutting, filing or drilling are removed from the trunking prior to the installation of cables. Where the finish has been removed due to the foregoing, one coat of anti-corrosive paint shall be applied and a further coat to match the original finish.

Conduit or other connections shall not be made to trunking lids, where luminaires are connected to the trunking body they shall be so arranged that the trunking lid can be removed without further disturbance to the installation.

Where trunking passes through holes in the building structure, a portion of the trunking lid shall be fixed to the trunking prior to installation and shall be arranged to project at least 100 mm beyond the finished surfaces of the building structure.

The Contractor shall include for trunking required at Distribution Boards and the like, in order to achieve a neat symmetrical layout.

3.6 Metal Cable Tray

Perforated cable tray shall be formed from plain sheet steel complying with BS 1449 Part 1: 1972 to classification CR4/GP, having a minimum thickness of 1.5 mm and either galvanised or zinc chromate painted after manufacture.

The dimensions of the tray shall be as detailed, but shall not be less than 150 mm wide with 25 mm returned flange sides, cable trays 600 mm wide and over shall have 50 mm returned flanged sides, securely fixed as described to galvanised mild steel brackets with zinc plated mushroom headed bolts and nuts at regular intervals of not more than 1000 mm (600 mm at bends).

The tray shall be mechanically continuous throughout and all joints connected with at least 4 bolts per joint or fixing bracket.

All holes or edges cut from the tray for the passage of cables shall be provided with suitable grommets complying with BS 1767 and any cut edges prepared and treated with zinc paint.

All bends, tees and crossovers shall be of the same material, thickness and finish as the main cable tray with an internal bend radius of 50 mm and gusset type (45degree) corners.

The entire cable tray system shall be fully earthed throughout.

3.7 Plastic LSF Conduit and Accessories

All plastic conduit and accessories shall be manufactured from a high impact resistant, rigid, self extinguishing LSF material in compliance with BS 4607: Part 1 and 5 to the heavy gauge type 'B' classification, and as amended by BS EN 50086-1, unless otherwise indicated or directed by the Engineers.

The system of conduit shall have a full range of normal accessories and fittings and be suitable for interconnections by either a clamp joint or by use of a solvent adhesive to ensure that all connections are sealed against the ingress of dust and water.

Plastic conduit shall be securely fixed by means of plain strap saddles on concealed installations and spacer bar saddles on surface installations, fixed at 1 metre intervals on horizontal runs and at 1.5 metre intervals on vertical runs, except on surface drops to switches and sockets, etc., where they shall be fixed at 600 mm intervals. All fixing saddles shall be a sliding fit to allow for normal expansion. Additional saddles shall be installed at 150 mm on either side of any bends.

Expansion type couplers shall be fitted on runs exceeding 3.5 metres, and shall be jointed using a mastic type cement to allow for longitudinal movement. Additional expansion couplers shall also be provided in any areas where the ambient temperature exceeds 25^{o} C.

All bends and sets required during site installation shall be made in accordance with the manufacturers instructions, by the use of correct size bending springs, without altering the section of the conduit. Cold bending of conduits up to 25 mm diameter shall be allowed but conduits in excess of this size shall be altered using a Hot Bending process by the gentle application of heat during the bending, taking shall avoid distortion by the direct application of a flame. No bends shall be made, having an inner radius of less than 2.5 times the outside diameter of the conduit.

Conduit terminations on all accessories, cable trunking and equipment which have no spout connection shall be made by means of a P.V.C. female threaded adaptor on the outside, with a P.V.C. male bush screwed from within any metallic accessory, or by a P.V.C. clip in spout adaptor, cemented to compatible plastic accessories.

The layout of all conduit routes, surface and flush to be well planned prior to installation so that crossing of conduits is avoided and that there is no clash with the intended works of other trades. Inspection and draw in boxes shall be provided on any continuous runs exceeding 7.5 metres on surface installations, or 8 metres on flush installations and where more than 3 bends are incorporated.

All P.V.C. conduit boxes shall be suitable for use at high temperature, especially where they are intended to support light fittings, and shall be complete with either special external metal fixing lugs riveted to the M4 brass insert fixings or fitted with steel insert clips to ensure that the fitting weight is carried on the fixings, independently from the P.V.C. box.

Conduit boxes and P.V.C. accessories shall be fixed by means of two mushroom headed screws, with an internal washer to protect the surface, secured to the building structure as described. All final outlet boxes shall contain a fixed brass earth terminal for connection between the attached accessory and the independent protective conductor of the circuit, which shall be included within all plastic conduit systems, without exceeding the rated capacity of the conduit.

4.0 WIRING SYSTEMS

4.1 XL-LSF Insulated Cables

Final circuits shall be wired in strict conformity with the arrangement and cable sizes set out on the Drawings.

Unless otherwise indicated, final circuit wiring shall be installed using 450/750 volt rated, stranded copper single core XL-LSF insulated, unsheathed cables to BS 7211 and BS 6004.

Particular care shall be given to the installation of cables in conduits, and all cables in a conduit shall be installed simultaneously. Draw wires, carefully attached to apply equal strain to all cables, shall be used, with cables being fed into the conduit at one end, the draw wire pulled at the other end. Under no circumstances shall the installation of cables be undertaken single handed, or in a manner exerting undue strain on the cables.

The installation of cables shall be in accordance with the IEE Regulations for Electrical Installations 17th Edition in respect of segregation between the circuit categories as detailed therein and between electrical services and exposed metalwork or other services.

No joints shall be allowed in final circuit, and cables shall be looped only at the terminals of lighting points, switches, socket outlets, etc. The same size of cable shall be used throughout any final sub-circuit and under no circumstances shall the size of a cable be reduced after leaving a final circuit protection device.

Where any final circuit cable is found at any time to have been jointed, or where the cable size is less than required, or where more cables are contained in a conduit or trunking than permitted, the Contractor shall, on receipt of written direction withdraw all relevant wiring as required and rewire in accordance with design without cost to the Contract.

Where laid in trunking, the cables of each circuit shall be taped at 1000 mm intervals with two laps of good quality transparent tape. At 2000 mm intervals, small paper tags with typewritten circuit identification shall be attached under one layer of transparent tape.

All wiring shall be neatly and logically dressed without undue bending at distribution fuse boards, control panels, etc. Where wiring enters control panels, etc., the cables of each circuit shall be neatly and carefully bonded together and secured by means of whip cord binding or other approved means.

Care shall be taken to avoid the cables coming into contact with oil, grease, creosote or injurious fumes, and no cable shall be handled or installed in temperature below 0^{o} C.

Wiring of not more than one phase shall be terminated in an outlet box, switch box, etc., other than one designed specifically for multi-phase use.

All cables shall have colour identification in accordance with the IEE Regulations for Electrical Installations 17th Edition.

All lighting management control system wiring shall utilise cable which is differently coloured to any other (e.g. general power, lighting and mechanical services) wiring.

The ends of all neutral and earth conductors connected at distribution boards, contactors, or relays shall be fitted with clip-on type cable markers as Messrs Critchley 'Z' type or equal, indicating in black engraving the phase and fuse number of the live conductor associated therewith. The said markers shall be of a size ensuring a tight fit to the insulation to avoid their being inadvertently dislodged. Similar markers shall be fitted to live conductors to designate the fuse number only.

In all instances, cables shall be neatly dressed to facilitate identification.

All strap wires of two way switched circuits shall be coloured as the phase conductor and have a cable marker 'S' clipped thereto.

The insulation of cables shall be removed only by the use of a specially designed stripping tool, and where strands of conductors are nicked, indented, scored or otherwise changed by this operation, that length of cable shall be replaced by the Contractor. No more insulation shall be removed than is necessary to form the connection, and where the conductor is excessively exposed, the Contractor shall remake the connection. Where faulty connections are found, the Contractor shall be required to carry out a detailed examination of all connections and shall thereafter submit a signed certificate that all connections throughout the installation have been examined and comply with the requirements of this Specification.

4.2 Mineral Insulated Copper Sheathed (MICS) Cables

MICS cables shall be 1000 volt grade, manufactured to BS 6207: Part 1 for all mains voltages. 600 V grade for fire alarm cables (24 V).

All cables, and accessories including seals, glands, compound, sleeves and saddles, etc., shall be of the one manufacturer.

MICS cables shall have copper conductors and solid copper sheath, with halogen free LSF covering overall.

All MICS cables shall be rated in accordance with the IEE Regulations for Electrical Installations 17th Edition and shall be used for both surface and concealed installation.

All cables, whether surface or concealed including cable trays, shall be fixed to the structure by means of a LSF covered copper spacing clips or multi-way spacing saddles which shall be secured by brass screws of adequate size. Cables shall be secured at 250 mm intervals.

All cable lengths shall be terminated at each end with a brass screw-on type earth tailed continuity pot type seal and appropriately sized universal (ring type) brass compression gland to BS 6081: Part 2, together with adequate lengths of cable tails, properly made off, and sheathed with coloured LSF identification sleeves, all as required to suit the type of apparatus being connected and mode of connection employed.

Where cables enter switchgear, distribution fuse boards, junction boxes, outlet boxes or the like, which have wall or end plates of minimum thickness of 6 mm, these wall or end plates shall be bored and tapped to receive the cable gland. Where wall or end plates are less than 6 mm thick, they shall be bored with clearance holes.

Cables which have to be concealed into walls or buried in plaster shall also be protected by a length of earthed galvanised metallic conduit raggled from the outlet to the ceiling or under floor void.

No through joints shall be permitted in MICS cable without written authority. Where cables emerge from a buried or concealed situation, they shall be lapped with good quality PVC tape for a distance of 100 mm on both sides of the point of emergence.

No bend in a cable shall have an inside radius of less than 6 times the overall diameter of the cable, and where run on the surface, careful attention shall be given to the dressing in straight orderly routes, and where this is not done satisfactorily, this section of the work shall be rejected on the grounds of defective workmanship.

Any length of MICS cable, including end termination, having an insulation value between conductors or between any conductor and earth less than 5 mega ohms shall be rejected.

Where two or more cables follow the same route, the cables shall be fixed to a perforated sheet steel cable tray. This cable tray shall be included by the Contractor.

Where glands are exposed to atmospheric conditions and in all instances where they are screwed into aluminium or zinc based alloy fittings or luminaires, either inside or outside the building, sheradised plated cable glands shall be used and bitumastic paint applied to the junction of the threads after erection to eliminate the possibility of corrosion.

4.3 Silicone Rubber Insulation (SRI) Flexible Cables

At all final connections to luminaires 300/500 volt grade SRI cables manufactured to BS 6500 shall be used. The cables shall comprise tinned annealed high conductivity, stranded copper conductors, silicone rubber insulated doubles glass fibre lagged, with overall glass fibre silicone varnished braid.

No flexible cable having conductors less than 30/0.20 shall be used.

4.4 LSF Insulated and LSF Sheathed Cables

LSF insulated and LSF sheathed cables shall comply with BS 6004, of 450/750 volt rating, and generally be either flat twin core and earth, C.M.A. reference 6242Y or flat three core and earth, C.M.A. reference 6243Y, with stranded copper conductors.

The minimum size of this type of cable to be used shall be 1.5 mm^2 and shall be colour coded in full compliance with European Directive, Irish Standards and RECI Requirements.

All cables to be similarly identified at both ends and under no circumstances shall the bare protective conductor be used for anything other than earth continuity. Neutral cables shall only be jointed at lighting points or junction boxes and no neutral joints shall be permitted at switch boxes.

The installation of these cables shall be carried out using the loop-in Principal.

All junction and accessory boxes shall be provided with a fixed earth terminal and an external means of clamping the PVC sheath of the cables entering to leave the full interior space for terminations and accessories.

The routes for all such cables shall be thoroughly planned and cables shall only be run parallel to the building structure, horizontally and vertically, no diagonal (Point to Point) wiring shall be permitted.

Where cables are installed on the building surface in an accessible location, they shall be secured by purpose made clips, not more than 250 mm apart on horizontal and 400 mm apart on vertical runs. Where cables shall be concealed but are accessible during the installation they shall be fixed at intervals not greater than 600 mm apart,

Cables run in ceilings, under floors, hollows, stud or cavity wall and partitions need not be individually protected but where installed as multiple runs of cables, then these shall be contained in plastic or metallic trunking or cable tray as detailed. Where cables pass through studs or walls, etc., they shall be protected by a short length of heavy gauge steel conduit with rubber bushes at each end.

Cables which have to be concealed into walls or buried in plaster shall also be protected by a length of earthed metallic conduit raggled from the outlet to the ceiling or under floor space.

All individual cables where clipped shall be by means of formed plastic clips or straps manufactured to suit the cable size, securely fixed to the building structure by screws or masonry nails, no self adhesive type fixings shall be used.

Cables run in trunking shall be laid with the larger cables at the bottom, and where they leave metallic trunking the opening shall be adequately bushed to prevent any abrasion of the cables.

Cables run on cable tray shall not be laid in groups with more than six cables. Each group of cables shall be not more than two cables in depth. 20 mm of spacing shall be provided between each group of cables. All cables shall be secured to cable tray using nylon cable ties at distances not greater than 400 mm (horizontal)and 250 mm (vertical).

LSF insulated and LSF sheathed cables as described above shall not be used for the distribution of sub-mains or final circuits, which are designated as multi-phase circuits.

5.0 WIRING ACCESSORIES

5.1 General

All accessories shall be mounted in zinc plated metal boxes manufactured to BS 4662 or BS 1363: Part 2, not less than 35 mm deep having provision for the connection and earthing of conduits as required under the section of this Specification headed "Earthed Containing Systems". Boxes shall contain an internal brass earth terminal for independent connection of the accessory to the protective conductor or earth system. All box faces shall be flush with finished surface.

Boxes shall be supplied by the manufacturer of the accessories and the Contractor shall be responsible for ensuring that the dimensions are in all respects suitable for the erection and fixing of the accessories.

Adjustable grids shall be manufactured from rust proofed pressed steel, and shall be fitted to the boxes by cadmium plated screws, arranged so as to give lateral and depth adjustment. Grids shall be fitted with earthing terminals and earth connections, consisting of a single insulated flexible 30/0.25 cable providing connection between the grids and earthing terminals in the boxes.

The switch cover plates shall be directly fixed by at least two fixing screws to the grid plate and shall be either metal finished or all insulated as detailed. Metal plates shall be a minimum of 1.5 mm thick and insulated plates 3 mm thick at the bearing surfaces.

Flush accessories shall have cover plates providing an overlap of not less than 6mm on the outside of the boxes. Surface accessories shall have cover plates of the same dimensions as the box to which they are fitted.

Unless otherwise stated, all accessories shall be of the same manufacture and finish throughout the installation.

Within two weeks of acceptance of the tender, the Contractor shall provide samples of every type of accessory, including boxes, grids, cover plates, switch, switch socket and connection unit interiors included on the drawings. Where a sample does not comply with the requirements of this Specification, the Contractor shall be directed to an acceptable alternative which shall be supplied for the works without additional charge to the Contract. A performance certificate in terms of this section of the Specification shall be lodged with the sample of an alternative accessory.

Prior to offering the works for acceptance tests, the Contractor shall check the correct operation and connection of every accessory and submit written confirmation that such a check has been made.

5.2 Lighting Switches

Lighting switches shall be 20 amp rated one way, two way or intermediate as required, manufactured to BS EN 60669-1 and shall meet the test requirements for inductive, fluorescent and resistive loads specified therein.

Switches shall be single pole, rocker pattern, connected so as to switch the phase conductor. Where more than one final sub-circuit is brought into a group of switches under a common cover plate, cable markers shall be fitted to identify every conductor

Weatherproof switches shall have polycarbonate back boxes, cover plates and switches complete with integral (sealed) fixing and gasket. The complete assembly including cable/conduit entries shall have an IP rating of IP56. Each switch shall be complete with a location neon indicator (green).

5.3 Switch Socket Outlets

13 amp, rectangular 3 pin, shuttered, switch socket outlets shall be manufactured to BS 1363: Part1.

Sockets shall be controlled by 20 amp, single pole, rocker pattern switches connected so as to switch the phase conductor. Each switch and socket shall be integrally connected and mounted on a common adjustable grid, under a common metal or insulated cover plate as detailed.

Socket outlets inserts shall be manufactured from non-tracking insulating material finished comparable with the cover plate and switch.

Weatherproof 13 amp rectangular 3 pin, shuttered, switch socket outlet assemblies shall be housed in galvanised cast iron surface mounting boxes with external fixing lugs, galvanised cast iron gasketed cover plates with non-tracking insulating inserts, brass screwed socket outlet caps with retaining chains and brass external switch operating handles. The complete assembly including cable/conduit entries shall have an IP rating of IP56.

5.4 Fused Connection Units (Switched)

13 amp, switched, fused connection units shall be manufactured to BS 5733. Load terminals shall be controlled by 20 amp double pole switches connected so as to switch the phase and neutral conductors via single pole fuse carriers fitted in the phase conductors.

Each switch, fuse carrier and load terminals shall be integrally connected and mounted on a common adjustable grid under a common cover plate. The switches, fuse carriers and indicating light shall project through the cover plate.

5.5 Fused Connection Units (Un switched)

13 amp fuse connection units shall be manufactured to BS 5733.

Each fuse carrier and load terminals shall be integrally connected and mounted on a common adjustable grid under a common cover plate. The fuse carrier and indicating light (if required) shall project through the cover plate.

5.6 Shaver Supply Units

Detailed Specification to follow.

5.7 Three Phase Power Socket Outlets

32 amp, round 5 pin, mechanical/electrical interlocked switch socket outlets shall be manufactured to BS EN 60309-2.

Sockets shall be controlled by an integrally connected residual current type, earth leakage circuit breaker manufactured in compliance with BS EN 61008-1, providing overload and short circuit protection, with a fixed rated residual operating tripping current of 30 mA.

Enclosures housing the accessories shall be manufactured from a fire retardant, oil resistant, fully insulated, high impact resistant material, providing watertight protection to IP 66.

5.8 Single Phase Power Socket Outlets

16 amp, round, 3 pin, mechanical/electrical interlocked switch socket outlets shall be manufactured to BS EN 60309-2.

Sockets shall be controlled by an integrally connected residual current type, earth leakage circuit breaker manufactured in compliance with BS EN 61008-1, providing overload and short circuit protection, with a fixed rated residual operating and tripping current of 30 mA.

Enclosures housing the accessories shall be manufactured from a fire retardant, oil resistant, fully insulated, high impact resistant material, providing watertight protection to IP 66.

5.9 R.C.C.B Protected Switch Socket Outlets

13 amp rectangular 3 pin, shuttered switch socket outlets shall be manufactured to BS 1363: Part1.

Sockets shall be protected by an integrally connected residual current type, earth leakage circuit breaker manufactured in compliance with BS EN 61008-1, providing overload and short-circuit protection, with a fixed rated residual operating and tripping current of 30 mA.

6.0 MANUAL/AUTOMATIC FIRE ALARM DETECTION & INDICATION SYSTEM

6.1 General

The contractor in conjunction with a preferred specialist shall supply and commission a complete automatic digital addressable fire detection system.

The installation shall be installed to meet the requirements of BS5839: 2002 and this Specification. The design shall be based on the following:

A series of break glass units throughout the premises.
A series of voice evacuation speakers.
Multi sensor carbon monoxide fire detector(s) to provide room within a room protection where required.
A series of detectors throughout the premises
Interface with all auto door control units (output for each auto door)
Interface with the Card Access system (output for each card swipe)
Music system (output).
Interface with the Monitored Line unit (output)

Control and indication equipment panel mounted in an aesthetic enclosure located within the building's main reception. A combined battery and charger unit and remote system monitoring equipment shall be provided.

Fire resistant cables that comply with the enhanced application in accordance with BS 5839-1: 2002 e.g. MICC/ LSF (Red sheath) or Pirelli FP Plus (Red sheath), shall be utilised throughout.

The operation of the sounders shall be initiated from either, manual call points, optical beam or smoke or heat sensors, (located throughout building).

The fire alarm system shall be interfaced with the following systems:

- All Mechanical Services Control Panels
- All Lift Control Panels
- Entrance Doors Locking Device
- Remote System Monitoring Equipment
- Music System

Each Mechanical services control panel shall be shut-down under fire alarm conditions.

Each lift shall return to the ground floor shall a fire be detected, however, if the fire is detected within the ground floor's core area then the lift shall proceed to the first floor. In any case, upon arrival to the given floor the lifts doors shall open and the lift be in-operable for further usage until the fire alarm condition has been removed.

All automatically locked doors shall immediately release upon a fire alarm condition and revert back to the normal mode of operation upon the fire alarm condition being extinguished.

All systems interfaced with the fire alarm system shall operate as normal upon the fire alarm condition being extinguished.

All activated sensors or manual call points shall be clearly indicated on the fire alarm control and indication equipment panel by means of an integral Alpha Numeric LCD message display panel.

The fire alarm system shall be provided with remote monitoring facilities such that the system's operation is fully Monitored Line by the system manufacturer's continually manned remote central fire alarm station via the public switched telephone network (PSTN) using auto-dial controls.

All equipment shall be labelled with their installation/operation reference information.

The Contractor shall be deemed to include all required boxes and accessories to be supplied by the manufacturer to house or mount the equipment, having the provision for the termination, connection and earthing of conduits and cables as required under the section of this Specification headed' Earthed Containing Systems'.

The Contractor shall be responsible for ensuring that the dimensions of boxes are in all respects suitable for the erection and fixing of equipment. All equipment shall be supplied from one manufacturer.

All equipment, system commissioning and maintenance (Initial 12 months) shall be provided by the same manufacturer.

The contractor shall ensure that the fire alarm installation throughout the premises is completed in its entirety, taking into account that the final inspection of the installation will be required to be demonstrated to the client and the associated Building Control Officer / Fire Officer in order that the appropriate certification can be obtained prior to occupation of the premises.

The contractor shall allow for all necessary liaisons with other specialists.

The Fire Alarm installation shall comply with BS 5839 and BS 7671. Component parts to comply with BS 5445, BS 5839 and BS EN 54 as applicable. Comply with the Electromagnetic Compatibility Regulations.

Final location of the fire alarm panel to be agreed with the Architect.

The contractor shall provide manual call points, automatic detectors, audible alarm devices and visual alarm devices, all controlled and powered from a single, combined control panel and power supply unit.

The panel shall be connected to a remote monitoring company control room via a Redcare automatic transmission system.

The fire alarm system to be of the digital-addressable type.

6.2 Call Points

Manual call points shall be made from red ABS material with a frangible glass panel which can be broken, without producing splinters and without the use of a hammer or similar implement. Allow their operation to be tested without the need to open the front cover or break the glass panel. In decorated areas, manual call points to be flush mounted elsewhere to be surface mounted. Where they may be subjected to impact damage or accidental operation, manual call points to be covered by transparent, hinged, polycarbonate flaps.

6.3 Heat Detectors

Heat detectors to be off-white, surface mounted devices complying with BS EN 54: Part 5 and be equipped with fixed temperature elements set at 57°C.

6.4 Carbon Monoxide Detectors

Carbon Monoxide detectors to be off-white, surface mounted devices complying with BS EN 54: Part 7 and be equipped with optical elements.

6.5 Sounders

Sounders to be vertically mounted omni-directional bells with an solenoid operated striker driven by an energy saving electronic circuit and a sound output of not less than 92dBA. Sounders to be

6.6 Visual Alarms

Visual alarms to be red xenon beacons with a flash rate of 1Hz, a flash energy of not less than 5J and a light output of not less than 14cd.s. Beacons for use in deep freeze storage rooms to be capable of operation at temperatures down to -30°C.

6.7 Automatic Alarms

The contractor shall supply, install, test and commission a Redcare Signalling Transmitter.

The contractor shall include in his tender for all works required to be undertaken by the specialist

The contractor shall supply, install and commission 4 pair CW1308 cables from each of the following panels, terminating in a 150 x 150mm adaptable box with internally labelled terminal blocks, located adjacent to the Redcare Signalling Transmitter:

The main Fire Alarm Panel
The intruder alarm panel
The sprinkler flow switch (where applicable)
NSI floor standing cabinet.

6.8 Control Panels

The control panels to monitor, control and power the fire alarm system and comply with BS EN 54: Parts 2 and 4.

Control panel to incorporate the following features:

i) Indication of a zone alarm.
ii) Indication of a zone cable fault.
iii) Indication of a device alarm.
iv) Indication of a device/ cable fault.
v) A supervisory buzzer unit.
vi) An alarm silence control.
vii) A system reset control.
viii) An alarm initiate control (continuous operation).
ix) Three volt-free changeover contacts to give remote indication of an alarm.
x) Facilities for connection to the Redcare system.

All alarm/ fault indications are to be displayed on a common alpha-numeric screen. Provide facilities for scrolling through multiple indications.

The control panel is to have facilities for storing the last 500 events on the system and for displaying them. Provide a port to allow the event log to be printed out.

6.9 Refuge Call System

The contractor in conjunction with the preferred specialist shall supply and commission complete Refuge Call System.

The contractor shall ensure that the Refuge Call installation is completed in its entirety, taking into account that the final inspection of the installation will be required to be demonstrated to the client's Fire Officer and the associated Building Control Officer / Fire Officer at the same time as the Fire Alarm System, in order that the appropriate certification can be obtained prior to occupation of the premises.

6.9.1 Small Systems (1-4 Outstations)

The system shall consist of the following:

a) Recessed Refuge Call Panel c/ w standby battery
b) Surface mounted, hands free Refuge Call Outstations.
c) Line driver cards (one per outstation).
d) Call Panel and Outstations shall be green finish.

6.9.2 Large Systems (1-16 Outstations)

The system shall consist of the following:

a) Recessed Refuge Call Panel c/ w standby battery
b) 16 line Central Exchange
c) Surface mounted, hands free Refuge Call Outstations.

d) 4 Way Line driver Cards (one per four outstations).
e) Call Panel and Outstations shall be green finish.

6.10 Installation

Joint cables in suitably labelled, fixed terminal, steel junction boxes.

Wire digital-addressable systems using one or more loop circuits, starting and finishing at the control panel. Each circuit to be Monitored Line for cable faults. Mount circuit isolating devices at each end of a circuit, where the circuit passes from one zone to another and within a zone to separate the devices into groups of no more than 10. In the event of a cable fault, the isolating devices at either end of the faulty section to operate and remove that section from the circuit. The remainder of the circuit to continue to operate fully as two radial circuits.

Where one or more automatic detectors are mounted within a closed room, mount a remote LED indicator unit over the outside of the main access door to show if the detector(s) operate(s).

Alarm devices to be electronic bells. However these shall be reinforced with beacons in noisy plantrooms, refigeration cold rooms/ cold holds and other areas with a high ambient noise level.

Wire the alarm devices and the manual call points and automatic detectors on common cabling where they are suitable for such a configuration.

Automatic detectors to be removable, mounted in common bases. The removal of a device is not to affect the operation of the other devices on the same circuit.

7.0 LUMINAIRES AND LAMPS

7.1 General

The Contractor shall include for all necessary suspensions, flexible cables, porcelain block type connectors, fixing screws, fixing brackets and any other materials or accessories deemed necessary.

All components and materials shall comply with the latest relevant British Standards. The use of new materials and components not dealt with in any current British Standard is not precluded, but their use shall be the subject of the written specification of a different body, or competent person, and shall result in a performance and degree of safety from fire and electric shock not less than that provided for in comparable British Standards.

The tender and contract drawings issued show, in plan, only the approximate location of luminaires, and the final position on site shall be checked by the Contractor using the latest drawings, including any ceiling tile layouts available and from working drawings of other trades. The final locations of all luminaires and accessories etc. shall be as detailed on the Drawings. Sizes and scaled dimensions shall not be measured from the general arrangement drawings.

No luminaires shall be ordered without the authorization of the Engineers, and the Contractor shall request this in writing, giving due notice of the latest dates for ordering in respect of the notified delivery period and the Main Contractor's Programme.

Unless stated otherwise, all luminaires shall be independently supported from the building structure by means of (2 no. 20 mm dia conduit - batten type fluorescent luminaires) or (4 no. 6 mm dia screwed rod suspensions - recessed modular fluorescent type luminaires) and shall not be fixed to any suspended ceilings or other services. Downlighter luminaires shall be provided with a fire retardant back board (500 x 500 x 6 mm) fixed to the upper side of plasterboard/ceiling tile to provide additional mechanical rigidity and using 2 no. 6 mm dia screwed rod suspension.

The Contractor shall be responsible for the final testing and checking of all luminaires to ensure the performance, circuiting and switching and general alignment is correct. Particular attention shall be paid to any abnormal noise or presence of flickering on fluorescent luminaires.

Generally, final circuit wiring shall terminate and loop at connectors within the conduit boxes at lighting points and not brought into luminaires. Porcelain connectors shall be of the block pattern with not less than two brass pinching screws per terminal. Interconnections between the porcelain connectors and luminaires shall be carried out in single silicone rubber insulated flexible cables. After connection of final sub-circuit wiring and flexible interconnecting wiring, the connector shall be wrapped in pure rubber or equal insulating tape, and there after black adhesive tape.

In suspended ceiling situations, final circuit wiring shall terminate and loop at plug-in type ceiling roses or controllers. Final connections to the luminaires shall be made using 3 core silicone rubber insulated flexible cable terminated in 6 amp 3/4 pin ceiling rose type plug top.

In suspended ceiling situations, final circuit wiring shall terminate and loop at lighting control system decoder switching units or plug-in type ceiling roses, as detailed. Final connections to the luminaires shall be made using 3 core 1.5 sq mm high temperature rated heat resistant silicone rubber insulated flexible cable terminated in 6 amp 3/4 pin ceiling compatible type plug top. Flex entries to luminaries shall be by means of compression gland (brass type).

Where conduits directly enter surface mounting bulkhead or totally enclosed type tungsten luminaires, a standard circular conduit box shall be installed in the conduit 400 mm from the luminaire. Final circuit wiring and interconnecting wiring shall terminate in the conduit box as previously described.

Luminaires to comply with BS 4533, BS EN 60598 and BS 5225.

Signs and high voltage installations to comply with BS 159.

Luminaires for use in potentially explosive atmospheres to comply with BS 5345.

Luminaires to meet the requirements of the Electromagnetic Compatibility Regulations in their design and manufacture, allowing compliance in their operation and maintenance with the Electricity at Work Regulations.

Luminaires that are mounted in direct contact with the building fabric to achieve an 'F' rating in accordance with BS 4533: Parts 101 and 102.

Wiring in luminaires to be of stranded copper, insulated with an LSF material suitable for operation at 105°C. Where the wiring passes control gear operating at a higher temperature, fit the wiring with over-sleeves of a suitable temperature capability.

7.2 Diffusers and Louvres

Diffusers to be either opal or prismatic, manufactured from acrylic or polycarbonate. Polystyrene not to be used.

Diffusers of dished construction produced from an assembly of an underside and side panels to be joined together by welding. Where glued joints are used to provide strength equal to a welded joint, allow the glue to retain its effectiveness.

Prismatic diffusers to have the prisms on the inside of the diffuser to minimise the build up of dirt and to aid cleaning of the external surface.

Where luminaires with prismatic diffusers are used for emergency lighting the diffusers are to be manufactured to meet the requirements of the hot wire test detailed in BS 5266.

Diffusers to be retained in place on the luminaire body by one of the following methods. (The method of attachment to provide support during the installation/removal sequence):
i) Spring clips holding the diffuser tight to the body, retaining their effectiveness for the design life of the diffuser.
ii) Metal or plastic hinges.
iii) The incorporation of a metal bezel which is attached to the luminaire body with screws or patent securing devices.

Louvres to be manufactured from aluminium, with a satin anodised finish. Louvres used in VDU areas to have a mirror reflective finish, with the aluminium surface treated to prevent iridescence.

Louvre finishes to be robust and able to withstand cleaning in the recommended manner.

Louvres to be attached to the luminaire body by seating on cut-outs or ledges formed in or on the body, securely retaining the louvre in place. No dislodgement due to vibration of the mounting surface or accidental impact is acceptable.

Provide louvres with safety chains or wires.

7.3 Lamp Holders

Lamp holders used within luminaires shall comply with the relevant British Standards Institute requirements and the IEE Regulations for Electrical Installation 17th Edition. (Appendices).

Tungsten lamp holders up to a maximum rating of 150 watts, shall be to BS 6776 type B22d with a temperature rating of T2. Where used in an open type luminaire, they shall be manufactured from a heat resistant material with solid steel sleeved interiors and brass spring plungers, with fully shrouded brass terminals and pinching screws.

Lamp holders within totally enclosed luminaires shall be manufactured with exteriors.

Tungsten lamp holders for use with lamps above 150 watt and up to 250 watts ratings shall be of the Edison Screw type E27 and those above this rating shall be Goliath Edison Screw type E40, complying with BS 6776. These holders shall have solid exteriors with heavy brass screw interior with a spring loaded centre base contact. The lamp holder shall automatically disconnect power at the lamp contacts upon lamp removal.

Lamp holders for mercury and sodium discharge lamps shall be of the ES or GES types E27 and E40 to BS 6776 as above.

Lamp caps and holders to comply generally with BS EN 60061 and to be suitable for continuous operation without deterioration at 100°C. Those for use with tubular fluorescent lamps to comply with BS EN 60400. Bayonet lampholders to comply with BS EN 61184. Edison screw lampholders to comply with BS EN 60238.

Lamp holders in luminaires of similar type and rating to be identical.

Metal lampholders to incorporate an earthing terminal.

Lampholders to be securely mounted in the luminaire where they are the sole support for the lamp. Lampholders suspended by cord to be fitted with an integral cord grip.

7.4 Lamps

All lamps supplied shall comply fully with the relevant British Standards Institute Requirements, and be suitable for use on a 240 volt, 50 Hz supply, tested for temperature rise of lamp caps to BS 5371.

Tungsten filament lamps up to 150 watt rating shall be of the Bayonet cap, coiled coil, clear and/or pearl type to BS 161 for interior luminaires and an equivalent Rough Service lamp for external luminaires.

Tungsten filament lamps above 150 watts rating shall be of the Edison Screw cap type to the above Specification and any such lamps of 250 watts or above shall have Goliath Edison screw caps.

All other miscellaneous Tungsten Filament Lamps for special luminaires and voltages other than 240 volts AC shall comply with BS 555.

Discharge high pressure mercury and sodium lamps shall be manufactured in compliance with BS 3677, with either ES or GES lamp caps, depending on the lamp size and detailed requirements. These lamps shall be covered by the manufacturers guarantee for average life expectancy.

Tubular fluorescent lamps shall be of the standard medium bi-pin cap type, manufactured to BS EN 60081, BS EN 60901, BS EN 61195 and BS EN 61199 to the size rating and colour as detailed.

Miniature and sub-miniature tungsten filament and fluorescent lamps shall be fitted with lamp caps complying with BS EN 60061-1 to the rating as detailed.

Under no circumstances shall mushroom type tungsten filament lamps be permitted.

All lamp types have been specified for Tender purposes only. Contractor to be advised of lamp types prior to ordering.

Tubular fluorescent lamps to comply with BS EN 60081 and BS EN 50342. Single capped fluorescent lamps to comply with BS EN 60901 and BS EN 61199.

High pressure mercury vapour lamps to comply with BS 60188 and BS EN 62035.

High pressure sodium vapour lamps to comply with BS EN 62035.

Lamps of each type to be supplied by the same manufacturer.

At completion of contract provide one complete box of spare lamps (minimum of 20) of all varieties specified.

7.5 Luminaires with G.L.S. Lamps *

Tungsten filament luminaires shall comply fully with the relevant sections to BS EN 60598, covering the various classifications on the types of luminaire detailed, but shall generally be of either Class I or II type for protection against electric shock, with a degree of protection to at least IP 21.

Luminaires shall be complete with all necessary metalwork, bases terminals, glassware or diffuser and a suitable lamp holder for the rating of lamp required.

The metal work of luminaires shall be effectively earthed and shall be suitable for either direct fixing to standard BS box or by means of a suspension system, supplied by the manufacturer.

All internal wiring within these luminaires shall be of the heat resistant SRI type as described.

Where any luminaire is supplied by a manufacturer, without the above SRI cable, then the Contractor shall arrange and include for the cost of re-wiring all such units.

7.6 Luminaires with Discharge Lamps

Luminaires using either mercury or sodium discharge type lamps shall be manufactured in accordance with BS EN 60598, with control gear ballasts complying with BS EN 60922 and capacitors complying with BS EN 61048.

Luminaires shall be supplied complete with integral control gear, diffuser and/or reflectors, suitable lamp holders and terminals, etc., and where required a fixing bracket or support system as detailed.

Luminaires shall be effectively earthed and wired with heat resistant SRI cables, and shall also be re-wired with this type of cable shall it not be supplied as standard by the manufacturers.

All external discharge lighting luminaires shall be complete with integral HRC fuse links.

Lamp Type	Rating of BS 88 Fuse in Luminaire
125 W Mercury Vapour	6 amp
80 W Mercury Vapour	4 amp
50 W Mercury Vapour	4 amp
250 W Metal Halide	10 amp
175 W Metal Halide	6 amp
150 W Metal Halide	4 amp
70 W Metal Halide	4 amp
9 W Compact Fluorescent	4 amp
400 W High Pressure Sodium	16 amp
250 W High Pressure Sodium	10 amp
150 W High Pressure Sodium	4 amp
7 W High Pressure Sodium	4 amp
40-150 Tungsten Halogen	4 amp

7.7 Luminaires with Tubular Fluorescent Lamps

All luminaires shall be manufactured to comply with BS EN 60598 and shall generally be to Class 1 classification and shall meet all relevant sections of Part 1 of these Standards for the particular type of luminaires detailed.

Luminaires shall be made from a minimum thickness of 0.8 mm sheet steel, treated against corrosion and finished with a stove enamelled paint (white).

7.8 Control Gear

Luminaire control gear and associated components to be suitable for the lamp type, wattage and starting characteristics. Confirmation of compatibility to be obtained from the manufacturer.
Control gear for use with fluorescent lamps to be of the high frequency type and comply with BS EN 60920, BS EN 60921, BS EN 61347: Part 1 and Part 2.8, having short-circuit and overload protection and a 'failed-lamp' detector to shut down the output.

Where glow starters are required to match an existing installation, comply with BS EN 60155 mounted in holders complying with BS EN 60400. Starter holders to be installed in the luminaire in such a way that it is possible to change the starter without having to gain access to areas containing energised parts and without removing the lamp.

Control gear for use with discharge lamps to comply with BS EN 60922, BS EN 60923, BS EN 61347: Part 1 and Part 2.9 and have short circuit and overload protection and a 'failed-lamp' detector to shut down the output.

Power factor of fluorescent and discharge luminaires to be a minimum of 0.9, with capacitors where necessary in accordance with BS EN 61048 and BS EN 61049. Capacitors to be of the self-healing, dry foil type with a tolerance of 10%, containing a device to ensure that the terminal voltage drops to less than 50V within one minute of the supply being removed.

Provide a fixed screw terminal block to receive the incoming supply cables, including the protective conductor, with each terminal suitable for receiving three 2.5mm² conductors.

Luminaires equipped with lamps rated in excess for 20 watts to be fitted with a fixed fuse holder and fuse in accordance with BS 1362. Fuse holders may be combined with the terminal block.

Where the control gear is not mounted within the luminaire, mount in a separate sheet steel enclosure with the same index of protection and finish as specified for the luminaire. Fit the enclosure with a lid or door requiring a tool or key to open it. The cable length between the control gear and the lamp not to exceed the maximum recommended by the manufacturer.

7.9 Extra Low Voltage Transformers

Feed extra-low voltage luminaires LV/ELV transformers with up to four lamps from one transformer.

Input voltage of the transformers to be 230V AC, with no-load output voltage to be 12V AC. Transformers to be rated for their anticipated load and be of the wire wound, laminated, low loss, low noise type.

Transformers to be suitable for installation in ceiling voids at temperatures up to 35°C and relative humidity up to 80%.

Transformers serving a single lamp to be installed within the associated luminaire. Elsewhere, transformers to be installed in suitable enclosures. The weight of the enclosure and transformer is not to be borne by the suspended ceiling but be independently supported.

Provide primary winding short-circuit and overload protection by cartridge fuse or MCB. Secondary winding protection by a self-resetting thermal cut-out.

The final connection to each lamp or luminaire to be via a plug and socket. Unless otherwise indicated, or needed to match an existing installation, the plug and socket to comply with BS 6972 and BS 7001.

Mount a label on the exterior of the transformer enclosure giving the following information:
i) Manufacturer's name.

ii) Model number.
iii) Serial number.
iv) Electrical characteristics.
v) Details of applicable standards.

7.10 Light Switches

Interior wall mounted light switches to comply with BS EN 60669, and have moulded plastic rockers and snap-action microgap mechanisms with a minimum rating of 15A. Mechanisms to be mounted on adjustable steel grids within pressed steel enclosures with a finish to match that of the associated conduit system. Integral earthing terminal to be provided in each switch box.

Pendant light switches to be of the pull-cord type with a snap-action microgap mechanism and a minimum rating of 15A, and be of the surface mounted pattern with a white moulded plastic enclosure. An integral earthing terminal to be provided in each enclosure.

7.11 Installation

Comply with the requirements of Building Regulations Document L2 with particular reference to the efficiency and energy usage of all lamps and luminaires.

Discharge and ELV lamps to be fitted with glass covers to protect against ultra-violet emission and the risk of the lamps exploding.

Secondary safety support to be provided for diffusers, louvres and gear trays so they are prevented from falling if their primary support fails or is released.

Luminaires of similar types to have the same photometric performance.

Luminaire Installation:
Supply, install and terminate all luminaires.

Adequately support all luminaires. Those over 600mm in length to have two supports and those over 300mm in width to have four supports. All suspended supports to be vertical.

Where luminaires are mounted direct from conduit, each mounting point to comprise a conduit box. Where the suspended mass exceeds 3kg or the material temperature exceeds 60° conduit boxes to be made of steel. Final circuit wiring to terminate in a terminal block within the supporting conduit box. Flexible cord to be used to connect the luminaire to the terminal block.

Conduit used to suspend luminaires to be made from steel and have a minimum diameter of 20mm. Where the conduit enters the luminaire, use back-nuts and washers to secure the luminaire body to the conduit. Final flexible cord connection to run within one of the conduits.

Luminaires suspended on rods to be made from cadmium plated steel, a minimum of 6mm in diameter and threaded throughout their length. Connections at top and bottom to utilise washers, nuts and lock-nuts. Cut ends of rods to be painted using calcium plumbate primer or zinc rich paint. Final flexible cord connection to be clipped to one of the rods at no more than 300mm intervals.

Chains used for suspending luminaires to be cadmium plated steel links. Carrying capacity of each chain to be at least twice the total weight of the luminaire, with the final flexible cord connection clipped to one of the chains at no more than 300mm intervals. Do not thread through the links.

Luminaires supported from trunking to be mounted using proprietary clamps or brackets. Where the suspended mass exceeds 3kg or the material temperature may exceed 60°C, trunking to be made of steel. Final connections to the luminaires to be via plugs and sockets, mounted on or beside the trunking and flexible cord.

Recessed luminaires to be installed flush with the finished ceiling level, and unless otherwise agreed be supported from the soffit above, their weight not borne by the ceiling.

Final circuit wiring to recessed luminaires to terminate in a plug and socket mounted on the soffit within 500mm of the access through the ceiling. Do not use flexible cord for the final connection from the plug and socket to the luminaire. The flexible cord within the ceiling void to hang loose, and not be attached to the luminaire supports. Unless otherwise indicated, or needed to match an existing installation, the plugs and sockets to comply with BS 6972 and BS 7001.

Final connections to luminaires to be made using three conductor flexible cord, except where Class 2 luminaires are used.

Cables entering a luminaire to do so through a conduit bush, cable gland or grommet of appropriate size. Loose wiring within a luminaire to be clipped or tied back using suitable proprietary devices at no more than 300mm intervals.

Where luminaires are fed from mineral insulated cable, cable glands to be fixed to the luminaire body and the conductors continued to the supply terminals.

7.12 Design Criteria

Provide adequate and correct:

i) Illumination levels.
ii) Uniformity of distribution.
iii) Limiting glare index.

For areas not detailed in the Specification, comply with the relevant CIBSE Guide.

Provide calculations for each installation to demonstrate that the required criteria has been satisfied.

Lighting schemes to be agreed by the Services Consulting Engineer prior to implementation.

The Detailed Design to be based on the luminaires detailed in the preferred manufacturer's list.

The lighting installation to comply with the requirements of Building Regulations Document L2 with particular reference to the efficiency and energy usage of all lamps and luminaires.

Where luminaires from non-preferred suppliers or non-standard products are specified/proposed, samples of the proposed luminaires and lamps to be submitted for acceptance. Each sample to be labelled with the manufacturer's name and catalogue number and proposed location.

Discharge and ELV lamps to be fitted with glass covers to protect against ultra-violet emission and the risk of the lamps exploding.

Secondary safety support to be provided for diffusers, louvres and gear trays so that they are prevented from falling if their primary support should fail or is released.

Luminaires of similar types to have the same photometric performance.

8.0 VOICE AND DATA SYSTEM WIRING CONTAINING SYSTEMS

8.1 General

The Contractor shall provide cable tray and/or basket containment systems only for voice and data systems. These systems shall fully comply with the section of this Specification headed "Earthed Containing Systems".

8.2 Mains/ Data Segregation.

The data cabling shall be separated from mains voltage supplies as indicated in the following chart.

Under no circumstances shall data cables be installed in the vicinity of mains voltage greater than 400V.

Fluorescent lighting control gear and luminaires shall be kept to a minimum of 127 mm from adjacent data cables.

Care shall be taken to segregate High Frequency/ Medium Voltage signs from data cables.

8.3 Cable Containment.

The cabling containment design is the responsibility of the services designer.

The Contractor shall install all the containment from the wiring cabinet to the final outlet positions, as indicated on drawings.

The containment system shall consist of galvanised steel trunking, tray or basket and shall be complete and continuous. Conduit, flexible and rigid shall be used to connect outlet boxes to the containment trunking.

The containment sizes indicated on the drawings have been selected in accordance with the table included in the Appendices to allow for future expansion rather than simply reflecting initial requirements.

All bends, tees, flanges, etc. shall be gusseted and shall be manufactured by the manufacturer of the trunking. Site-made bends, tees, flanges, etc. will not be acceptable.

The trunking/ conduit system shall be mechanically and electrically continuous throughout its length.

The containment shall be effectively earthed as extraneous conductive parts. Where necessary, bonds and jumpers shall be used at joints and junctions to ensure continuity.

The Contractor shall be aware of the following maximum cable lengths, when installing the data cables. If it is impractical to respect the maximum cable lengths, the matter shall be referred to the IT Design Engineer immediately.

i) Main wiring cabinet to final wiring cabinet: 86m
ii) Any wiring cabinet to Data Outlet: 76m
iii) Data outlet to device: 15m

The above figures refer to containment lengths from cabinet to cabinet. In assessing maximum cable lengths, a 2m tail has been allowed for dressing at each end of the cable.

All rough edges, swarf, burrs and waste shall be removed, and the conduits shall be 'pulled through' before any cables are installed.

Where a trunking or conduit passes through a fire barrier, the barrier shall be reinstated to the satisfaction of the Engineer. A fire barrier shall also be installed inside the trunking by the Contractor where required.

Trunking covers shall be secured using turnbuckle fasteners, which shall be within 100mm either side of a cover joint.

Fixed covers shall be used where a trunking penetrates a wall or floor slab. The fixed cover shall extend 80mm from a wall and 150mm from a floor slab.

Where trunking is installed with the cover bottom-most, cable retainers shall be provided at 1m intervals.

Where trunking enters a cabinet, a flanged coupling shall be used.

Inspection bends and tees shall not be used on conduits. Inspection boxes shall be provided at 10m intervals on rigid conduit and 5m intervals on flexible conduit.

The inspection boxes shall be located and aligned to give access for installation and maintenance.

No more than the equivalent of 180 degrees of bend shall be allowed in rigid conduit between access or inspection points.

The maximum length of a run of flexible conduit shall be 8m.

A draw-wire shall be left in each conduit and trunking, installed and provided by the Contractor to assist in the later installation of the cabling.

The specialist data contractor shall leave a spare draw wire within the wireway trunking system for future cable installations.

The Contractor shall be responsible for securing all cable retainers, covers and box lids after the cables have been installed.

Where a conduit runs behind a fascia board to an outlet box, the conduit shall terminate in a flush-mounted box 35mm deep in the fascia board.

The structured cabling may share the same containment as other data cables.

8.4 Final Data Outlets.

8.4.1 General Requirements

The Contractor shall install outlet boxes in the locations indicated on the drawings.

The outlet boxes shall either be standard single or twin flush back boxes or special ceiling boxes, as indicated

The flush back boxes shall be 35M deep MK type 866ZIC (single) or (twin), suitable for use with the Logic Plus range of face plates.

Where the back boxes are to be surface mounted, these shall also be from the MK K Range, K2211 single, K2212 double.

The Specialist Wiring Contractor shall mount the indicated face plates when terminating the data cables.

The outlets are designed to be of two types, double, or quad.

The connections between the trunking system and the outlet boxes shall be made using rigid or flexible conduit.

The method of installation of the data outlets shall be as described in the following sections, and as indicated on the drawings.

8.4.2 Earthing

The Contractor is to check the earthing and bonding of all metalwork and complete a test certificate.

The Contractor shall be responsible for advising the Main Contractor and the equipment installing contractor if the earthing and bonding of all metalwork is inadequate, for rectification.

The Contractor is responsible for ensuring that all equipment is suitably earthed and MUST now allow any other trades to connect to a power supply without testing the podia or furniture installation.

8.4.3 Outlets within a Ceiling Void

Where the ceiling is of Plasterboard construction the cables should be terminated adjacent to a ceiling access hatch not more than 3m from the IT equipment position.

Where the ceiling is a composite of plasterboard and ares of lift out tiles the outlets should be installed at a position where they can be accessed from the lift out tile area not more than 3m from the till pole or other IT equipment.

9.0 EMERGENCY LIGHTING INSTALLATION

9.1 General

A system of emergency lighting shall be installed throughout the building. This system shall be installed in full compliance with BS 5266: Part 1.

The system shall comprise of self-contained, maintained and non-maintained type units used for the general illumination and self contained, maintained and non-maintained exit luminaires. Each type of luminaire shall operate in the event of local lighting final sub-circuit failures.

On completion of works, the contractor shall fully test the operation of the emergency lighting system and mark on as-fitted drawings the light levels at floor level with a 2 m grid arrangement. This test shall be undertaken with no light spillage to the area being tested.

From exhaustion, each unit shall be arranged to re-charge on restoration of the mains supply, within a period of 24 hours and thereafter operate for a minimum of three hours.

Where applicable, luminaires shall comply fully with the requirements of the section of this Specification headed "Luminaires and Lamps" and all metal housings shall have the provision for the connection and earthing of conduits as required under the section headed "Earthed Containing Systems"

All emergency packs shall be provided by a single manufacturer. No other manufacturer's equipment shall be used unless approved by the Engineer in writing.

Exit and emergency exit signage shall be provided as each location dictates.

9.2 Self Contained (Non-Maintained)Exit Luminaires

Shall comprise a stove enamelled zinc coated sheet steel or chrome plated housing and comply with BS EN 60598 and ICEL 1001.2.

Contained with the housing or base, a sealed nickel cadmium battery, constant current charger, silicon transistor inverter, and a solid-state changeover circuit shall be mounted on a hinged gear tray fitted with an 8 watt fluorescent lamp. The gear tray shall also be fitted with an LED indicator visible from underneath.

The emergency pack shall be rated to have a serviceable life of at least 5 years. All emergency packs shall be date labelled when installed.

9.3 Self Contained (Maintained) Exit Luminaires

Shall comprise a stove enamelled zinc coated sheet steel or chrome plated housing and comply with BS EN 60598 and ICEL 1001.2.

Contained with the housing or base, a sealed nickel cadmium battery, constant current charger, silicon transistor inverter, and a solid-state changeover circuit shall be mounted on a hinged gear tray fitted with an 8 watt fluorescent lamp. The gear tray shall also be fitted with an LED indicator visible from underneath.

The emergency pack shall be rated to have a serviceable life of at least 5 years. All emergency packs shall be date labelled when installed.

9.4 Self Contained (Non-Maintained) General Luminaires

Shall comprise of integral or remote (within 1 meter of luminaire). The emergency pack shall fully comply with ICEL 1004, BS EN 60598, BS EN 60924/925, and be complete with a sealed nickel cadmium battery, constant current charger, silicon transistor inverter and a solid-state changeover circuit.

Emergency pack shall be capable of operating a single lamp of the luminaire for a minimum period of 3 hours under conditions of local circuit failure.

The emergency pack shall be rated to have a serviceable life of at least 5 years. All emergency packs shall be labelled when installed and when shall be replaced.

9.5 Self Contained (Maintained) General Luminaires

Shall comprise of integral or remote (within 1 meter of luminaire). The emergency pack shall fully comply with ICEL 1004, BS EN 60598, BS EN 60924/925, and be complete with a sealed nickel cadmium battery, constant current charger, silicon transistor inverter and a solid-state changeover circuit.

Emergency pack shall be capable of operating a single lamp of the luminaire for a minimum period of 3 hours under conditions of local circuit failure.

The emergency pack shall be rated to have a serviceable life of at least 5 years. All emergency packs shall be date labelled when installed.

10.0 AUTOMATIC LIGHTING MANAGEMENT CONTROL SYSTEM

10.1 General

The contractor is invited to submit proposals for the automatic lighting management control system.

11.0 PUBLIC ADDRESS SYSTEM

11.1 General

A public address system shall be supplied, installed, tested and commissioned comprising the following:-

a) Floor standing purpose made cabinet incorporating public address amplifiers, tone generator equipment, system fault monitoring facilities and indicators.

b) Master control unit, multi-zone programmed to be activated by individual push buttons for each zone or by a single master button to serve all zones.

c) 3 hour battery unit to provide standby power in the event of a mains failure.

d) A free-standing goose neck microphone.

e) Public address speakers.

The master control, amplifier unit and the battery power unit shall be suitable for 19 inch rack mounting.

The public address control panel shall be provided in a sheet steel enclosure finished in an acrylic colour to be agreed prior to manufacture. The front shall incorporate high glazed hinged lockable doors. The amplifying equipment shall be sized to power all speakers plus additional capacity for future requirements of 25%. All amplifiers shall be of one type and one output rating.

The public address system shall be provided with a desk console and microphone station of finish to be agreed. Sound control switches shall be push-to-illuminate type.

Public address loudspeakers shall be provided and shall comprise horn or steel cabinet type loudspeaker within plant rooms, stores, etc. Loudspeakers shall be 10 watt with transformer tappings at 7.5, 4, 2 and 1 W. Stirrup mounting brackets shall be provided for each speaker. Final connection of cabling to speakers shall be via a local surface mounted conduit outlet boxes with compressions gland connections and final connection via PVC/PVC flexible multi-core cables to each loudspeaker.

Flush mounted fully recessed loudspeakers shall be provided to all offices, rooms, toilet and circulation areas. Surface mounting for plant areas. Loudspeakers shall be provided with white enable bezel and baffle. Loudspeakers shall be 6watt with transformer tappings at 3, 2, 1 and 1/2 W with the frequency response in the region of 110 to 12,000 Hz. Final connection as for cabinet type loudspeakers.

Full allowance shall be made to adjust the loudspeaker tappings during the testing and commissioning stage to ensure adequate audibility in all areas. The system shall be fully tested and commissioned by the equipment manufacturer with a full demonstration of operation being provided to the Client.

12.0 WIRING ASSOCIATED WITH MECHANICAL SERVICES

12.1 General

All electrical supply and control wiring associated with Mechanical Services shall be carried out by the Electrical Contractor with low smoke cable enclosed in conduit and trunking containing systems and clipped to cable trays and shall require to comply fully with the Parts of this Specification headed "Wiring Systems" and "Earthed Containing Systems".

Low voltage screened cabling shall be run on dedicated cable tray containing systems with conduit connections from the cable tray to a convenient position local to the item being served.

Conduits shall be run between trunking/cable trays local to diverting and mixing valves, immersion thermostats and all terminal boxes, etc., conduit shall terminate a convenient position with a standard circular MI conduit box containing a block connector having not less than two brass pinching screws per terminal, into which shall terminate the final circuit wiring. Interconnections between the connector block and the various units shall be carried out in high temperature heat resistant single silicone rubber insulated flexible cables run in a 600 mm length of watertight flexible conduit. After connectoion of final circuit wiring and flexible interconnecting wiring, the porcelain connector shall be wrapped in pure rubber or equal insulating tape, and thereafter black adhesive tape.

The Electrical Contractor shall fit Critchely type identification markers to all cables and make the final cable connections to all items of Plant and Remote Control Equipment.

The Electrical Contractor shall install, test and loom cables to the termination section of the main mechanical services control panel, however final terminations and commissioning of the system shall be the responsibility of the Specialist Controls Sub-Contractor.

The Electrical Contractor shall be responsible for taking delivery of, erecting and connecting all sensors, thermostats, fan speed controllers, etc. i.e. all control equipment which is not fitted on to a section of pipe work or ductwork. This including the control panels, at which all final connections shall be made.

After appointment the Electrical Contractor shall liaise with the Mechanical Services Control System Specialist Contractor to determine exact positions, schematic details, etc. of all mechanical control items including cable types, current rating of isolators and number of poles of isolators.

The control wiring and system shall then be installed, to the Specialist Contractors details, after approval of the drawings by the Engineer.

On approval the Specialist Sub-Contractors drawings shall become construction issue and shall supersede all Tender issue mechanical control drawings.

13.0 UNINTERRUPTABLE POWER SUPPLY SYSTEM

13.1 General

The UPS system shall be supplied from the essential element of the main electrical switchboard associated with the building using a XLPE insulated, steel wire armoured, LSF sheathed cable with copper conductors or adequate size. The system shall incorporate adequate termination facilities to accept the cable.

The UPS shall comprise a single module of standard manufacture complete with inverter, rectifier/charger and static by-pass switch. The UPS system shall have a continuous rating providing a continuous clean AC power supply in a highly reliable manner regardless of transients, disruptions and interruptions of primary supply. The system shall be suitable for operation at temperatures between 10^{o} C and 35^{o} C ambient within the room where it is to be located. Batteries shall be of the sealed lead acid type, rated to provide the standby duration stated in the Design Brief.

All materials and parts, comprising the UPS shall be new, of current manufacture, of a high grade and free from all known defects and imperfections. No components shall have been in prior service, except as necessary for factory testing. All active semi-conductor devices shall be solid steel and hermetically sealed, and all relays shall be dust tight.

The UPS module shall be constructed from no less than 1.5 mm thick sheet steel plate and arranged in a floor standing cubicle, with hinged lockable access doors, constructed on a rigid base frame. Cabling shall be top entry, with gland plates provided as necessary. Adequate ventilation shall be provided to ensure that all components operate within their environment ratings. Acoustic noise shall not exceed 75 dB(A) 1 metre from the UPS and RF interference suppression shall comply with BS EN 55014. The module shall be finished in a colour to be agreed.

Upon failure of the primary AC supply, input power for the inverter shall be automatically supplied from the battery bank with no interruption to or disturbance of inverter outputs in excess of the requirements of the specification. At the same time, the UPS shall energise an alarm circuit and associated fault indicators.

When the AC power is restored, input power for the inverter unit and for recharging the battery bank shall automatically be supplied from the rectifier/charger output, without interruption or disturbance in excess of the limits of the specification.

The rectifier/charger shall be totally solid-state and provide direct current to the inverter unit and to the battery.

Start-up and shut-down controls shall be provided within the module. The rectifier/charger shall accept input voltage over a range of $\pm$ 10% from nominal voltage and with frequencies between $\pm$ 5% from nominal frequency. Line filters shall be provided to the UPS input to eliminate harmonic currents of order 13 and below.

The input rectifier/charger shall provide for input current limiting whereby the UPS module shall draw only sufficient power to drive the critical load with an additional pre-set maximum power level to recharge the battery.

When the mains is restored following an outage the UPS input modules shall initially draw no power except for transformer inrush current. Over a period of approximately 15 seconds ('walk-in' time) the input power requirement shall rise to a level dictated by the power required to drive the critical load and the additional pre-set power to recharge the batteries.

In addition to supplying power for the load, the rectifier/charger shall charge the battery at a sufficient rate to restore the battery from discharge to 95% charge within ten times the discharge period. Changing current shall be voltage regulated and current limited. After the battery is

recharged, the rectifier/charger shall maintain the battery at full charge until the next emergency operation. Batteries shall be of the heavy duty, industrial type and enclosed within a steel floor mounting cubicle style enclosures with all intercell connectors and insulators and power cabling. The battery enclosure shall be suitably enclosed with Perspex to prevent accidental or unauthorised access. A battery circuit breaker shall be provided, wall mounted, with protection by under voltage and thermal trips and suitable for on-load connection and disconnection.

The inverter shall be a solid-state device capable of accepting the output of the rectifier/charger or emergency battery and provided a sinusoidal alternating current output. PWM controlled inverters shall be used for this purpose. The outputs of the inverter switching units shall be summed together by means of a transformer network and then passed through a 3 phase filter to the output terminals.

The UPS shall supply 120% of rated power for 10 minutes and maintain full output voltage when supplying up to 150% of rated power. Above 150% of full output power the UPS module output voltage shall be progressively reduced to prevent the total load current exceeding 150% of the rated figure.

The UPS module shall have built-in self protection against:-

a) Over and under voltage power line surges.

b) Over voltage and voltage surges introduced at the output terminals by paralleled sources.

c) Load switching and circuit breaker operation in the distribution system.

d) Sudden changes in the output load.

The UPS shall be fitted with an integral control and indicating panel. All of the instrumentation alarms and indicators showing the operation of the UPS shall be mounted on this panel.

The system shall be equipped with a static by-pass switch. This switch shall instantaneously allow the uninterrupted transfer to the by-pass supply shall a total UPS system malfunction occurs.

In the event of the load current exceeding 150% of the rated output current facilities shall be incorporated to pulse the static by-pass switch, thus providing sufficient energy from the by-pass source to load sub-circuit faults whilst maintaining UPS power

All power semi-conductors shall be fused to prevent cascades of sequential semi-conductor failures. Indication of blown fuse conditions shall be readily observable by the operator without removing panels or opening of the cabinet doors. Insulated matting shall be provided at the front of the UPS covering the full width of the UPS module.

The UPS shall be fully tested at the manufacturers works in accordance with an agreed schedule of testing, which shall be submitted to the Engineer in advance of the test date.

The Engineer's and Client's representatives reserves the right to witness factory tests, at the expense of the Contractor, and requires a minimum of 14 days prior notice to be given.

A complete set of test certificates showing all readings shall be submitted to the Services Engineer prior to despatch.

A maintenance bypass switch suitably rated shall be provided to allow full bypass of the UPS installation for maintenance purposes.

The UPS equipment shall be provided with auxiliary contacts capable of BMS connection for fault monitoring.

On site a full battery discharge test shall be conducted and witnessed by the Engineer. The test shall be for the full duration time of the required standby period at full load using a suitable load bank. This test shall be conducted with the room containing the UPS at normal operating temperature range.

14.0 STAND-BY GENERATOR

14.1 General

The generator installation shall be undertaken by a specialist manufacturer. The installation shall comprise the supply, delivery, off loading, erection, connection, testing and commissioning of diesel standby generation plant. The generator shall be delivered to site fully works tested.

Mains failure shall be sensed by phase failure relays, sensing all phases of the incoming services on the main switchboard. Failure of the supply shall initiate the automatic starting of the generator.

The generator shall commence the automatic shutdown procedure when all mains supplies have returned. Delay timers, set normally at 60 secs, shall ensure that they shutdown sequence is not commenced until mains supplies have returned for a continuous period of approximately 60 secs. After the changeover from generator supply to mains supply is completed, the generator shall continue to run off load, for a further five minutes (minimum) for cooling purposes, and then automatically revert to standby mode.

The generating set shall fully comply with all relevant British Standards and the IEE Wiring Regulations. The generating set shall be suitable for supplying non-linear loads, which shall comprise 70% of the total load on the set. Typical values of the harmonic components of the non-linear loads are as follows:

Harmonic	Theoretical Maximum Amplitude	Typical Amplitude
Fundamental	100%	100%
3	33%	-
5	20%	19%
7	14%	10%
9	11%	-
11	9%	6%
13	8%	5%
15	7%	-
17	6%	3%
19	5%	2%

The standby generator set shall be of standard manufacturer with a diesel prime mover, arranged for automatic mains failure starting. The generating plant shall comprise a brushless alternator coupled to a diesel engine, providing a continuous running electrical output of 415 volts, 3 phase, 50 Hz, at 0.8 power factor, at 1500 rpm 'A' rating, in accordance with BS 5514. The set shall also have capacity to give 10% overload for one hour in any period of 8 hours consecutive running.

The generator set shall be finished with primer, undercoat and two coats of gloss to a BS 4800 colour to be agreed.

The diesel engine shall be water-cooled, turbo-charged with after cooling, four stroke cycle and be of proven reliability with high standards of manufacture.

The fuel system shall be of the direct injection type. Full flow replaceable fuel filters and a fuel solenoid shall be fitted.

The engine shall have separate head units to permit servicing individual cylinders without destroying seals on adjacent cylinders.

The engine shall be fitted with a precision electronic governor to provide speed regulation within class A1 limits of BS 5514, providing the facility for variable droop. The engine and alternator shall be supplied complete with heaters to maintain the set ready for load acceptance immediately after start up.

The engine shall be supplied complete with lubricating oil top-up system suitable for continuous and full load operation of the set for seven days.

The engine shall be capable of accepting the first 65% of the total rated capacity in one step.

The alternator shall be a conventional brushless design having a rotating field main generator with an AC exciter and full wave bridge rectifier assembly, constructed in accordance with BS 5000. The alternator shall include permanent magnet initiated exciter windings and detachable solid-state automatic voltage regulator.

The alternator enclosure shall be screen protected and drip proof, to a minimum IEC 144 IP21 rating. Insulation shall be class H for the rotor and stator, fully impregnated with oil and water resistant finishing varnish.

The alternator voltage regulation shall be within +2% of nominal, from no load to full load with power factor between 0.8 and unity including cold to hot variations. The alternator shall be such that the normal transient voltage dip on full load shall be 17% maximum, with recovery to 3% within 300 ms.

The temperature rise during operation shall be in accordance with BS 4999 for the appropriate insulation class. Radio interference from the alternator shall be in accordance with BS EN 55014.
A large terminal box shall be provided, welded to the frame of the alternator, incorporating suitably rated load output terminals and output cable gland plate. Both ends of each phase shall be brought out and the neutral ends connected in star formation and connection to earth via a neutral link.

Short circuit overloads of 300% full load current shall be sustained for a minimum of 5 seconds prior to operation of generator protection equipment.

The engine and alternator shall be coupled together, using a suitable flexible coupling and flywheel housing, to form a robust monobloc unit. A four point lifting arrangement with built in lifting eyes shall be incorporated.

The combined engine/alternator unit shall be rigidly attached to a main frame and anti-vibration mountings shall be installed between the main frame and the floor slab or base,

Starting of the engine shall be by a starter motor driven by 24V DC, heavy duty, lead acid batteries. Charging of the batteries shall be a fully automatic plug-in modular constant potential low rate charger, powered from the mains supply, which keeps the battery fully charged when the set is not running.

The battery capacity shall be adequate to give three consecutive starts at 0^{o} C when in a 20% discharged condition based on a 10 second crank with a 10 second rest between each start attempt before locking out on a fail to start situation. Suitable battery leads and lugs shall be supplied and installed. Additionally, the electronic constant potential charger shall be duplicated by an engine driven charger to provide maximum reliability of starting.

The daily service fuel tank (which shall be provided as an integral part of the generator base), including supply and installation of fuel feed and spill return connections to the engine shall be included. Heavy weight mild steel piping shall be installed with the final engine connections made in flexible piping. Fuel level probes shall be supplied and installed in the daily service tank to give high and low level indication and transfer pump control signals. The generator control panel shall incorporate high and low level fuel indication, a fuel level gauge and pump control contacts.

A fuel valve shall be installed within the fuel feed system, which shall shut off the fuel to the generator in the event of a fire alarm within the generator housing.

Exhaust silencers shall be provided complete with support brackets, expansion bellows and insulation.

The generator control panel shall be modular type house in a fabricated steel floor mounted cubicle to IP31 adjacent to the generator set. The panels shall be a pre-wired package unit, with hinged lockable front access doors. The panel shall be finished with a polyester powder coating of a colour to match the generator set. An insulated rubber mat shall be provided in front of the control cubicle.

The control system shall be arranged for remote start signal operation. The control panel shall contain contacts to provide alarms in remote locations. All control cabling shall be colour coded throughout and flagged with numbered cable markers, at all terminations. All wiring shall be flexible HOFR insulated, impervious to the action of water, fuel and lubricating oil. A fully detailed circuit wiring diagram shall be provided, prior to manufacturer. All auxiliary fuses shall be to BS 88.

The control system shall be suitable for operation in ambient temperatures ranging from –10^{o} C to 50^{o} C. Illuminated push button controls/indicators shall be provided and connected via flexible bus wiring to integrated circuit technology module cards. All the module cards shall plug into a 'mother' board and be easily removable for service or replacement.

The following minimum instrumentation shall be provided for each generator. These instruments shall have a minimum of 76 mm scale, pivot less movement and an industrial grade performance of BS 89, IEC 51:

a) Voltmeter with 6-way and off switch giving generator phase to phase and phase to neutral voltages.

b) Frequency meter.

c) 1 No. line ammeter.

d) kW meter. For multiple generator control panels a total generated kW meter shall also be provided.

e) Battery voltmeter.

f) Hours run meter (Digital)

The control, instrumentation, and indication current transformers (CT's) shall be mounted in the generator control panel.

Commissioning of the complete generator installation shall be carried out by a specialist company.

The following digital timers shall be incorporated in the generator control panel:-

a) Multi-attempt to engage starter timer

b) Multi-attempt to start timer

c) Start failure timer

d) Mains failure timer

e) Warm up timer

f) Protection hold off timer

g) Mains return timer.

h) Run-on timer

Illuminated controls/indicators shall be provided for the following functions:-

a) Stop control. Mushroom head, twist to release

b) Manual stop and start control

c) Off-Manual-Automatic duty selector switch

d) Alarm reset (press to reset)

e) Lamp test

f) Start failure indicators

g) Low oil pressure indicator

h) High temperature indicator

i) Battery low voltage

j) Low fuel level alarm

The Engineer shall witness works tests at the expense of this Contract, and shall be given a minimum of 10 working days prior notice of such tests being carried out. A complete set of Test Certificates showing all readings shall be submitted to the Engineer prior to the generator leaving the works.

The Engineer shall be given a minimum of 10 working days notice of any tests on site being carried out.
At practical completion, a framed glazed circuit diagram shall be hung on the wall of the generator enclosure.

A full set of tools and two copies of circuit diagrams, general arrangement drawings, operating and maintenance manuals shall be provided.

A full list of the recommendations for spares shall be submitted to the Engineer prior to delivery to site.

The following tests shall as a minimum be demonstrated to the Engineer:-

a) Ensure that the plant is built in accordance with the Manufacturing Schedule and all drawings referred to therein. Any deviations shall be referred to the Engineer and either corrected, or the relevant schedule section(s) and/or drawings amended accordingly.

b) Ensure that the plant is reasonably level.

c) Ensure that the exhaust system is correctly assembled and connected, using suitably flexible exhaust pipe sections and correctly sized silencer.

d) All oil, water (water-cooled sets), air and fuel pressure switched, temperature switches shall be removed, checked for calibration and setting and then replaced in their appropriate positions. All pipe work shall be checked for completeness in accordance with the relevant drawings and all joints checked for tightness.

e) Consumables of the correct grades shall be inserted, lubricating oil for the sump and where necessary for the governor. Coolant water on water-cooled sets for engine block and radiator. Oil and where appropriate water levels, shall be checked and corrected if necessary, and leaks or air

blocks shall be located and corrected. The fuel oil supply and spill lines shall be connected and turned on, any leaks or air locks shall be located and corrected. Once supplied with fuel, the engine system shall be vented to free any trapped air.

f) All electrical connections, including temporary test cable on the plant or between the plant and switchboard and/or switchgear shall be of adequate current and voltage rating. They shall also be checked for continuity and correct polarity. All live connections shall be protected to prevent danger from electric shock.

g) The alternator neutral, bed plate frame and associated control panel shall be adequately bonded at one point inside the control panel and suitably connected to the factory earth point using earthing cable of correct size and rating.

Pre-Starting Tests

a) A suitably charged battery and adequate battery charger shall be available to power all DC circuits. This DC supply shall be connected only after preliminary tests, prior to the commencement of static functional tests.

b) All protective devices and circuits shall be statically checked and tested when the DC supply is connected. The tests are carried out by simulation to ensure correct operation.

c) Where possible, all auxiliary equipment necessary for correct running, shall be electrically supplied from the set output, using contract switchgear and starters. This equipment shall be checked and tested for correct operation. When fitted, all fuel make-up transfer pumps, water make-up and lubricating oil make-up equipment shall also be checked for correct operation.

d) Insulation resistance tests shall be carried out on the plant and control panel main poles and carried out as follows:-

i) Isolate sensitive equipment from the main poles of the alternator and control panel.

ii) Open any neutral earthing links.

iii) Use 1000 volt insulation tester and check resistance is a minimum of 50 Mega-ohms.

Between load terminals and plant structure.

Between mains input and plant structure and between alternator terminals and plant structure.

All insulation resistance values shall be recorded on test card. Reconnect sensitive equipment and neutral earthing links.

Functional Tests

With the set running at normal speed and voltage and at no-load, tests shall be made by simulation to check the function and circuit operation of all warning and shutdown protective devices and their associated alarms. A record shall be made of all trip settings, all adjustable timer settings and all high and low level monitoring settings. Voltage and speed controls shall be checked for correct operation and their maximum and minimum range of adjustment shall be recorded.

Load Duration Test

The load test shall be carried out at 100% full load in accordance with BS 5514. All site ratings given are by using de rate requirements in accordance with BS 5514 except where specified engine manufacturers parameters are used. The set shall be run and load applied and increased to 100% as soon as possible and maintained for a two hour period. Immediately after this the load shall be further increased to 110% for a period of one hour.

Readings shall be taken and recorded every 30 minutes.

Load Test Data

- Load percentage
- Load kilowatts
- Voltage
- Current
- Power factor
- Frequency
- Lubricating oil pressure
- Lubricating oil temperature
- Water temperature
- Ambient temperature
- Alternator air temperature IN and OUT

Check the fuel consumption, during the load tests. Fuel consumption checks shall be carried out at 100% load and at 110% load and recorded on the appropriate test sheet.

Regulation and Governing

Immediately after the 110% load duration test, the load shall be reduced to 100% and the following procedure carried out, recording on the test card the steady state values of load, voltage, frequency and speed:-

- 100% full load
- 110% full load
- 100% full load
- 75% full load
- 50% full load
- 25% full load
- No load

Standard Governing Temporary Change Test

a) A record shall be made on the test sheet of the maximum and minimum transient excursions of the voltage, frequency and speed during a load change. The value of the percentage load at which this test is carried out is in accordance with BS 5514/ISO 3046 IV as a function of BMEP at declared power and standard reference conditions as to the maximum load that can be applied suddenly to the engine whilst running at full speed, with no load and at normal operating temperatures.

b) Removal of rated load shall result in transient frequency change not exceeding 15% recovering to 5% change within 15 seconds.

c) Application or rejection of engine manufacturer's recommended maximum step load up to 60% of rated load, shall result in a transient frequency change not exceeding 10% recovering to 3 % change within 10 seconds.

d) Application of removal of any step load of 25% rated load shall result in a transient frequency change not exceeding 4% recovering to 1.5% change within 15 seconds.

It shall be observed that the steady-state speed band does not exceed 1% of rated speed.

The test card shall be signed by the Test Engineer responsible for the tests in the presence of the Witnessing Engineer.

Functional tests on site shall include, but not be restricted to the following:-

Site Functional Test

a) With the generator running at normal speed and voltage, but not on load, tests shall be made by simulation to check the function and circuit operation of all shutdown and warning protective devices and their associated indicators and alarms.

b) As all the protection devices have been pre-set during the works testing programme, the functional tests are carried out as part of the commissioning to confirm that the settings or adjustments are still within specification.

c) The following recordings shall be made of the settings of any adjustable devices:-

- Engine high temperature protection

- Engine low temperature protection

- Battery charger 'float' voltage

- Phase rotation of the alternator (pre-checked against the site requirements)

- Timers, standard or non-standard

- Voltage sensing units, standard or non-standard

Site Load Duration Tests

a) Once the functional tests have been completed the generator shall be tested on load utilising dummy loads or the site load if available.

b) The site load, where practical, shall be applied to the generator, ensuring that it is within the generator's capability as indicated by BS 5514, taking into account any de rate and/or power factor involved.

c) If a derate shall apply, affecting the performance of the generator, it shall be noted on the Commission Report.

d) The duration of the load test shall be as for the Works Test Programme.

e) If for some reason the recommended test duration cannot be achieved, the generator shall be run for a minimum duration so as to achieve stable operating temperatures and pressures. If the available load does not total at least 25% of the full capacity of the generator, the duration of the test shall not exceed 10 minutes.

f) If the loading between the phases cannot be balanced within 30% between any two phases, assuming that no phase exceeds the nominal maximum continuous rating, the Load Duration Test shall still be performed.

g) Recordings shall be taken and entered on the Commission Report during the load test.

h) The intervals that the readings are taken is dependant on the duration of the load run:-

1 hour test duration - every 15 minutes

2 hour test duration - every 30 minutes

3 hour test duration - every 60 minutes

i) The following readings are taken and recorded on the Commission Report at the recommended intervals:-

- Time
- Load, percentage of full load
- Load, kilowatts
- Load, kVA

- Voltage, phase to neutral
- Current, all three phases
- Power factor
- Frequency
- RPM, engine
- Oil pressure, engine lubricating
- Ambient temperature
- Water temperature, engine
- Oil temperature, engine, where applicable
- Hours run counter

Acoustic Enclosure

The general arrangement of the generator and acoustic enclosure shall be such that all of the equipment can be incorporated within it with adequate access for maintenance.

The enclosure shall be suitable for external duty, with acoustic walls and roof fixed to a flat bed floor. The canopy shall be of the one-piece drop over type, to be securely bolted to the bed after erection.

The bed shall form part of the acoustic enclosure and shall be provided by the enclosure manufacturer. The bed shall be formed for RHS steel with steel chequered flooring and be designed and constructed to contain oil spillages up to a total of 300 litres. Anti vibration mountings shall be provided and be of the type that can be permanently bolted to the bed framework and building structure.

Inlet and exhaust air attenuators, plus the exhaust silencers shall be mounted within the acoustic enclosure to give a neat external appearance. Exhaust silencers shall be thermally treated to prevent high surface temperatures. The generator exhaust systems shall be designed in conjunction with the specialist manufacturers, to achieve the design requirements and performance criteria.

The exhaust shall be fitted with adequate rain protection at its discharge point.

15.0 INTRUDER ALARM SYSTEM

15.1 General

The specialist Intruder Alarm contractor shall allow within their tender submission, for a half a day training, to be programmed by the contractor in agreement with the client.

Upon completion of works, the supplier shall be responsible for providing a copy of the as installed drawing (AutoCAD release 2000) on disk.

The specialist Intruder Alarm contractor shall provide a fully functional demonstration of the system during out of trading hours.

15.2 Intruder Alarm System

All equipment, wiring and accessories shall be supplied, installed and commissioned by the Specialist Contractor.

The system shall be fully compliant with BS 4737 and all NACOSS requirements.

The intruder alarm system shall detect unauthorised entry into the building by means of passive infra-red detectors, glass break detectors and the monitoring of door contacts.

In the event of an alarm condition external electronic sounders (2 no.) shall operate and a signal shall automatically be sent to a remote manned centre via a British Telecom telephone line using digital dialling equipment.

The system shall consist of a main control panel remote keypad (located within entrance area), passive infra-red detector (located within entrance area), door contacts located on each escape stair's final exit doors) and electronic sounders (located at high level on each of the building's gable ends).

The entrance area's remote keypad shall provide full control of the system and shall be the main means of setting and re-setting the system.

The intruder alarm system to provide protection to the car park, building perimeter, entrance area etc.

15.3 Main Control Panel

The intruder alarm system's main control panel shall be microprocessor based and shall provide the following facilities:

- Internal zone alarm indicator

- Monitoring of detector wiring, mains supply, vital circuit, battery and detector faults and induction

- The programming of detectors on a ‘time of day’ basis in "secure" or “access" mode

- The programming of the final entry/exit route

- Signalling to a remote manned centre

- Current drives for 2 no. external sounders, 2 no. strobe lights, 2 no. sounder battery chargers and internal sounders

- Time delay on operation of sounders following an alarm condition, adjustable between instantaneous and 10 minutes

- Re-setting of alarms from all zones and silencing alarm sounders

- Detectors placed in the "access" mode shall not instigate an alarm condition

- Detectors placed in the "secure" mode shall, on operation, instigate and alarm condition and operate the alarm sounders and remote alarm signal

- The final entry/exit route shall have two stage entry timing system to minimise false alarms. The designated/entry door contact shall activate the system

- The system shall operate on a "report by exception" principle to minimise false alarms and system reports

- The system control panel to be fully addressable panel sited within the communications room, or an alternative secure location.

- Tamper circuits and connections to be connected and Monitored Line.

- The panel to be fitted with up to 63 x 8 remote input output modules (RIOs) or RIOs with power supply (smart power supply unit), giving a maximum 504 zones.

- Addressable outputs of 4 to 256 may be provided.

- Remote input and output devices to be connected to a maximum 4 x RS485 data communication lines (1, 2, 3 & 4), each not to exceed 1km in length. These units to be located in the vicinity of the alarm devices and grouped where possible.

- A printer interface and telecom module to be provided and connected to line 1.

15.3.1 Setting Options

The system to be configured to provide the following 'set' options:

a) Full set.
b) Part set to suit occupancy.

15.3.2 Power Packs

The Contractor to determine the system power requirement and provision of smart power supply units.

An additional 15% of duty capacity to be allowed for and provided in each power supply unit.

All PSUs to be located within the protected zone to be inaccessible and 'out of view' to customers.

15.4 Remote Key Pad Controller

This unit shall be wall mounted and provide full system control functions.

An alpha-numeric LCD display shall be integral to the key pad.

Remote keypad for engineer access to be located at the panel

A 15 number Key Fob setting/ unsetting devices shall be handed to the hotel manager.

15.5 Door Contacts

Door contacts shall be magnetic reed switches or similar recessed into the door frame with the operating magnet recessed into the door (preferred location is on the head at the opening edge).

All doors to be fitted with flush door contacts where practicable.

Security shutters and roller shutter doors are to be fitted with heavy duty surface mounted contacts.

Door contacts to be as follows:
a) Flush type utilising 'normally closed' circuit contacts.
b) Surface type may be used where 'flush' fitting is not appropriate.
c) Heavy duty surface type for roller shutter doors and folding doors.
d) No interior doors to be grouped with exterior doors on the same circuit.
e) Single door or pairs of doors to be wired on the same circuit.
f) Magnetic contacts to be installed 200mm from opening edge

15.6 Detectors

15.6.1 Passive Infra-red Detectors

The sensors shall incorporate a walk past test facility, which shall indicate via a flashing LED and shall incorporate self-check and anti-masking facilities.

A combination of both radiation detection and movement detection within a present time shall result in an alarm condition.

Sensors shall be selected to provide long range protection for corridors and aisles, or volume protection for rooms to suit the application.

All passive infra red detectors (PIRs) to be positioned to ensure they are not activated by air curtains, or air conditioning outlets etc.

All external doors are to be programmed for 24 hour operation and fitted with a local day alarm

The location reference given to each door contact and PIR etc. to be agreed with the appointed person by the client prior to programming.

The agreed text description to be programmed on the main panel.

The type of PIR appropriate for the task to be determined given the following criteria and facilities:
a) Detection range.
b) Protection pattern.
c) Creep zone.
d) Environmental conditions (air movement, light, heat, reflective surfaces, etc.)
e) Insect guard.
f) Adjustment where appropriate.
g) Temperature compensation.
h) Test facilities.
i) Tamper switch.
j) White light immunity where appropriate.
k) Mounting flexibility.

15.6.2 Dual Technology Detectors

The type of dual tech's appropriate for the task to be determined given the following criteria and facilities:
a) Detection range.
b) Protection pattern.
c) Creep zone.
d) Environmental conditions (air movement, light, heat, reflective surfaces, etc.)
e) Insect guard.
f) Adjustment.
g) Temperature compensation.
h) Test facilities.
i) Tamper switch.
j) White light immunity where appropriate.
k) Mounting flexibility.

15.6.2 Breakglass Detectors

The type of break glass detector appropriate for the task to be determined given the following criteria and facilities:

a) Detection range.
b) Coverage pattern.
c) Environmental conditions.
d) Performance through blinds and drapes, etc.
e) Thickness of glass.
f) Type of glass.
g) Insect guard.
h) Adjustment.
i) Temperature compensation.
j) Test facilities.
k) Tamper switch.
l) Mounting flexibility.

15.6.3 Other Detectors

Subject to the security assessment, other proprietary detector devices may be considered including, multi-beam infrared, microwave, volumetric and pressure type.

15.7 Alarm Sounders

The alarm sounder shall incorporate an electronic sounder, sensing circuits and a rechargeable battery unit within a substantial weatherproof enclosure (white).

They shall operate continuously on the occurrence of the following conditions:

- Security system alarm

- Open or short circuiting of the supply cable

- Attempted removal of the unit from its fixings

- Attempted removal of the protective case

- Interference with the mains, or battery standby power supplies to the main security system.

The operation of the alarm sounder circuit shall be delayed according to the setting of an adjustable timer within the control and indicator panel.

The alarm sounder shall automatically stop operating after 20 minutes to minimise nuisance.

The Contractor to supply and fit an external self-actuating sounder/strobe unit, aesthetically sited and at a location agreed to with the client.

The unit is to be located such that activation will be highlighted in the most prominent position to be detected by the public and/or the local police.

Advice regarding the operation of external sounder/ strobe units should be sought from the local Police Authority to ascertain their policy in respect of particular sounder activation delay, if applicable

Where multi-access and/ or remote areas may be identified as giving higher risk, it may be necessary to supply and fit additional self-actuating sounder/ strobe units or alternative 'dummy' sounders.

The security specialist contractor to supply and fit an internal sounder/ strobe unit to a location agreed to with the client.

The internal unit is normally installed such that activation will be highlighted in the most prominent position to be detected by an intruder or during 'part set' by the Client or his appointed representative.

15.8 Battery and Charger

The batteries shall be sealed non-gassing cells of the lead acid type, mounted with charger inside a lockable steel case, which itself shall be linked to the security system to detect interference.

The batteries shall be date stamped on installation and on every subsequent test date

The battery shall be capable of powering the complete system including alarm buzzers, etc. for a period of 72 hours minimum, following a mains power failure.

The charger shall be capable of powering the entire system and charging the battery from a completely discharged state within a period of 24 hours. It shall incorporate all necessary automatic boost, trickle or other charge facilities, fuses etc., to provide correct continuous operation of the system

It shall be acceptable to provide battery and charger units local to areas to be detected. These units shall be contained within secure cabinets with tamper detection. Any additional part supplies required shall be provided as part of this Contract.

15.9 Zones

The following detectors and input devices to be wired on individual circuits from the RIOs and have their own unique zone description programmed in text and available at each remote keypad:

a) Each PIR.
b) Each dual tech.
c) Each break glass detector.
d) Each door.
e) Each pair of doors.
f) Each 'other' detector device.
g) Each PA button.
h) Each exit terminator button.
i) Each day alarm unit.

15.10 Monitored Line

A Monitored Line line to be made available for communication of Monitored Line alarms to the Romec alarm receiving centre. The specialist contractor shall highlight the requirement for the line as soon as practical and at least 6 weeks before the system is due for commissioning.

15.11 Containing System for Security Wiring

The equipment and wiring shall be supplied and installed by the Specialist Contractor.

The Contractor shall supply and install and concealed or flushed conduit containing system outlet box and draw wires for use by the Specialist Sub-Contractor.

Wiring shall be flexible twin and multi-core LSF insulated cable, with conductor size suitable to ensure efficient operation of the system.

All wiring shall be run in galvanised earthed conduit containing systems.

15.12 Manned Centre Link

The transmission of alarm signals to the continually manned Security Centre shall be by means of dedicated BT / Eircom lines using digital dialling equipment.

15.13 Test and Commission

The complete security installation shall be tested and commissioned by the Security System Manufacturer to accord with agreed programme of work. The commissioning shall prove the operation of magnetic door contacts, bells and movement detectors along with functional tests of the control panels. When the commissioning is completed the system shall be demonstrated to the Employer. At handover all instruction manuals, test certificates and operating instructions shall be made available at the time.

15.14 Maintenance

As part of the invitation to tender the Installing Contractor shall have the necessary expertise and manpower to provide a complete maintenance service with a 8 hour maximum call out response time.

The Intruder Alarm System Contractor shall provide detailed maintenance specification for the installed equipment, which shall be in accordance with the equipment manufacturer's recommendations and shall take into account site conditions and operations.

The equipment shall be under warranty for the first year and the contractor shall include in the tender the service costs for the first year.

16.0 EARTHING AND BONDING

16.1 General

The earthing of the installation shall comply with the 17th Edition of the IEE Regulations for Electrical Installations.

Switchboards shall be provided with a fully rated copper-earth bar running the full length of the switchboard at the rear. The switchboard framework shall be bonded to the earth bar at a minimum of two points.

Wall mounted distribution units, etc., shall be provided with an earthing stud. All earthing nuts, bolts, washers etc. shall be of the sheradised type.

In no other circumstances shall fixings, which are being used for other purposes, be used for an earthing termination. If an earthing terminal is not provided on the apparatus, the contractor shall be deemed to have ascertained this and include in his costing for drilling, tapping and supplying the necessary brass nuts, bolts and washers to form an effective earthing terminal.

All cables, conduit and trunking entering or leaving switchboards shall be bonded to the switchboard earth bar.

All cables, conduit and trunking entering or leaving distribution units, control panels etc. shall be bonded together and finally bonded to the equipment concerned.

Where the sizes of bonding leads are not specifically detailed, they shall conform to 17th Edition of the IEE Regulations.

All earth clamps shall comply with BS 951 and where they are fitted to lead sheathed cables. a suitable lead sleeve shall be fitted to protect the cable sheath before the clamp is fitted.

All ends of bare conductors shall be tinned. All joints shall be tinned and clamped using a minimum of two copper rivets. The joints shall be tinned overall after completion.

All insulated conductors shall be terminated with sweating lugs and all conductors shall be fixed to equipment with steel cadmium plate set screws, nuts and brass washers.

All conduit outlet boxes shall incorporate an earthing terminal and a 30/0.25 mm green coloured PVC insulated conductor shall be connected between this terminal and associated accessories and equipment.

The lightning protection system, structural steel work and mechanical services pipe, ductwork and all other items as detailed shall be connected to the electrical system.

Incoming gas and water pipes shall be bonded to the electrical system as near as practical to their point of entry into the building.

At sinks, basins and baths, the hot and cold pipe work shall be bonded together and where the sink, basin or bath is of metal construction, this shall be bonded to the pipe work. Bonding leads shall be copper 4 mm with PVC green and yellow insulation.

Structural and ornamental Steelwork including windows, curtain walling and fixed room furniture etc. shall be permanently bonded to the building's electrical system to ensure compliance with the regulations of the IEE Wiring Regulations - 17th Edition.

All steel work within the building shall be bonded to the building's electrical system to ensure compliance until the requirements of the IEE Wiring Regulations - 17th Edition.

At each and every earth connection point, a suitable durably marked warning label shall be provided with the words "SAFETY ELECTRICAL CONNECTION - DO NOT REMOVE".

17.0 LIGHTNING PROTECTION INSTALLATION

17.1 General
The Contract document describes the general intent of the lightning protection system.

It shall be the responsibility of the Specialist Lightning protection system Designer and Installer/Contractor to provide a fully comprehensive design warranty for the system as designed and installed by them to fully comply with the requirements of BS 6651 - Code of Practice for Protection of Structures Against Lighting.

Fully detailed design drawings shall be forwarded to the Engineer by the Specialist Lightning Contractor within two weeks of acceptance of Tender.

The lightning protection system shall be designed, installed and commissioned in strict accordance with the requirements of BS 6651.

The specialist lightning protection system contractor shall guarantee full compliance of design and installation with BS 6651.

The system in general shall utilise, where suitable, structural metal columns for down conductors with a roof network of conductors forming a grid and linking down conductors. All metal work including curtain walling, railings, flues, ductwork and aerials etc. shall be bonded to the lightning protection system. The system shall also be connected to the building's main earth bar.

Shall be Specialist Contractor determine that the metallic roof covering be suitable for use as a conductor in lieu of the network of tapes located at roof level, and upon the BS 6651 together with detailed Method Statements, this method shall be approved by the Engineer. Approval from the Engineer shall be confirmed in writing.

The system shall be designed and installed to provide a compliant system which complements the aesthetics and finishes of the building.

17.2 Tapes
Tapes shall be LSF insulated high purity copper and have minimum dimensions of 25 x 3 mm or 8.0 mm dia LSF covered circular high purity copper conductor.

17.3 Connections
Connections from tape to steelwork shall be made by suitable connectors and clamps.

17.4 Down Conductors
If suitable, down conductors shall utilise the structural metal columns.

17.5 Air Terminations
Air terminations shall consist of 15 mm x 1000 mm copper taper pointed air rods and 15 mm diameter copper multiple point terminal.

The taper pointed air rod shall have a 16 mm diameter threaded at the base end for securing to an air terminal base.

17.6 Fixings
Conductor/tape fixings shall consist of LSF covered copper tape clips. Colour of LSF insulation shall be determined by the Architect.

17.7 Concrete Pits
The inspection pit shall consist of a preformed concrete unit with an open base and 7 holes earth bar for rod/tape terminations.

The pit shall be complete with a flush fitting concrete lid with lifting eye.

Final locations shall be as detailed by the Landscape Architect's layout drawings.

17.8 Earth Rods

Earth rods shall consist of copper bond lengths - low carbon steel core with molecularly bonded copper outer. All earth rods shall be designed and manufactured to fully comply with BS 6651.

Individual rods shall measure a nominal length of 16 x 2440 mm with couplings constructed from aluminium bronze.

An earthing termination point outside the building (located at an agreed position) shall be provided at each earth rod to allow each earth rod to be connected to the buildings main earth bar.

17.9 Test Link

Within each inspection pit, a disconnection link shall be installed to allow testing of the installation separate from the earth rod(s).

17.10 Testing and Commissioning

Prior to commencement on site the Specialist Contractor shall carry out a fully detailed soil resistivity test of the site.

Testing and commissioning of the entire installation shall be carried out by the Specialist Contractor with the Electrical Contractor in attendance at all times.

Fully detailed results shall be forwarded to the Engineer on completion of the installation.

A certificate of compliance shall be included with the specialist contractor's operating and maintenance manual.

18.0 TESTING AND COMMISSIONING

18.1 Tests at Contractor's Works

The Contract Administrator has access at all reasonable times to such parts of the contractor's works as shall be necessary for the purposes of inspecting, examining and testing the materials, workmanship and the performance of the plant.

Except where otherwise provided in the Contract, the Contractor shall provide all labour, materials, power, fuel, stores, apparatus and properly calibrated and certified instruments for carrying out necessary tests at his own or his Specialist Sub-Contractors works.

The Contractor shall give the Contract Administrator written notice when any portion of the plant is ready for test, and if the Contract Administrator does not himself or through his representative, attend to witness the test within seven days from the receipt by them of such notice, then the contractor shall proceed with the tests, duly forwarding to the Contract Administrator certified copies of the results obtained. In such cases, the test shall be deemed to have been made in the Contract Administrators presence.

18.2 Testing on Completion

The complete Electrical Installation shall be thoroughly tested on completion in full accordance with the 17th Edition of the IEE Regulations.

The contractor shall note that all tests, including the under noted, shall be carried out and that allowance shall be made for the hiring of all test equipment required.

The results shall be entered on the proper test sheets, as provided by the IEE and duplicate copies shall be submitted to the Contract Administrator for checking and approval.

Where the Contract provided for tests on site the Contractor shall, unless otherwise provided in the Specification, provide all necessary duly certified instruments, labour and material required for the purpose of the tests; all instruments used for testing shall carry a recent calibration certificate from an approved body.

In the event of the plant not so passing the tests, the Contract Administrator shall be at liberty to deduct from the Contract Price all reasonable expense incurred by him in repeating the tests.

On completion of the Electrical Installation, the Contract Administrator shall require adequate tests to verify that the system operates in a satisfactory manner, in accordance with the Specification and in accordance with the 17th Edition of the IEE Regulations for Electrical Installation.

Records shall be taken during the tests and on satisfactory completion, duplicate sets of the records shall be provided.

Manufacturers, or other proof test certificates, shall be provided in duplicate for all electrical equipment.

In addition to the tests required by this Specification, the Contractor shall test desks, fixed office furniture, radiators, metal sinks, basins and baths and other extraneous conductive parts for continuity with the protective conductor of the electrical system. Any such parts found not to be at earth potential shall be reported to the Contract Administrator for instruction on suitable equipotential bonding.

The emergency lighting system shall be tested as required by BS 5266 and Section 11 of the Specification. Levels shall be indicated on as-fitted drawings on a 3.0 x 3.0 m grid.

The building's fire alarm system shall be tested for audibility. Each defined space within building shall have sound levels marked on as-fitted drawings on a 6.0 x 6.0 m grid.

The Lightning Protection System shall be tested to BS 6651.

18.3 Commissioning

After completion of the Installation and testing, the Contractor shall instruct the person nominated in writing by the Contract Administrator, or an appointed representative, in the use of the electrical installation, e.g. purposes of switchgear, operation of special systems such as fire alarms etc., and re-assembly of lighting fittings for re-lamping and cleaning and demonstrate the satisfactory operation of the plant.

18.4 Operating and Maintenance Manual

4 hard copies of the Manual shall be provided.

The format of the Manual shall be in accordance with the following sections after a preface and index:-

(a) Section 1 shall comprise:-
Introduction, Abbreviations, Health & Safety at Work Act and Warning Notices etc.

(b) Section 2 shall comprise:-
A full description of the installation

(c) Section 3 shall comprise:-
The complete technical data of each item of equipment, e.g. manufacturers name and address, type and size of apparatus, reference numbers etc. This information shall be derived from information obtained from manufacturers and shall include the following:-

1) All guarantees and warranties

2) Manufacturers literature providing general description, circuit details and operation and maintenance instructions for the following:-
i) Mechanical Services Control Equipment
ii) General Power Equipment & Apparatus
iii) Luminaires and General Accessories
iv) Schedule of Luminaires using reference codes related to "As fitted" drawings and giving manufacturer, catalogue number, lamp size and lamp type
v) Fire Alarm Equipment

(d) Section 4 shall comprise:-
The emergency procedures to be adopted by personnel engaged in the operation and maintenance of the mechanical and electrical services with respect to fire, first aid, general failures to electrical systems and call out procedures for maintenance personnel in working hours and out of working hours.

(e) Section 5 shall comprise:-
A recommended action on plant malfunction to assist both the user and maintenance engineer in the event of a fault developing in a system by indicating the nature of the fault and recommended action.

(f) Section 6 shall comprise:-
A list of recommended spares, the preparation of this section shall be carried out by obtaining the manufacturers recommendations and also incorporating the clients requirements regarding spares.

(g) Section 7 shall comprise:-
A schedule of the record of drawings, together with reduced copies (A4 size) of the record drawings in numerical order. The reduced copies of the record drawings shall be printed on good quality paper identical to the paper used for the remainder of the manual.

(h) Section 8 shall comprise:-
Test Certificates, Commissioning Reports including all set points.
A distribution sheet for each final circuit distribution board giving details of type and rating of protective device for each circuit, points served, type and rating of wiring, maximum earth loop impedance for compliance with the 17th edition of the IEE Regulations for the Electrical Installation and actual earth loop impedance as determined by test.

(i) Section 9 shall comprise:-
A list of manufacturers, including addressed, telephone numbers and equipment supplied. The manufacturers list shall be arranged in alphabetical order. The manufacturers literature shall also be included within this section and arranged in alphabetical order to match the manufacturers list.

Preparation of the Manual

(a) The manuals shall be prepared within the sub-contractor and shall be particular to the Mechanical/Electrical services to the contract.

(b) The manual shall be arranged with the Index and Referencing systems.

(c) A draft text to the manual shall be issued for approval four weeks prior to practical completion.

(d) The paper to be used in the final issue of the manual shall be good quality, high white 80 g/m^2 and the reproduction shall be dry photocopy.

(e) The material of the Manufacturers and the number of sets shall be in accordance with the number of manuals required.

(f) The covers shall be hard bound with four post loose-leaf system. The Contract details shall be shown on the front cover. A matching flysheet shall give the names and addresses of the principals involved on the Contract.

(g) Numbered Card dividers shall be inserted between sections.

(h) The completed sets of Manuals shall be provided to the Contract Administrator two weeks prior to practical completion.

(i) One full set of paper copy of draft "As-fitted" drawings to be forwarded to engineer within one month of signing practical completion certificate. When draft copy of drawings are accepted as correct, a full set of plastic and one 3.5" disc copy shall be forwarded within a two week period of acceptance. All drawings on disc shall be in Auto-Cad Release 12 for Windows format.

19.0 CLOSED CIRCUIT TELEVISION SYSTEM

19.1 Specification

The contractor is invited to submit proposals for digital recording system.

This Specification describes the likely general content of the system and materials to be used.

19.2 General

This section details the requirements for the closed circuit television system.

All system components shall be sourced from the same supplier and shall be compatible in all respects. The system shall be complete in all respects and shall include all necessary components and accessories.

All components and composite assemblies shall be suitable for operation in site external ambient temperatures in the range -10 to 40 deg C and site internal ambient temperatures in the range 5 to 40 deg C.

The Contractor shall be responsible for the programming of the installation and the testing and commissioning of the complete system.

The Contractor shall retain on site competent labour who are fully conversant with the requirements of the CCTV manufacturers wiring, connection and testing details.

Prior to the works commencing, the Contractor shall obtain (and retain on site) a copy of the manufacturers wiring handbook and specifications. The work shall be carried out under the general supervision of, and to the satisfaction of the CCTV equipment manufacturers authorised engineers.

Paper copy images to be made available via a colour A4 photographic printer at the remote view location.

Prior to commissioning, the specialist contractor to provide and install within the 19" security rack, A3 laminated drawings of each floor level detailing each camera position and number.

A CCTV log book containing control forms and 24 number writable CD's (12 for hotel and 12 for evidence) to be supplied.

Where the requirements of the specification do not cover the construction of the building fabric or any doubts arise, advice shall be sought from the principal contractor and architect.

The contractor shall provide with their tender return, detailed drawings of external equipment along with the fixing brackets. These will be required by the architect to obtain planning permission for the installation of external camera units.

The contractor shall co-ordinate the security layout with the electrical and mechanical services to ensure that there is no area of clashing.

The contractor shall ensure adequate lighting levels are provided throughout these areas for the correct operation of the cameras.

The contractor shall identify all additional power required by the security specialist contractors on their tender drawings, a copy of which shall be returned with the tender submission.

The contractor shall be responsible for outlining all CCTV cabling, cable tray and electrical cable routes.

The contractor shall be responsible for incorporating within his design the electrical requirements. All electrical supplies shall be derived from the same phase and from distribution boards supported by the generator when available.

19.3 System Performance

Operation:-

The system shall be used for continuous visual surveillance of the premises for safety, security and management purposes, by a single operator located at the reception desk.

The system shall display and, where indicated, record high quality monochrome/colour pictures of live action.

Coverage:-

The areas covered by the system shall be advised, but are likely to be the car park, building perimeter, entrance area etc.

Where any camera is fitted with a zoom lens it shall be capable of providing high resolution pictures of exposed facial features of any individual within the area covered by the camera at prevailing ambient illumination levels.

19.4 System Components

Monitors:-

The number and location of monitors shall be advised.

A 17" metal cased monitor with both switchable A and B inputs to be shelf mounted within a security rack for system monitoring.

i) A input for digital recorder 1.
ii) B input for digital recorder 2.

The fascia of each monitor shall continue the following controls:-

a. Power Switch
b. Horizontal Hold
c. Vertical Hold
d. Brightness
e. Contrast

Each monitor shall be suitable for operation at 240 volts, 50 hertz, single phase.

Each camera within the installation shall have an individual address, this address shall be displayed on the bottom left hand corner of the applicable monitor when viewed.

Monitors, video multiplexers, camera remote control units, recorders and power supplies shall be suitable for desk mounting.

The interconnection between items of adjacent equipment shall be via plugs and sockets and flexible cables generally run surface.

Cameras:-

CCD cameras shall be colour or monochrome, as appropriate to their use.

Cameras shall be fitted with lenses appropriate to their location and field of view. Motorised zoom lenses shall be fitted where indicated.

The Contractor shall, by making use of a "Focal Length Finder Scope", verify all camera positions and details with the Contract Administrator prior to ordering.

Cameras shall be fitted with ceiling or wall brackets as necessary.

External cameras shall be vandal resistant & weatherproof. External camera housings shall be fitted with heater, defroster, cooling fan and wiper kit, to provide continuous operation. Heater and cooling fan kit shall operate automatically as necessary.

All cameras to be interchangeable so that any static camera may be exchanged for a PTZ camera with no wiring modifications and be fully 'Plug & Play'.

Supply and fit to the lift car, a corner mounted static camera. The electrical contractor to provide a fused connection unit within the lift motor room for use by the CCTV specialist contractor.

The lift contractor shall be responsible for the supply and installation of appropriateley rated 'Lift Shaft' wiring to provide 1 No. pair for video and 1 No. pair for ELV power. The said wiring to originate from the lift motor room and be ready for termination by the security specialist within the lift car.

Cameras at each semi-recessed modular ceiling camera position, the CCTV specialist contractor shall provide an extra 5M length of composite wiring for local resiting of the camera where required. The extra length of cable shall not lie on the ceiling grid or tiles and is to be secured for easy access and extension within the ceiling void. Semi recessed cameras fitted to ceiling tiles shall be fitted with ply to strengthen the support

Note: Prior to installation, the specialist CCTV contractor to provide a detailed drawing of the fixing requirement for the FLEXIBLE CAMERA domes giving a 'Plug & Play' flexible option for the sitting of all internal recessed cameras.

Pan/Tilt Heads:-
Cameras indicated shall be fitted with motorised pan/tilt heads.

Control Multiplexing Equipment:-
Recording capability for multiple multi channel digital recorders to record each camera at a frame rate of 1 PPS for 30 days using video motion detection (VMD) and at S-VHS equivalent quality.

Digital recording of all cameras to be continuously carried out via Honeywell 4/ 9/ 16 channel DVR's fitted with integral 80/ 160/ 320GB hard disk storage and CD writers.

19.5 Monitors
The number and size of the CCTV video monitors shall be as advised.

19.6 Camera Control
All security control equipment to be mounted within the security 19" 42 U rack fitted with a lockable vision panel front door.

19.6.1 CCTV Remote View Facility
A Remote Viewing facility shall be provided.

PC/ hard drive, 17" TFT Screen, Internal CD Writer and A4 colour photographic printer shall be provided. A box of 50 No. A4 photographic quality colour paper shall be supplied to the management. Communication to the DVRs shall be via CAT 5E structured wiring. For 2 number DVRs, the specialist security contractor shall allow for the supply, installation and commissioning of a USB Hub at the DVR control position to enable the remote viewing of multiple DVRs

19.7 Wiring
Signal cables shall be of the type and characteristic impedance recommended by the manufacturer. All cables shall be installed in accordance with the relevant sections of this electrical specification. In addition, the coaxial cables used, shall be suitably screened to avoid any interference from mains cables.

Wiring accessories shall comply with the relevant sections of this specification.

All terminals and cable ends shall be permanently identified.

Unless otherwise indicated cables shall generally be fixed surface or concealed within ceiling voids using proprietary clips. Where cables are exposed to a particular risk of physical damage they shall be contained within a galvanised conduit.

Cables fixed to inverted cable tray shall be fixed by screwed copper strips (banded), note that tie-wraps shall not be acceptable.

Cable routes shall be agreed with the M&E Engineer prior to the installation commencing.

Transmission shall be by means of a coaxial cable with a frequency spectrum and mid-ban point of 3.5-4 Mhz and band with 7.5- 1 0 Mhz.

All camera wiring for video, telemetry and power to use conventional composite wiring from the CCTV control position to each camera.

The electrical contractor shall provide and install a 20 Amperes single-phase radial sub circuit from an essential distribution board to a suitable wall/ ceiling location at the security 19" 'U' Rack. Circuit protection shall be provided via a 20 Amperes MCB, Type C. The sub circuit shall terminate with 2No. un-switched fused connection units solely for security systems use. Circuit wiring to be detailed within the Electrical Contractor's specification.

From the above, 2No. 4 way surge protected Power Distribution Units, (PDU) outlets for CCTV equipment shall be mounted within the security rack.

All camera wiring circuits including for Dummy Domes to include for video, telemetry and power so that any point may be used for a fully functional PTZ camera.

A CAT 5E circuit for CCTV remote view use shall be installed by the IT specialist contractor and shall extend from the CCTV control rack to the remote view office location. The circuit shall terminate in an RJ 45 wall mounted outlet.

19.8 Test and Commission

The complete CCTV installation shall be tested and commissioned by the CCTV equipment manufacturer to accord with the agreed programme of work. The commissioning shall prove the operation of cameras, monitors, controllers and recording facilities. When the commissioning is completed the system shall be demonstrated to the Employers Agent at handover, the complete system shall also be separately demonstrated to the employer and all instruction manuals, test certificates, operating instruction shall be made available at that time.

19.9 Maintenance

The successful installing contractor shall have the necessary expertise and manpower to provide a complete maintenance service with a 12 hour maximum call out response time.

The successful CCTV Surveillance System Contractor shall provide a detailed maintenance specification for the installed plant, which shall be in accordance with the plant manufacturers recommendations and shall take into account site conditions and operations.

The equipment shall be under warranty for the first year.