Project No. B1289-21-0001	**Ferbane Garda Station Refurb**	
DATE: 03/02/26	**ELECTRICAL SERVICES SPECIFICATION**	
	GENERAL ELECTRICAL SPECIFICATION	


OPW

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1. General Requirements

1.1 Standards and Regulations

The complete installation carried out as part of this contract shall be in accordance with the published documents of the Electro Technical Council of Ireland. In particular the following publications are relevant:

- National Rules for Electrical Installations (4th Edition), Issued 2008;
- Code of Practice for the Design, Selection and Erection of Low Voltage Switchboards for Industrial/Commercial Applications, Issued 2005;
- Code of Practice for Control Systems involving Programmable Electronic Products and Systems, Issued 1995;
- Code of Practice for the Selection and Installation of Low Voltage Generators, 2003;
- National Rules for Electrical Installations in Potentially Explosive Atmospheres, 2nd Edition. Issued 2001;
- Guide to the Selection of Electrical Apparatus for Use in Potentially Explosive Atmospheres. Issued 2001;
- Good Practice Guide on the Management of Electrical Safety at Work. Issued 2009;
- Electricity in the Medical Workplace: An Educational Guide for Users of Electrical Equipment in Medical Practice. Issued 2010.
- The latest document, effective at the date of tender issue shall be considered including all amendments, corrigenda and errata and any other published updates

Where no relevant guidance exists in these publications then the contractor shall refer to in the first instance to the publications of the Institute of Electrical Engineers, BS 7671 and other relevant British Standard or Code of Practice.

The contractor shall comply with all statutory instruments and regulations current at the date of tender.

The Contractor shall test the installation on the completion of the work. Should the installation fail to fulfil the requirements of the above regulation the Contractor shall at his own expense alter, amend and retest until such requirements are met, carrying out the test in the presence of the Engineer or his representative. On completion of the installation a certificate shall be given by the Contractor to the Engineer as described in the Commissioning Section of this document.

Where this specification is at variance with any other tender documents or drawings, the tendering party shall obtain clarification before submitting their tender. Failure to do so will be deemed to imply that the most onerous requirements have been included for.

1.2 Co-operation

All contractors engaged in the execution of the work shall co-operate with each other.

1.3 Co-ordination

The electrical contractor shall liaise with other contractors on the site to ensure that all services are co-ordinated. It shall be the duty of the electrical contractor to ensure that he is fully briefed on the extent of both his and other contractors work where such work impinges directly or indirectly on the electrical installation.

1.4 Sub-contractors

The electrical contractor shall be responsible for co-ordinating the work of all sub-contractors in his contract including specialist sub-contractors. The electrical contractor shall appoint a foreman or site manager to co-ordinate all the work in his contract including sub-contractors.

1.5 Allocation of Responsibility

The following table is a summary of the responsibilities attached to this contract:

	Activity	Designer	Installer	Other
1	**Design**			
	The design of all electrical plant and equipment, circuits, sizing and capacity.	√		
	The design of all specialist plant systems such as follows: Fire Alarms Intruder/CCTV Systems UPS Generators Data and Telephone	√		
2	***Agree Work Programme and Information Schedule***	√	√	**Building Contractor**
3	**Request for Confirmation of Design.** Prior to commencing installation confirmation of all design for that portion of the work shall be sought		√	
4	**Main Containment Routes**	√		
	Main trunking and tray routes	√		
5	**Secondary Containment Routes** Not shown on the drawings Generally Trunking equal or less than 50X50, tray equal or less than 150mm, conduit.		√	
6	**Ordering** Provide orders to suppliers in good time to meet agreed programmes		√	
7	**Submit details for changes** Document and submit proposed changes to the design for approval		√	
8	**Approve Changes**	√		
9	**Supply Utility**			
	Arrange Application for Supply	√		
	Liaise with the Supply Utility		√	
10	**Commissioning**			
	Arrange and attend commissioning meetings	√	√	
	Produce commissioning method statement and programme to match the agreed programme.		√	
	Approve commissioning strategy	√		
	Provide commissioning information as necessary	√		
	Witness commissioning and tests	√	√	
	Produce commissioning reports including exception reports on original design		√	

	Examine commissioning reports, comment and instruct on refinements as necessary	√		
11	**Handover**			
	Demonstrate to building managers and users the operation of plant, equipment and services.		√	
	Arrange and witness demonstration of specialist equipment	√	√	
	Assist in the development of an operating and maintenance strategy	√	√	
	Provide record drawings, operating and maintenance manuals		√	
12	**Health and Safety File**			
	Provide all documentation for inclusion in the safety file	√	√	

2. Cable Support, Trunking and Conduit

2.1 Cable Tray

2.1.1 General

Cable tray shall be perforated and manufactured from cold rolled mild steel to B.S. 1449: Part 1. Cable tray and accessories shall be supplied with a hot dip galvanised finish to B.S. 729. All accessories including bends, vertical and horizontal, intersections, tees shall be purpose made by the manufacturer.

The engineer's approval shall be required for the use of site made bends. Where cable tray detailed on the drawings necessitates site fabrication, full details shall be shown on Fabrication Drawings.

Except where specified or shown otherwise the contractor shall be responsible for the selection of the correct grade of cable tray to meet site conditions and the requirements of this Specification.

Include take-off plates for conduits, trunking etc. Fit holes cut in tray for passage of cables with grommets, bushes or other lining.

Support all cables throughout their length using conduit, trunking and enclosures, cable tray, cable racking, special support systems, cleated or clipped fixing direct to building fabric, or aerial catenary suspension systems, as required.

Ensure tray, racking and special support systems are continuous and firmly fixed to building fabric. Allow space for indicated cables + 30% spare, unless otherwise indicated.

Fixings and supports shall be installed at regular intervals of on adjustable steel brackets, to the engineer's approval. Install fixings at regular intervals to prevent visible sagging when loaded, with maximum spacing 1.2m and 230mm from fittings. Support from building fabric with minimum clearance behind of 20mm,

Cable tray and accessories shall be electrically and mechanically continuous throughout its length and bonded to the earth system.

2.1.2 Standard Medium Duty

Cable trays shall be perforated and manufactured from cold rolled mild steel in accordance with BS 1449: Part 1.

All accessories including bends (vertical and horizontal), intersections, tees, risers and reducing sections shall be purpose made by the tray manufacturer. Only one manufacturer's tray and accessories shall be used on the project.

The thickness of normal cable tray and accessories shall comply with the following requirements:

Width of Cabletray and Accessory	Minimum Thickness
Up to and including 152	1.0
Above 152 up to and including 254	1.2
Above 254 up to and including 457	1.5
Above 457 up to and including 914	2.0

2.1.3 Heavy Duty

Where heavy-duty cable tray is shown on the drawings or where the span between supports and/or cable loading necessitates its use then the thickness of tray and accessories shall comply with the following requirements:

Width of Cabletray and Accessory	Minimum Thickness
Up to and including 457 above 457	1.5
Up to and including 914.	2.0

Heavy duty cable trays shall be manufactured with plain return flanges.

2.1.4 Light Duty

Light duty tray over 100mm shall not be installed. All light duty cable tray shall require the express permission of the engineer or as detailed in the drawings or particular specification. Fixing centres shall be at 400 mm maximum.

2.1.5 Bonding

Cable tray and accessories shall be electrically and mechanically continuous throughout its length and bonded to the earth system. Tray carrying LV cables shall be bonded to earth with green/yellow PVC insulated stranded copper, single core cable. Tray carrying HV cables shall be bonded to earth with copper strip with a minimum cross-section of 50mm².

2.1.6 Installation of Tray and Workmanship

Sections of cable tray and accessories shall be jointed in accordance with the recommendations of the manufacturers or alternatively by using mushroom-head roofing bolts, nuts and washers.

Any damage caused to the tray, accessories and finish during cable installation and prior to Practical Completion shall be made good using either a zinc rich epoxy primer or equal alternative with a generous overlap on the existing sound metal coating. The jointing screws, nuts and washers shall all be galvanized or sheradized steel, brass shall not be used.

Cable trays shall be cut along a line of plain metal and not through perforations. Burrs or sharp edges shall be removed prior to the installation of tray sections or accessories. Holes cut in cable tray shall be suitably bushed with grommets complying with BS 1767. In either case the cut or damaged metal shall be made good by the contractor by first treating the surfaces with a suitable rust-proofing agent, similar to that used in its original manufacture and then applying finishes comparable to the remainder of the surface.

Fixings and supports shall be formed from sections of purpose made racking with purpose made accessories.

Fixings and supports shall be installed at regular intervals of 1000mm and not more than 150mm from all bends, tees, intersections and risers. Midspan joints between cable tray sections shall be avoided and they shall be positioned as close as practicable to the tray fixing or support.

A minimum clear space of 25mm shall remain behind all installed runs of cable tray.

Cables shall be installed on trays in a single layer, leaving 25% of the tray width spare for future use.

Cable trays shall preferably be installed such that they offer direct support to cables without the use of cleats or saddles. Purpose made straps, cleats, or saddles shall be employed, however, to maintain a neat and regular disposition of cables. Where trays do not directly support cables, e.g. vertical try, then load bearing cable cleats or saddles shall be employed and securely fixed to the tray. All cable cleats, saddles and straps shall comply with the cable manufacturer's recommendations and shall be compatible with the cable tray finish and cable sheath or serving.

When horizontal runs of cable tray cross building or structural expansion joints, then the tray shall be cut between supports installed on either side of the expansion joint. The tray sections shall then be jointed with bolts, nuts and washers installed in elongated holes permitting a lengthwise movement of + 10mm from the initial fastening position. Vertical runs of cable tray shall not be installed such that they straddle vertical expansion joints of the building structure.

2.2 Cable Basket

Cable basket shall only be installed as indicated on drawings or with the express permission of the engineer.

Basket tray to have 50mm square grid and side walls.
Light duty to be 25mm sides, medium duty 50 mm sides and heavy duty 75 mm sides. For under floor basket tray three independent supports legs shall be provided along each standard section of tray, where legs are required. Support leg depth as indicated. Every section shall have at least one connection point screwed to the floor. Accessories and fittings shall be as manufacturers standard items. Include take-off plates for conduits, trunking etc.

2.2.1 Ladder rack

Proprietary system of channel sections or tube with return lip and compatible jointing and fixing accessories.

2.2.2 Cable Cleats, Ties, Saddles and Clips

For cables supported on horizontal tray use ties for each circuit. Use tie manufacturer's special tensioning tool where available. Crop off tie ends.

For cables on inverted horizontal or vertical tray use cleats bolted to tray for paper, plastic or elastomeric insulated cables and saddles or clips for mineral insulated cables. Use cleats sized to grip cables firmly without undue pressure or strain on cable, but preventing slipping.

For cables on vertical or horizontal rack use proprietary fixings for plastic or elastomeric insulated cables and saddles or clips for mineral insulated cables. Use cleats sized to grip cables firmly without undue pressure or strain on cable, but preventing slipping.

For cables on vertical or horizontal rack use proprietary fixings for plastic or elastomeric insulated cables and saddles or clips for mineral insulated cables.

For sub-circuit wiring on continuous flat surfaces of wood, plaster, brick etc. Use polypropylene surface fixing clips with pre-fixed hardened steel pin for PVC insulated and sheathed cables and sheathed or bright mineral insulated cables. Use round or flat twin pattern as appropriate, manufactured specifically for cable being fixed. Use one hole 'P' clips or two way saddles of bright copper for unsheathed mineral insulated cable. Use PVC covered for sheathed mineral insulated cables.

Space cleats, ties, saddles and clips as Appendix 1 of Guidance Note 1 'Selection & Erection' published by the IEE.

2.3 Trunking

2.3.1 General

The Contractor shall be responsible for co-ordination with other trades and for working to any trunking layout drawing.

Surface mounted trunking runs shall be horizontal and vertical and where these requirements are not met then the trunking shall be run parallel to the building lines.

Set out cable trunking as indicated on the drawings, making due allowance for any diagrammatic presentation. Provide all necessary offsets, bends, tapers, transformation pieces etc., whether or not these are detailed. Manufacturer's standard fittings shall be used for all connections and changes of direction.

Where trunking passes through walls, floors and ceilings, non-combustible, non-metallic fire barriers shall be installed in the trunking.

A protective conductor of no more than 2.5mm sq. shall be installed throughout the trunking installation.

2.3.2 Surface Steel Trunking

Material Steel trunking to BS 4678 Part 1. Gauge of Metal Table 1 BS 4678. Trunking of each type shall be from one manufacturer. Partitions and covers shall be of the same material as the trunking. Use only trunking manufactured with inward return edge flanges and fitted with flange couplers, which ensure that when the cover is removed a minimum of 80% of the nominal trunking or compartment width is available for access.

Resistance against ingress of water and solid foreign bodies shall be rating IP31 to BS EN 60529 for internal use.

Colour to be Manufacturers standard or to BS 4800 standard as scheduled.

CLASS	**PROTECTION TO BS 4678 PART 1**
Class 2	Electroplated zinc having a minimum thickness of zinc coating of 0.0012mm inside and outside with additional coating of stoved or air-drying paint, applied at least to the external surface.
Class 3	Hot dip zinc coated steel to BS EN 10142 or BS EN 10143 and BS EN 10147

2.3.3 Fixings

Use purpose made brackets to fix to structural steel or suspension rods. Provide external fixing lugs where specified protection for the installation is IP44 or greater.

2.3.4 Fittings

Use bends, tees and angles of similar gauge, type and finishes as trunking body and supplied by same manufacturer. Use standard fittings where possible. Where site fabricated fittings are necessary ensure they are comparable in construction and finish with system. Obtain prior approval in writing before site fabricating any fittings or special accessories.

2.3.5 Partitions and Covers

Ensure partitions are electrically continuous with the body of the trunking or provide a connector for a circuit protective conductor. Ensure gap between partitions and lids maintains segregation of circuits.

2.3.6 Joints

Use purpose made jointing pieces fixed with screws into captive nuts. Ensure screws do not protrude through the nuts. Ensure rigidity of trunking is maintained across joint. Ensure external dimensions of trunking are maintained and not reduced by more than 4% across joints between

trunking lengths and/or fittings. Use purpose made fittings of the same manufacture where trunking connects to switchgear and distribution boards.

Provide flanges for connection of flush floor trunking to vertical trunking to maintain the cress sectional area of compartments with 50 mm minimum radius.

Maintain electrical continuity at each joint by a copper link, (tinned copper for galvanized trunking), fixed on outside of trunking, secured by screws, nuts and shake proof washers. Screws must not project through the nut. Make provision for continuity to be achieved without need to remove paint from ferrous metal where trunking has a painted finish.

2.3.7 Screws, Nuts, Washers

Do not use self-tapping screws. Use cheese or round head screws except where provision is made for the use of counter-sunk heads. Screws, nuts and washers to be made of brass or steel zinc coated.

2.3.8 Cable supports

Provide horizontal trunking with removable cable retainers or bridges to retain cables in-situ. Provide vertical trunking with pin racks to support cables at 3000 mm maximum spacing. Use insulated pins or insulation sleeved pins on pin racks.

2.3.9 Underfloor/Flush Floor Steel Trunking

Trunking material Sheet steel trunking to BS 4678 Part 2. Gauge of Metal Table 1 BS 4678. Degree of Protection Class 3. Provide flanges for connection of vertical trunking and temporary blanking plates. Maintain cress sectional area of compartments with 50mm minimum radius for connections to vertical trunking.

Secure covers by steel cam locking devices for use with a removable tool. Provide cork gasket or equivalent between cover and flange for sound deadening.

Supply trunking bodies complete with flanged connections for service outlet boxes with screwed levelling device. Ensure securing devices on recessed covers are accessible without removing applied floor finish.

Trunking and connectors shall be manufactured generally in accordance with B.S. 4678: Part 1. Trunking and fittings shall have removable lids extending over the entire length. The lids to be of the same thickness of material as that of the trunking as a minimum.

Where trunking is run in floor trenches it shall be continuously hot dip galvanised plain sheet steel to comply with BS 4678, part 1.

The number of cables to be installed in the trunking shall be such that a space factor of 45% is not exceeded.

The fixings and spacing of fixings shall conform to the manufacturer's instructions.

Where more than one circuit it run in the same trunking, or more than one service, the cables for each circuit or service shall be bound together at 1.2m intervals with PVC tape suitably coloured.

The trunking shall be manufactured by Electrofast or equal and approved.

2.3.10 Lighting Trunking

Where specified the lighting trunking shall be manufactured from 1.2 metres, galvanised, sheet steel.

The trunking shall be 50mm x 50mm in size and shall be complete with all necessary couplings, blank ends and all accessories.

The trunking and suspension brackets shall be of a design to allow the trunking lid to be removed without disturbing the suspension bracket.

2.3.11 Lighting Trunking Cover

Provide cover strip to prevent ingress of foreign materials, locate cabling in place and act as closure strips between luminaries. Use trunking cover strip clipped into place in trunking body. The

Cover strip is to match lighting trunking body or high quality colourfast extruded plastic as scheduled. Colour and shade to BS 381 and/or BS 4800 as indicated.

Trunking to be manufactured by Electrofast or equal and approved.

2.3.12 Dado Trunking (Plastic)

Dado trunking shall be supplied and installed using proprietary manufacturers bends, accessories , covers and lid.

Trunking shall be white in colour unless otherwise stated and shall be either :

a) Schneider Prima 60 Plastic Three Compartment Dado Trunking. 190mm x 62mm. Colour White

b) MK Prestige 3D Plastic Dado Trunking. 170mm x 57mm Colour White Provide cover strip to prevent ingress of foreign materials, locate cabling in place and act as closure strips between luminaries. Use trunking cover strip clipped into place in trunking body. The

2.4 CONDUIT

2.4.1 General

The Contractor shall be responsible for co-ordination with other trades and for working to any conduit layout drawings.

Surface mounted conduit shall be run horizontal or vertical. Where this requirement can not be met then conduit shall be run parallel to the building lines.

No conduit smaller than 20mm shall be installed.

The maximum number of cables drawn into any one conduit shall not exceed 80% of those allowed by the relevant regulations and Annex 52A in the ETCI National Rules and IEE Regs, 16th Edition.

A protective conductor of 2.5mm sq. minimum shall be installed throughout the conduit installation.

2.4.2 Metal Conduit

All conduit, bends and couplers shall comply with BS 4568: Part 1. The conduit shall be heavy gauge screwed. Internally screwed couplers shall be made from steel.

Conduit fittings and components shall comply to BS 4568: Part 2 and be suitable for use with screwed conduit.

Inspection elbow and bends, tees and manufactured bends will not be allowed.

Particular attention shall be paid to the continuity of all conduits and fittings to avoid high resistance between joints and connections. Continuity tests shall be made at the completion of the conduit installation and details of the test results shall be entered in the Inspection Certificate.

Conduit shall be supported in accordance with ETCI Rules. Where conduit is connected to surface mounted equipment or accessories it shall be additionally supported within 150mm of each side of the item.

Where bends and sets occur the conduit shall be fixed at a distance of 150mm on each side of such diversion. Unless otherwise indicated on the drawings all concealed conduit work shall be installed on the "loop-in" system.

The inner radius of any conduit bend shall not be less than 2.5 times the external diameter of the conduit. Where conduit has to be bent it must be bent without altering its section.

Conduit buried in concrete shall have a minimum depth of 25mm cover over its entire length. Conduit buried in a plaster shall have a minimum cover of 15mm over its entire length.

Conduits in chases shall be held in place by purpose made crampets.

All fixings shall be by means of spacer bar saddles using either slotted or keyhole pattern type saddle tops.

Throughout the course of the Contract, all conduits and accessories shall be effectively protected against the ingress of plaster and other building materials.

The Contractor shall ensure that conduits are free from dampness and moisture before any wiring is installed therein and shall swab them dry if there is any doubt or if such should prove necessary.

No cables shall be installed until such time as the relevant part of the building is reasonably weathered and free from major water ingress.

No cables shall be inserted until the conduit and boxes are fixed and the plastering complete. No greater pull than 15kg shall be exerted.

2.4.3 PVC Conduit

All rigid PVC conduit and conduit fittings shall comply with BS 4607. Concealed conduit shall be medium and surface conduit shall be heavy classification.

Conduit, fittings and accessories shall be of the same manufacturer.

All conduit joints shall be in accordance with the manufacturers installation recommendations. Screwed PVC conduit shall not be used.

No inspection elbows, bends or tees will be allowed. All bends shall be made using the correct size spring.

Surface mounted conduit shall be fixed by means of PVC spacer bar saddles. Conduits shall be supported at regular intervals in accordance with Regulation 522.8.4 and Annex 528.2 of the ETCI Rules. A separate 2.5mm sq. earth shall be used throughout the installation.

2.4.4 Flexible Conduit

Flexible conduit shall be constructed by means of two leaded steel layers covered by black PVC, and a minimum size of 20mm.

Connectors shall be aluminium or zinc plated steel.

The conduit shall be Kopex supplied by Irish Industrial Supplies or equal and approved. A separate 2.5mm sq. earth shall be run in the flexible conduit.

3. CABLES

3.1 Cable Manufacturer

Use new cables, delivered to site with seals intact, manufactured not more than one year prior to delivery, labelled with manufacturer's name, size, description, BS number, classification, length, grade and date of manufacture.

3.2 Certification and Markings

Mark all types of cable with CENELEC cable certification marking or if included in British Approvals Service for Electric Cables (BASEC) in accordance with BASEC regulations.

3.3 Cable Records

Keep records of cable drum numbers and supporting information, mark information on record drawings, indicating precise location of each length of cable, and submit copies of manufacturer's cable test certificate.

3.4 Conductor Material

3.4.1 Flexible Cords

All flexible cords shall have tinned copper conductors and be rated for 600/1000V operation unless otherwise indicated.

3.4.2 Wiring and Power Cables

All wiring and power cables shall have copper conductors unless otherwise indicated. All cables shall have a voltage rating and performance characteristics suitable for the application. For multicore cables the conductors shall be circular up to 16mm2 and shaped over 16mm2 unless otherwise indicated. LSF means Low Smoke and corrosive gas emission compound.

3.5 Colour Coding

Cables for different phases, neutral, and protective conductors shall be distinctively coloured as shown in E.T.C.I. Regulations.

3.6 Flexible Cables

Flexible cable used shall, in all cases unless otherwise specified, be to B.S. 6500 heat resistant type suitable for temperature up to and including 2000F. All flexible cables shall be manufactured by an approved manufacturer and shall comply with approved I.E.E. regulations in all respects.

3.7 P.V.C. Cables

P.V.C. insulated cables shall be 600/1000 volt manufactured in accordance with B.S. Specification No. 6004. The conductors shall be high conductivity tinned copper.

3.8 PVC/PVC/SWA/PVC CABLES

Where indicated PVC/PVC/SWA/PVC cables shall be installed as outlined below. The cables shall comprise copper stranded conductors insulated with PVC enclosed in PVC sheath and covered with steel wire armour which shall be covered with a PVC sheath.

The cables shall comply with B.S. 6346. Cables shall be of 600/1000 volt grade. The cables shall be installed in strict compliance with the manufacturers requirements and bends in the cables shall be of the minimum radius of 8 times the overall diameter of the cable.

All runs of cable inside the building shall be supported on cable tray/ladder or securely fixed to the walls at high level and to steelwork with approved cable clamps, on Unistrut brackets and in all instances the spacing of supports shall comply with the cable manufacturers recommendations.

All cables shall be terminated in the makers glands. Termination of the cable core shall be by means of makers compression termination lugs in accordance with the makers instructions. The cable armouring shall be carefully made off in the makers gland at each entry to switchfuses etc.

Bonding to the metal work for the earthling shall be by proprietary earth tags.

Where necessary separate earth wire shall be installed alongside the PVC/PVC/SWA/PVC cable to comply with the E.T.C.I. Regulations.

3.9 XLPE INSULATED ARMOURED LSF CABLES

Cables shall be armoured and LSF sheathed. Multi-core cables shall be steel tape or single wire armoured and single core cables shall be aluminium strips armoured. Generally multi-core cables shall be XLPE/LSF/SWA/LSF and single core XLPE/SWA/LSF.

The cables shall comply with BS 5467: 1989 and shall be of 600/1000 volt grade.

Cable installation, support, glanding, termination etc as per PVC/SWA/PVC above and manufacturer's guidelines.

3.10 MICS CABLE

Where specified MICS cable shall be installed as outlined below. The cable shall be 660 volt grade with seamless copper sheath and powered mineral insulated high conductivity copper conductors in compliance with BS 6207. 750V heavy-duty cables shall be used for for sizes over 2.5mm2 to 25mm2. Outer sheath colours shall be:

Red	-	Fire Alarms
White	-	Emergency Lighting
Orange	-	Other Services

All wiring where MICS cable as specified shall be carried out in two or four core cable not less than 1.5 sq. mm cross sectional area.

All MICS wiring shall be carried out in strict accordance with the makers instructions and to the approval of the engineers. All sealing glands shall be made with the makers cold type seal. Where cables are fixed to brick or concrete suitably sized rawplugs shall be used.
Immediately after cutting, each cable end shall be sealed, either by the permanent seal or by being dipped in bituminous compound.

Termination for cables shall comply with BS 6081, and shall be made off strictly in accordance with the manufacturer's recommended procedures.
All cables shall terminate using only screw-on pot type seals incorporated in the universal ring type glands and shall be adapted to suit the various boxes, switches, etc. All cables shall be effectively sealed using only the makers sealing compounds. Sealing pots and glands shall be marked with the appropriate cable reference. All terminations, fixings, and accessories and all tools used shall be made by the same manufacturer as the cable itself.

All sheathing shall be electrically continuous across all joints and earthed in accordance with the ETCI Regulations.

All cables shall be securely fixed at sufficient intervals with brass saddles and screws. In no case shall saddles be placed at intervals greater than 300mm. Where cables pass through floors, walls or ceiling they shall be protected by a short length of galvanised steel conduit of suitable size, correctly bushed.

MICS cables installed in under-floor or similar ducts, on galvanized tray, on a dampstone, brick, or concrete surface, or elsewhere in damp or corrosive conditions, or where specifically called for in this Specification, or on the drawings, shall be provided with an overall extruded orange sheath.

Terminations of PVC or similar sheathed MI cables shall be protected by the correct size of plastic gland shroud. Any exposed metal sheath remaining after the installation of the cable gland shall be wrapped with PVC tape, as supplied by the cable manufacturer, before fitting the gland shroud.

Bending radius for M.I.C.C. with copper sheath is 6 times the diameter.

Cable clips and saddles shall be purpose-made by the cable manufacturer. The use of bare or PVC covered copper strip for site fabrication of saddles or clips will not be permitted. Clips with single hole fixings may be used when installing single cables. Where two or more cables are grouped together then saddles with two hole fixings shall be employed. Plain copper sheathed cables shall be held with bare copper clips or saddles; PVC or similar sheathed cables shall be held with PVC covered

clips or adjustable nylon saddles. The type of fixings employed shall be consistent throughout the installation.

Connections between cables shall be by means of mechanical connectors of approved type. Every connector shall be easily accessible and shall not have a resistance greater than that of the equivalent length of the largest conductor to which the connector is fixed.

All cables shall have their conductors tested for insulation resistance immediately prior to terminating the cable end. Tests shall be carried out with a 500V 'Megger' insulation tester, or similar instrument, to prove the integrity of the insulation between cores and the cable sheath.

MICS shall be as manufactured by BICC or equal and approved.

3.11 Glanding and Terminating Cables

3.11.1 Glanding

Only glands specifically manufactured to suit the cable shall be used.
Armoured cables shall be brass. Shrouds shall be used in all instances. MICS glands shall be as supplied by cable manufacturer.
IP rating shall be as specified but not less than

Holes cut in gland plates, adaptable boxes and other equipment shall be correctly sized for the gland to be installed such that minimum of free play exists between the gland body and the cut metal. Paint or other finishes around the hole periphery shall be removed and the metal thoroughly cleaned before the gland is installed.

Large single-core cables shall be terminated in the manner recommended by the manufacturer to reduce losses due to eddy currents or circulating currents.

Where glands are installed on non-conducting materials then earth tail seals or sheath earth bond clamps shall be employed. The earth tail or clamp shall be bonded to the appropriate earth terminal or bar.

3.11.2 Terminations

Ensure all joints and terminations are made by appropriately qualified cable jointers, using jointing materials, components and workmanship recommended by the cable manufacturer and the jointing accessory manufacturer. Install cable glands in accordance with BS 6121 Part 5. Cold pour resin and heat shrink joints in accordance with BS 6910 Part 2.

Cut all cable ends immediately prior to jointing or terminating. Seal cables left unconnected for more than 24 hours to prevent the ingress of moisture. Seal plastic sheathed cables using proprietary shrink on end caps. Seal lead sheathed cables by a plumbed dressed lead cap with an air space to allow conductor movement.

Strip cables to bring out the cores and expose conductors, for the minimum length required for connection, to leave no exposed length of conductor after termination. Ensure that strands are not damaged when stripping cable cores. Twist strands together. Do not reduce number of strands. Secure all strands at terminations.

At connections to equipment and switchgear without integral cable clamping terminals, use compression or solder type lugs for bolted terminal connections, of correct bore. Form all compression connections to components using tools that cannot be released unless the correct degree of compression has been achieved. Install and inspect compression and mechanical connectors, to BS 6360, on conductors in accordance with BS 7609.

Bolt core termination with lugs to equipment using washers or proprietary shake proof devices. Provide separate bolted connection for each core.

For auxiliary and sub-circuit wiring do not bunch more than three cores at clamping terminals or bolted connections. Individual stranded cores should be twisted together and folded back to form a “U” where entering screw or clap type terminals.

Mark cable conductor phasing, or other core identification, at each end of all cables, and at all joints, maintaining consistency of marking with any existing system.

Connect all cores, including multicore cable spare cores, at all joints and terminations. Bond any unused cores of multicore cables to earth at both ends, unless otherwise indicated.

3.12 Cable Fixing

Cables fixed to the building structure or to cable tray shall have clips or saddles spaced at the following regular intervals as a minimum:

Overall Diameter of Cable (mm) (excl. P.V.C. Sheath).	**Horizontal & Vertical Fixing Centres (mm)**
Up to 7.5 inclusive Above 7.5 up to 12.5 inclusive Above 12.5	450 600 750

Cable saddles and clips shall be fixed to the building fabric or to cable tray as follows:

(i) Building fabric - brass roundhead screws and fibrous or approved plastic plugs.

(ii) Galvanized trays in damp or wet conditions - zinc coated roundhead screws, nuts and washers.

(iii) All other cable trays - brass roundhead screws, nuts and washers.

3.13 Cables in Trenches

See work section P30. Cable trenches to be by others but supervision of all works is to be carried out by electrical contractor. Insure that all PVC cable marker tapes are installed in accordance with the following table (also in work section P30):

WIDTH	**Up to 600m**	**600-1000mm**	**1000-1400mm**	**1400-1800mm**
DEPTH Up to 500mm	1 tape at 200mm below ground level in the centre of the trench	2 tapes at 200mm below ground level horizontally spaced 400mm apart	3 tapes at 200mm below ground level horizontally spaced 400mm apart	4 tapes at 200mm below ground level horizontally spaced 400mm apart
DEPTH 500-800mm	1 tape at 200mm and 1 tape at 500mm below ground level in the centre of the trench	2 tapes at 200mm and 2 tapes at 500mm below ground level each tape on each level horizontally spaced 400mm apart	3 tapes at 200mm and 3 tapes at 500mm below ground level each tape on each level horizontally spaced 400mm apart	4 tapes at 200mm and 4 tapes at 500mm below ground level each tape on each level horizontally spaced 400mm apart

Lay cables on newly prepared bedding. Ensure multiple layers of cable are separated vertically by a 50mm layer of hard rammed bedding material. Cover newly laid cables with 100mm of bedding material.

When using a power winch ensure tension on the cable is taken by element of the cable designed for that purpose, that is armour or conductor cores as appropriate and not plastic sheath, metal sheath or core insulation.

During hand pulling cable ensure no kinks are formed and that flaking when used is done in the correct direction.

Do not allow cable to twist during installation. Use swivels to connect pulling bond to cable stocking or equivalent fitting.

Check drum is suitable for jacking before commencing installation. If drum or reel is unsuitable for jacking, flake cable in correct direction in maximum size turns from drum or reel before commencing installation. Use skilled labour to supervise all unreeling, flaking or running of cable from a drum.

Lay cables in the formation shown, ensure spacing is not reduced below that indicated.

Bind trefoil groups at 1m intervals. Bind any associated earth or protective conductor to its cable or trefoil group at 1m intervals.
Ensure installation radii and permanent bending radii are not less than those recommended by the manufacturer.

Do not lay that cables that are not suitable, are not waterproofed or mechanically protected in the ground.

3.14 Cables in Trunking and Conduit

Throughout the course of the Contract, all trunking, conduits and accessories shall be effectively protected against the ingress of plaster and other building materials.

Cable trunking to be clear of debris, in particular metal swarf, prior to the installation of any cabling.

The Contractor shall ensure that all trunking and conduits are free from dampness and moisture before any wiring is installed therein and shall swab them dry if there is any doubt or if such should prove necessary.

No cables shall be installed until such time as the relevant part of the building is reasonably weathered and free from major water ingress.

No cables shall be installed until the trunking and conduit system is complete, outlet boxes are fixed and the plastering complete. No greater pull than 15kg shall be exerted.

4. EARTHING AND EQUIPOTENTIAL BONDING

4.1 General

To provide systems for the transfer of electric current to earth, to protect personnel, buildings, structure, plant and equipment in the case of an electrical fault within the supply system and from interference from electro-magnetic fields and electro-static forces.

4.2 Standards

All necessary earthling and equipotential bonding shall be done in accordance with the ETCI Regulations and local electricity supply requirements.

4.3 Existing Installations

Check earth continuity conductors and loop impedance values of existing installation. Report defects and elements not in accordance with ETCI Regulations before connecting new or modified installations to existing supply.

4.4 Earth Electrodes

Earth electrodes shall be molecularly bonded copper clad steel rods driven vertically into the ground. Threads shall be properly rolled so that the copper cladding is unbroken throughout. Couplings shall be of silicon aluminium bronze and shall be fully threaded to allow metal-to-metal contact of the rods. Couplings shall be counter-bored and of sufficient length to completely cover and protect the threaded portion of the rods to minimize corrosion.

Driving heads for the rods shall be high tensile steel and shall be fully threaded to ensure head-to-rod contact. Driving shall be accomplished by using a purpose made power hammer. Each rod shall be fitted, after driving, with a conductor clamp.

Where the ground is unsuitable for copper clad steel rods, other types of earth electrodes complying with BS 6651 may be used. Where building elements are to be used as the earth electrodes they shall be tested during construction to ensure the resistance is low enough to make suitable electrodes. A formal record will be kept of the resistance readings taken.

Appropriate sealing methods shall be used where rods or conductors pass through concrete into earth. Pre-cast concrete inspection pits and puddle flanges or, in tanked structures, more elaborate seals as described in BS 6651, shall be cast in at the time of construction. Permanent waterproofing and sealing shall be accomplished after installation and testing of the earth rods or conductors.

Earth pits shall be pre-cast concrete with reinforced covers. When fully embedded in concrete, earth pits may be of galvanised steel construction or moulded plastic bodies with galvanised steel frames and lids. Pits shall be installed so that they are flush with the finished floor or ground level.

Covers shall be removable for inspection and testing of the earth electrode and shall be inscribed 'Lightning Protection Earth'.

Drilled earth bars shall be fitted in pits where the number of connections exceeds one looped conductor (interconnecting electrodes) plus one external connection. The driller earth bars shall be copper, not less than 50mm x 6mm and mounted on insulators.

Where natural earth electrodes are used, such as sheet steel piling, reinforced concrete raft or pile foundations or other suitable structures, provision shall be made during construction to ensure suitable electrical connection to such electrodes. If parts of the structure are also to be used as natural down conductors then electrical continuity between the elements used as down conductors and those used as earth electrodes shall be ensured during construction in consultation with the Engineer and the Structural Contractor.

4.5 Joints and Connections

Use proprietary cast gunmetal accessories, fixings, clamps and couplings with phosphor–bronze bolts, nuts and washers.
Provide waterproof protection at joints subject to moisture.

4.6 Test Joints

All test joints shall be accessible for testing at the time of installation and for future routine tests.

Test joints shall be provided at the bottom of each down conductor so that the integrity of the earth electrodes can be tested separately. Where natural building elements are used as down conductors then test joints shall be provided at the top of the building to measure the resistance to earth.

4.7 Protective Conductors

Use insulated cable generally - PVC Single core to BS 6004 or XLPE Single core to BS 7211 as appropriate.
Armouring and/or metallic sheathing of armoured cables may be used within the ETCI Regulations but in new installations provide separate cable as standard. Integral copper conductor is preferable in multicore cables and shall be used wherever possible.

Provide protective conductors sized in accordance with ETCI Regulations.

All expressed metalwork on the roof an on the outside of the building shall be bonded to the lightning protection system. Interior metalwork shall be bonded if it is close enough to elements of the lightning protection system to risk the danger of flashover. The need for bonding shall be assessed by the calculation method given in BS 6651.

In life installations only, the continuous rigid metal structure shall be bonded to the lightning conductor and to adjacent structural steelwork and such bonding shall be confined to the top and bottom of the continuous rigid metal structure. The guide rails are not part of the structure for this purpose but shall be bonded as exposed conductive parts.

4.7.1 Main Earth Terminal

Provide earth bar at incoming electrical service position. Bond earth terminals and metallic structure of switch and control gear and plant. Connect all earth terminals to each other.

4.8 Main Earth Cable

Cable as protective conductor above sized as per regulations. Provide Mechanical protection throughout. Provide mechanical moisture seals as appropriate where structure or membrane is broken.

4.9 Main Earth Terminal Connections

Connect separately each main earth conductor and main equipotential bonding conductor to main earth terminals.
Terminate circuit protective conductors on switchboard earthing bar.
Terminate conductors with compression type lugs suitable for bolting direct to bar or solder lugs suitable for bolting direct to bar.
Extend separate protective conductor from main earth terminal to main switch/switch panel served by incoming main cable
Provide terminations on each main earth bar as appropriate for all main connections.

4.10 Neutral/Earth Connection

Provide neutral/earth connection at main distribution board.

4.11 Clean Earth Bar

Where specified provide clean earth bar.

Materials and installation similar to above.

4.12 Test Certificates

A test certificate shall be provided on completion of the installation to certify that Inspection and Testing have been carried out in accordance with the Standards.

The test certificate shall contain the resistance measurement of each earth electrode and earth termination network, of each down conductor and of the building a whole. In addition to resistance measurements, the certificate shall contain the following information for each reading:

(i) the date and time

(ii) the weather conditions

(iii) the type of soil

(iv) the condition of the soil (e.g. wet, dry, average). Any measures taken to reduce soil resistance. Details of the reference earth used for testing.

5. MAIN AND SUPPLEMENTARY EQUIPOTENTIAL BONDING

Bond in accordance with ETCI Regulations to main earth terminal all extraneous conductive parts of the installation. Ensure that all of the following services are bonded for each building or equipotential zone:

- Main water pipes.
- Main gas pipes.
- Fuel oil pipes.
- Air ductlines.
- Heating pipework.
- Chilled water pipework.
- Exposed metallic parts of building structure.
- Thermal insulation metallic cladding.
- Metallic cable sheaths of all cables except.
- Lightning protection systems.

Bond all simultaneous accessible conductive parts with supplementary equipotential bonds to protective conductor system. Ensure that all of the following areas are bonded:
Bathrooms and shower rooms.

- Boiler houses.
- Calorifier rooms.
- All other plant rooms.
- Wet and damp process areas.
- Kitchens and laundries

5.1 Identification

Use numbered and/or lettered plastic cable sleeves to indicate circuit numbers and phases of corresponding phase conductors on all cables.
Ensure conductors are connected to earth bar in same sequence as phase and neutral conductors.
Identify at substation, switchboard and building earth bars each protective, bonding and earthing conductor.
Label earth bar “SAFETY ELECTRICAL CONNECTION – DO NOT REMOVE” with wall mounted laminated plastic tablet engraved in 10mm high red letters on white ground.
Provide a permanent label durably marked in letters 4.75mm minimum height “SAFETY ELECTRICAL CONNECTION – DO NOT REMOVE, in visible position, at each bonding conductor connection to extraneous conductive parts.

6. ACCESSORIES

6.1 Supplier

Unless otherwise indicated source all accessories form the same manufacturer.
Unless otherwise specified all accessories shall be MK Albany Plus MCO. Industrial type outlets shall be MK unless otherwise specified. The contractor must submit any alternatives for approval prior to installation.

6.2 Samples

Where indicated submit samples of proposed materials and equipment for approval before work is started. Label each sample with name, catalogue number and services in connection with item.

6.3 Common Requirements

All enclosure box to BS4662 for recessed and to BS5733 for surface. For interior use these shall be IP30 and for exterior IP 54 or as specified. All coverplates to be overlapping unless otherwise specified.

Enclosure material and finish to match conduit system. Enclosures to be recessed unless otherwise specified.

6.4 Interior Light Switches

These shall be BS 3676 Part 1., grid type, and shall incorporate rocker bars unless otherwise specified.

Rating of all the switches to be 15A. Mounting to be on an adjustable steel grid. All switches shall have a snap action microgap mechanism. Multiswtich units shall be used as appropriate. Switches on differing phases shall be mechanically separated.
MK MCO or similar and approved unless otherwise specified.

6.5 Pull Cord Switches

To BS3676 Part 1 rating of all the switches to be 16 A for lighting circuits and 40-45A for showers, fans etc as specified. All switches shall have a snap action microgap mechanism and a neon indicator lamp.
MK MCO or similar and approved unless otherwise specified.

6.6 Exterior Light Switches

To BS 3676 Part1 switch type shall be either rocker bar with sealed-in plastic membrane or rotary disc or lever operating through sealing gland. Rating of all switches shall be 15 A. Action shall be two positions, unless otherwise stated. Enclosure pattern shall be weatherproof and shall be surface, unless otherwise stated. Enclosure material shall be galvanized cast iron or impact resistant moulded plastic. Neon etc shall be as indicated on the drawings.
MK or similar and approved unless otherwise specified.

6.7 Luminaire Connections

Rating shall be 5A minimum. Load carrying captive cord grip type plug/socket and clip-on cover to BS 5733, BS 546 or BS 5733 Load Supporting BS 7001 (3 or 4 pin as appropriate).
Load carrying capacity to match connected luminaire.
Coverplate finish white moulded plastic.
MK Klix or similar and approved unless otherwise specified.

6.8 Isolating Switches

Provide isolating switches for fixed appliances, with utilization category and making capacity as indicated. These shall be to BS 3676 Part 1 or BS EN 60947-3. Mounting to be on an adjustable steel grid. Engrave front plate to indicate equipment served. Switch type toggle.
Neon indicator with red lens.
Cord outlet with cord grip.
MK or similar and approved unless otherwise specified.

6.9 Fuse Connection Units

To BS 1363 Part 4. Engrave front plate to indicate equipment served. Units shall be switched unless indicated otherwise. Fuses to BS 1362 sized as indicated.
Cord outlet and cord grip.
MK or similar and approved unless otherwise specified.

6.10 Socket Outlets

Standard 13A socket-outlet to BS 1363. MK or similar and approved unless otherwise specified. Socket outlets shall be single or twin and switched unless indicated otherwise.

Industrial socket-outlets, BS EN 60309-1. All 110V, 230V and 430V volt industrial outlets shall be IP44 rated indoors and IP67 rated for outdoors. Conduit entry to the outlets shall be to suit each particular application. All industrial outlets shall be from the MK Commando Range similar and approved unless otherwise specified.

6.11 Cooker Control Unit

Standard
Cooker unit to BS 4177.
The rating shall be 45A double pole with neon indicator light.
MK or similar and approved unless otherwise specified.

6.12 Cord Outlets

BS 5733
BS EN 61058-2-1.
Engrave front plate to indicate equipment served. Rating shall be 20A for all outlets except cooker and for cooker and for cooker outlets 45A. Pole configuration to be DP&E.
Terminal block sized for cables.
For cooker 2 x 10mm², for all other 2 x 2.5mm²
MK or similar and approved unless otherwise specified.

6.13 Cable and Appliance Couplers

BS 4343:1968
BS EN 60309-2 (BS 4343:1992)
Industrial couplers, BS EN 60309-1,Bs EN 60320-2, Bs 196.
MK or similar and approved unless otherwise specified.

Material polycarbonate male and female type connectors.

Colour coding as follows:
25V, Violet
50V, White
110 – 130V, Yellow
220 – 240V Blue
380 – 415V Red
500 – 750V, Black.

Degree of protection to BS EN 60529
Internal – IP 44
External – IP 67

6.14 Telephone and Data Outlets

Refer to Data and Telephone Specification.
For jack socket to BS 6312 Part 2 or RJ 45, LJU.

6.15 BNC Sockets

Circuit configurations as indicated on drawings. Connections shall be crimp terminals. The impedance of the outlet shall be 75. The mounting shall be insulated unless otherwise indicated. Connections shall be insulation displacement type unless otherwise indicated.

Ancillaries shall be dust caps for sockets unless otherwise indicated.

6.16 Aerial Sockets

Standard BS3041 Part 2

Circuit configurations (single or dual or TV and/or FM) as indicated on drawings. Connections shall be insulation displacement type unless otherwise indicated.

Ancillaries safety isolation to BS 6330 for communal aerial systems.

6.17 Low Voltage Isolating Transformer Units

Standard EN 60742 (BS 3535 Part 1) and BS 3535 Part 2.

The configuration shall be single phase, double wound. Rating – Input 230V/Output power 1500VA, unless otherwise indicated on the drawings.

Type	Output voltage	Description
V1	110V	For power tools in plantrooms with plug and socket to BS 4343
V2	24V	For portable lights in plantrooms
V3	110/24V dual	For power tools and portable tools and portable lights in plantrooms

Plug and socket for 110V
Plug and socket for 25V
Switch primary supply
Centre tapped secondaries
Secondary side fusing.

6.18 Shaver Points

Provide shaver points, internally switched by plug insertion to BS 4573,BS EN 60742 (BS 3535 Part 1) and BS 3535 Part 2.

Engrave input and output voltages and ‘SHAVERS ONLY’. Rating 20VA.

Double wound single-phase transformer 230/230V and 110V to BS EN 60742 and BS 3535 Part 2.
Internal overload protection.

6.19 External and internal lighting PIR’s

Internal PIR types and locations to be used

Type 1
Location Covered: All areas except corridors unless otherwise specified
Type: LUXOMAT PD4-M-2C-DUO-FC (Flush)
Setting: Off Delay 25min – Photocell Zero

Type 2
Location Covered: Corridors unless otherwise specified
Type: LUXOMAT PD4-M-1C-C-PS-SM MK K4031
Setting: Off Delay 15min

External PIR types

7. Fixings and Grounds

7.1 General

The Electrical contractor shall be responsible for the fixing of all equipment supplied as part of electrical contract including specialist panels and boards supplied by other contractors and specialist suppliers.

7.2 Standards

Fixings shall comply with BS 3974 Part 1. Expanding anchors or similar fixings shall comply with BS 5080.

7.3 Methods and Materials

7.3.1 Load Bearing Fixings
All load bearing fixings shall be type tested and certified.

7.3.2 Size and Quantity of Fixings
Generally the largest bolt or screw size to fit the diameter of the hole of the item to be fixed. Ensure that all holes are used.

7.3.3 Build-in or cast-in fixings
Mark out and provide all assistance necessary.

7.3.4 Screws and Bolts
Generally sheradized for dry areas. In damp areas brass screws and galvanised bolts shall be used. In exposed or wet areas stainless steel screws or brass as appropriate and and stainless steel bolts should be used. Galvanised and stainless steel items shall not be in contact with each other.

7.3.5 Fixing to Steel or Similar Structure
Obtain prior approval both for fixing and method.

7.3.6 Fixing to Concrete
Avoid reinforcement. Generally fdo not fix to within 100mm of edge of concrete without approval.

7.3.7 Fixing to Brickwork/Stone
Fix directly onto brick or stone. Do not fix to mortar or any unsound materiaI.

7.3.8 Fixing to Stud Partitions and Walls
Advise Main/Building contractor on the provision of grounds.
Where equipment is light such as battery wall clocks and the like toggle type fixings may be used.

8. Installation and Protection of Accessories

8.1 General

Ensure that all cable terminals suitably sized for cable.
Ensure all metal parts are bonded to earth.

Ensure there is no physical or electrical damage to accessories when they are removed from their packaging and during installation.

Provide masking covers for surface mounted accessories to protect surface from paint.

Where accessories are flush mounted install front plate after painting is finished.
Align accessories horizontally and vertically, as indicated. Where accessories are grouped, mount horizontally in line and parallel to each other and equidistant.

Fix cover plated to boxes with brass fixing screws.

8.1.1 Mounting Height

Mount electrical accessories in accordance with the following table, unless otherwise indicated. Measurement to be to centre line of equipment, unless otherwise stated, from either finished floor or worktop. If specified height coincides with top of tiling mount above tiling with a clear gap of 50mm. Where located below a worktop mount 100mm below underside of worktop.

Accessory	Location	Height mm	Mounting Height for Access form Wheelchair
Lighting switch		1100	1000-1200
Socket outlet	General	450	800
	Kitchen	1400	800
	Above worktop	200	150
	For disabled use	1000	
	Plantroom	1400	800
	External	1400	800
Shaver socket outlet		1400	800
Fused connection unit controlling	Radiant heater: - wall	1800	800
	Radiant heater: -focal point	200	800
	Tubular heater	200	800
	Clock	2200	
Cooker control unit		1400	150 above worktop
Cooker connection unit		600	600
Safety isolating transformer		1400	
Room thermostat		1600	900-1200
Telephone outlet		200	800
Radio/TV outlet		200	800
Pushbutton		1400	800
Fire alarm manual call point		1200	800

Bell or buzzer		2200	
In car parks and garages comply with appropriate petroleum regulation for mounting heights of socket outlets.			

Accessory	Location	Height mm	Mounting Height for Access form Wheelchair
Lighting switch		1400	1000-1200
Socket outlet	General	200	800
	Kitchen	1400	800
	Above worktop	200	150
	For disabled use	1000	
	Plantroom	1400	800
	External	1400	800
Shaver socket outlet		1400	800
Fused connection unit controlling	Radiant heater: - wall	1800	800
	Radiant heater: -focal point	200	800
	Tubular heater	200	800
	Clock	2200	
Cooker control unit		1400	150 above worktop
Cooker connection unit		600	600
Safety isolating transformer		1400	
Room thermostat		1600	900-1200
Telephone outlet		200	800
Radio/TV outlet		200	800
Pushbutton		1400	800
Fire alarm manual call point		1400	800
Bell or buzzer		2200	
In car parks and garages comply with appropriate petroleum regulation for mounting heights of socket outlets.			

For wheelchair access the following pull cord lengths are recommended: -

Ceiling mounted switches	Cord pulls to extend to 1000mm above finished floor level.
	Alarm pulls to extend 500mm above finished floor level and be coloured red.
Shower circuit switch	Pull cord to isolating switch to extend to 1000mm above finished floor level.

9. General Requirements

9.1 LV Switchgear – Standards

All switchgear supplied on OPW projects shall be designed, constructed and tested in strict accordance with the ETCI Code of Practice for Low Voltage Switchgear Assemblies and the current version of the relevant standards listed below.

9.2 IEC Standards

- IEC 60038I - EC Standard Voltages
- IEC 60255 - Electrical Relays
- IEC 60269 - Low voltage fuses
- IEC 60439 - Low voltage switchgear and control gear assemblies
- IEC 60670 - General requirements for enclosures for accessories for household and similar fixed electrical installations
- IEC 60715 - Dimensions of low-voltage switchgear and control gear. Standardised mounting on rails for mechanical support of electrical devices in switchgear and control gear installations.
- IEC 60721 - Classification of environmental conditions
- IEC 60831-1 - Shunt power capacitors of the self-healing type for AC systems having a rated voltage up to and including 1000 V - Part 1: General - Performance, testing and rating - Safety requirements - Guide for installation and operation
- IEC 60898 - Electrical accessories. Circuit breakers for over current protection for household and similar installations.
- IEC 60947 - Standards for low-voltage switchgear and control gear
- IEC 60947-2 - Circuit Breakers
- IEC 60947-3 - Switch, Disconnectors, Fuses
- IEC 60947-4-1 - Magnetic Starters
- IEC 60967-6-1 - Automatic Transfer Switches
- IEC 61009 - Residual current operated circuit breakers with integral over current protection for household and similar uses (RCBOs)
- IEC 61378 - Converter Transformers
- IEC 61439 - Low-Voltage switchgear and control gear assemblies
- IEC 61642 - Industrial AC networks affected by harmonics - Application of filters and shunt capacitors
- IEC 61643 - Surge protective devices connected to low-voltage power distribution systems
- IEC 61921 -Power capacitors - Low-voltage power factor correction banks
- IEC 62020 - Electrical accessories. Residual current monitors for household and similar uses (RCMs)Bottom of Form
- IEC 62262 - Degrees of protection provided by enclosures for electrical equipment against external mechanical impacts (IK code)

9.3 European EN Standards

- EN 50274 Low-voltage switchgear and control gear assemblies. Protection against electric shock. Protection against unintentional direct contact with hazardous live parts
- EN 60715 Dimensions of low-voltage switchgear and control gear. Standardized mounting on rails for mechanical support of electrical devices in switchgear and control gear installations
- EN 60947-2: Circuit-breakers
- EN 60947-3: Switches, disconnectors, switch-disconnectors and fuse-combination units
- EN 60947-4-1: Contactors and motor-starters. Electromechanical contactors and motor-starters
- EN 60947-5-8:2006 Control circuit devices and switching elements
- EN 60947-7-1: Ancillary equipment. Terminal blocks for copper conductors
- EN 60947-7-2 Ancillary equipment. Protective conductor terminal blocks for copper conductors

- EN 60947-7-3: Ancillary equipment. Safety requirements for fuse terminal blocks
- EN 61008 - Residual current operated circuit breakers without integral over current protection for household and similar uses (RCCB's)

- EN 61009 - Residual current operated circuit breakers with integral over current protection for household and similar uses (RCBOs
- EN 61095 Electromechanical contactors for household and similar purposes
- EN 61439-1: Low-voltage switchgear and control gear assemblies. General rules
- EN 61439-2: Low-voltage switchgear and control gear assemblies. Power switchgear and control gear assemblies
- EN 62026-1: Low-voltage switchgear and control gear. Controller-device interfaces (CDIs). General rules
- EN 62026-3 Low-voltage switchgear and control gear. Controller-device interfaces (CDIs). DeviceNet
- EN 62208: Empty enclosures for low-voltage switchgear and control gear assemblies. General requirements

9.4 British Standards

BS 6423: Code of practice for maintenance of electrical switchgear and control gear for voltages up to and including 1 kV
BS 6518: Specification for low voltage switchgear and control gear for industrial use. Control switches. Position switches 42.5 x 80. Dimensions and characteristics
BS 7767: Method for assessing the short-circuit withstand strength of partially type-tested assemblies (PTTA)

9.5 Switchboards

For the purpose of this specification a switchboard is deemed to be either of the following:

- A main distribution board
- A sub main distribution board

In all cases these switchboards will generally feed major loads such as final circuit distribution boards, HVAC control panels, lifts, chillers etc. Unless other wise noted on the drawing switchboards shall be sheet steel type multi-compartment enclosures to Form 4 Type 2 as described elsewhere in this specification.

Form 2 Type 2 sheet steel cabinet enclosures, as described elsewhere in this specification, may also be used for the Main Distribution Board in smaller installations subject to the following:

- The supply is single phase or 3 phase whole current metered.
- The incoming protective device does not exceed 125 Amps.
- There are no downstream sub main distribution boards in the building.

9.6 Final Circuit Distribution Boards

Final Circuit Distribution Boards are fed from switchboards and typically feed light, sockets and small power final circuits. In some cases they may be an integral part of a switchboard. They shall be Form 2 Type 2 sheet steel cabinet type enclosures as described elsewhere in this specification.

Where the total number of outgoing circuits is less than twelve a metal clad type consumer unit will suffice for the Final Circuit Distribution Board.

9.7 Partially Type Tested Assemblies

All LV switchgear assemblies for supply on OPW jobs shall meet the requirements for “Partially Type Tested Assemblies” in accordance with EN 60439 – 1 and as summarized below.

The assembly shall be derived from a Type Tested Assembly. Deviations from the tested configuration are only permitted provided they can be verified by calculation or equivalent methods.

As a means of demonstrating design compliance with the Standard, manufacturers must have available Type Test documentation for the original design and any calculations relating to modified elements.

The Assembly shall consist, as far as practical, of a series of standard elements configured to suit a particular application.

Customization should be restricted to situations where it cannot be avoided, e.g. facilities for terminating over size cables, use of an alternative tested component, etc.

All components and devices shall be fully Type Tested to their respective product standards. Documentation shall be available for examination.

Combinations of Type Tested components and devices installed in an otherwise untested Assembly are not covered by this definition and the Standard.

9.8 Form of Separation

Forms of separation shall be as defined in EN 60439-1 and as summarized below.

- Main and Sub main Distribution boards - Form 4 Type 2
- Final Circuit Distribution boards - Form 2 Type 2

The requirements are summarized in the relevant sub sections which follow.

9.9 Clearance and Creepage Distances

Clearance and creepage distances shall be determined in accordance with EN 60439-1 based on the following criteria.

- Pollution Degree 3: For normal indoor applications
- Pollution Degree 4: For external / damp applications
- Voltage Category 4
- Inhomogeneous Electric Field

9.10 Degree of Protection

The degree of protection of the enclosure shall be in accordance with IEC 60529 and as summarized below.

- Local Distribution Boards – Minimum IP 43 – preferred IP 54
- Main Distribution Boards – Minimum IP 54
- External Distribution Boards – Minimum IP 65

Switchboards

10.1 Enclosure and Compartmentation

The form of separation for Switchboards i.e. Main or Sub Main Distribution Boards shall be shall be Form 4 Type 2 as described in EN 60439-1 and as summarized below.

- Busbars shall be separated from the functional units.
- The functional units shall be separated from each other.
- Cables shall be terminated within the functional unit and glanded at the top, bottom or side of the cable chamber.
- Separation shall be achieved by metallic partitions in all cases.

Switchboards shall be of metal clad construction using a proprietary modualar switchgear enclosure system such as Logstrup, Cubic or Elsteel.

The assembly shall be a multi-compartment distribution board comprising 1.5 mm sheet steel panels and rolled steel frame construction. The assembly shall have a bake-on powder spray finish in the manufacturer's standard colour. It shall have an ingress protection rating of at least I.P. 54.

The layout of the switchboard shall generally follow the following format as indicated in Appendix 1:

- Main incomer section for mains and generator supplies and multi function meters as required
- Main Horizontal busbars fully accessible
- Secondary Vertical busbars fully accessible
- Outgoer protective device compartments – vertically stacked adjacent to secondary busbars.
- Separate compartment doors shall be provided for each outgoer
- Cable compartment – Full Height adjacent to outgoer protective device compartments.

Glanding plates shall be supplied at top and bottom. It shall be suitable for over duct floor mounting.

10.2 Busbars Compartment

The switchboard busbars shall be of bare copper mounted in their own compartment. The complete system shall have an ASTA certified short circuit rating of 50kA for 3 sec at 400V.

The entire busbar assembly shall be a fully type tested system and the manufacturers shall supply short circuit test certificates for the system

The busbars and all associated connections shall be fully accessible from the front or top or bottom without having to remove switchgear.

A sheet of perspex or equivalent material shall be located behind the metal covers of the busbar compartment to enable safe inspection with a thermal imaging camera.

The busbar configuration shall be indicated on the busbar compartment covers as described later in this specification.

10.3 Cable Compartments

Cable compartments shall be provided in all switchboards beside and/or between the various vertical rows of outgoing protective devices. They shall be wide enough to ensure that cables can be

terminated easily and that cable-bending radii for the cables specified on the schematic drawings are not exceeded.

Each compartments shall be fitted with an earth busbar. Neutral bars shall not be permitted in this compartment. Neutral connections shall only be made onto a solid neutral link in the outgoer compartment.

10.4 Outgoer Protective Device Compartments

Each outgoing protective device compartment in the switchboard shall be door interlocked so that the switch or circuit breaker must be 'off' before the door can be opened. The interlock must be defeatable by insertion of a 2 mm diameter pin or equivalent.

Each compartment of the switch board shall be labelled to indicate the following:

- Function of compartment – e.g. Supply to Distribution Board G1
- Size and type of outgoing cable - e.g. 5X16 mm² XLP SWA PVC
- Max size of Fuse e.g. – Max Fuse 63A or where an MCCB is used Max thermal and magnetic settings - e.g. – Max trip Setting - I_n = 63A, I_m = In x 2.5

These labels shall be supplied by the LV switchgear manufacturer and fitted on site on completion of the works.

10.5 Surge Protection Devices

Surge Protection Devices (SPDs) shall be installed in switchboards and distribution boards as described below to suppress over voltages and transients due to network disturbances and or lightning strikes.

Class 1 SPDs shall be fitted to each main switchboard at supply the intake point to each building. Class 2 SPDs shall be fitted downstream at each local distribution boards. These units shall be rail mounted within a dedicated compartment of the switchboard or distribution board.

SPDs shall be of Furse manufacture or equal and shall comply with IEC 61643.

Where there is Lightning Protection System Specialist employed on the project The SPDs shall be supplied by that specialist and handed over to the switchgear manufacturer along with installation instructions.

10.6 MCCBs and ACBs General requirements

This section of the specification covers general requirements for Moulded Case Circuit Breakers (MCCBs) and Air Circuit Breakers (ACBs). Specific requirements in relation to each type is given below.

Unless otherwise indicated on the schematic drawings - ACBs – shall be used as main incoming protective devices for mains and generator supplies for ratings above 630 Amps.

MCCBs and ACBs shall be installed in appropriate cubicles in the Switchboard, with the appropriate busbars or cable connections as recommended by the manufacturer. Dimensions and ventilation of the cubicle shall be sufficient to dissipate the heat generated by the breaker at its nominal rated current.

Adequate space shall be provided above the breakers for the inspection and eventual replacement of the arc-chutes. Terminal blocks of the auxiliary circuit's terminals shall be easily accessible from the front of the breaker.

Were MCCBs and ACBs are indicated in the schematics they shall be of the same manufacture throughout. They shall provide protection against overloads, short-circuits, and, earth fault protection where indicated on the schematics.

All MCCBs and ACBs shall meet the following requirements in terms of their making, breaking and withstand capacities

- The Thermal Rated Current (Ith) shall be at least equivalent to the nominal current of the circuits they have to protect,
- The Service Breaking Capacity (Ics) shall be at least equivalent to the maximum presumed three-phase short-circuit current which may occur on their outgoing terminals.
- The Rated Making Capacity (Icm) shall allow the breakers to be closed on the maximum presumed three-phase short-which may occur on their out-going –terminals
- The short-circuit current withstand capacity (Icw) for 1 second shall be at least equal to the current corresponding to their Service Breaking Capacity Ics.

Internal accessories such as under voltage release coils, shunt trip coils etc shall be field installable and conveniently located behind the front accessory cover for easy replacement.

All MCCBs and ACBs in the switchboard shall be provided with duplicate volt-free contacts to provide “open”/“closed” and “trip” status signals to the BEMS.

All MCCBs and ACBs shall be provided with ancillary components to achieve the operational and control functions as specified or as required. These would typically power closing, under voltage releases and shunt trips as required to achieve the design intent as indicated on the schematic drawings.

All ACBs and MCCBs shall be fitted with electronic trips. Standard thermal and magnetic types shall not be acceptable.

Restricted Earth Fault (REF) relay protection shall be provided on all main circuit breakers to monitor earth leakage between the customer’s MV/LV transformer and the main LV breaker. This shall be provided whether indicated or not on the schematic.

With this protection scheme the medium voltage breaker shall be tripped once the REF setting is reached. The MV breaker should not be tripped under long, short or instantaneous over current faults.

10.7 Discrimination Study

The switchgear manufacturer shall select the circuit breaker trips to ensure full discrimination is achieved throughout the entire installation. Using the breaker manufacturers software and cable sizes and lengths to be confirmed by the contractor he shall submit computer calculations to indicate the prospective fault levels throughout the installation along with verification that full discrimination has been achieved.

10.8 ACBs – Specific Requirements

All ACBs shall comply with EN 60947-2 and EN 60947-3. All their electrical and operating characteristics shall be expressed in accordance with these standards. The reference ambient temperature shall be 40ºC.

Unless other wise stated all ACBs shall be withdrawable.

The operating mechanisms of the circuit breakers shall be of the “stored-energy quick-make” and “free-trip” type. They shall ensure “positive on” and “positive off” indications.

All settings shall be programmable on the field, without the use of any external device. A means of connection shall be provided for an external test device, allowing for periodical tests of the status of the electronics of the trip unit.

They shall be provided with independently powered tripping units such that the breaker does not trip due to under loading.

To avoid unauthorized tampering, the trip unit shall be sealable once adjusted (key-lock, or seal), behind a transparent door or plate, allowing the settings to be visible.

"Long Time" Protection against overloads shall be based on an inverse time/current characteristic adjustable between 0.4 and 1.0 times the rated current In.

A "pre-alarm" device shall be provided, to allow eventual load-shedding before an over-load trip occurs. A "thermal memory" shall be provided, adjustable to the type of load to be protected.

To allow discrimination with down-stream breakers, a delayed short-circuit protection shall be provided, with thresholds adjustable by steps, and ranging from 1.5 to 12 times Ir. The delay of this protection shall be adjustable from 0.1 to 1 second.

An instantaneous short-circuit protection shall also be provided, over-riding the delayed short-circuit protection, with its threshold adjusted to the current corresponding to the maximum breaking capacity of the ACB.

Where indicated on the schematic drawings ACBs shall also be equipped, with trip units to provide "Restricted earth fault (REF), Unrestricted earth fault (UEF) or Stand-by-earth fault protection (SEF). UEF and SEF relays shall include an I2t sensing device, allowing for an adjustable delay in the tripping time, to ensure discrimination with other down-stream ACB's.

A specific "over-ride" protection, independent of the trip unit, shall ensure the trip when closing the ACB onto a short-circuit. This "over-ride" trip shall be unoperative if the short-circuit occurs with the breaker already in its closed position.

The electronic trip unit shall be self-protected, and ensure the tripping of the ACB in case of its malfunction. It shall enclose an "excess temperature" device and signal, which shall trip the breaker if the temperature inside its installation cubicle reaches a temperature, which may damage the ACB or the trip unit.

ACBs shall be equipped with both a local indicator and an auxiliary contact indicating "springs charged" when its closing mechanism is ready for operation.

The trip unit shall have LED indicators or LCD display to indicate the following:

- In-service
- Over-load pre-alarm (current 1.1 Ir, 60% of thermal memory consumed)
- Tripped on "Long Time" - overload
- Tripped on "Short Time" - short circuit or inrush
- Tripped on "Instantaneous" protection
- Trip unit malfunction.

ACBs shall be equipped with a minimum of three volt free auxiliary contacts, operating simultaneously with the ACB and rated for 10 Amp and 250 VAC.

The trip unit shall provide 3 out-put signals, indicating:

- Pre-trip alarm - "Load-shedding required" alarm
- Tripped on external fault (overload or short-circuit)

An LCD display on the ACB shall indicate the following

- The current flowing through the ACB (phase by phase)
- The number of mechanical operations of the ACB
- A record of up to the last 16 trips

The trip unit shall have at least 4 inputs for external tripping signals, allowing the ACB to be remotely tripped. In addition the trip unit shall be able to communicate bidirectionally, via an RS485 serial connection and MODBUS protocol.

All ACB shall be equipped with a stored energy spring closing mechanism. The springs required shall be charged by means of a charging handle. The ACB shall be closed by means of green push-button marked "ON" and opened by means of a red push-button marked "OFF"

Where automatic closing is required e.g. as part of an automatic load transfer or load restoration system, an electrical motor shall charge the springs within 5 seconds.

In order to allow quick replacement and adaption to a different voltage, closing coils and trip coils shall be easily accessible from the front of the ACB, and require no tools for its replacement.

Unless otherwise greed with the engineer in writing all ACBs shall be withdrawable type so that the circuit breakers can be replaced without the need to power down the busbars. They shall be mounted on telescopic slide rails with limit stops and shall incorporate a racking mechanism capable of horizontally isolating the circuit breaker from the busbars and enabling it to be withdrawn from the housing for inspection and maintenance. The carriage shall incorporate a location latch and withdrawal limit stops.

The moving part of withdrawable ACBs shall have 4 positions inside its fixed part:

- “Inserted”, with main and auxiliary circuits connected.
- “Test”, with main circuits isolated, and auxiliary circuits connected
- “Withdrawn”, with main and auxiliary circuits disconnected
- “Extracted” (only for dismounting)

Except in the “Inserted” position, shutters will automatically close the access to the live parts of the mains at the rear of the ACB. “Test” and “Withdrawn” Positions shall not require the opening of the cubicle door.

The ACB shall automatically go into its “tripped” position and open its contacts, and remain open, as long as the withdraw handle is inserted in the withdraw mechanism.

The extraction handle for the withdrawable mechanism shall be stored in a convenient space inside this fixed part of the ACB.

All control and auxiliary circuit wiring shall be automatically connected / disconnected upon inserting/ withdrawing the moving part of the ACB. A plug and socket arrangement shall be provided for the isolation of the control and auxiliary circuits.

The fixed part of the ACB shall have a memory device, storing all the parameters of its movable part, down-loading them automatically into the replacement ACB as soon as it is placed into the movable part and reaches the “test” position.

To ensure highest safety for the operating personnel, the ACB shall be equipped with a key to lock the ACB in its withdrawn position, the insertion of the key being necessary to move the movable part into its “inserted” position. A padlocking device shall also be provided to lock for the shutters closed.

10.9 MCCBs – Specific Requirements

Moulded case circuit breakers (MCCBs) shall be of compact and modular design complying with EN-60947-2 standard.

Unless otherwise greed with the engineer in writing all MCCBs shall be plug-in type so that the circuit breakers can be replaced without the need to power down the busbars.

MCCBs shall typically range in standard IEC frame ratings from 125A up to 1600A. The frames shall be available in three interrupting capacities as follows:

- N - Normal
- H - High
- L - Very High

All MCCBs shall be fitted with interchangeable trip units with a choice of trip functions and features. The interchangeable trip units shall be available in three varieties as follows:

- Thermal-Magnetic
- Electronic
- Electronic with LCD display

MCCB with non-interchangeable trip units shall not be acceptable unless agreed in writing with the engineers.

Thermal Magnetic trip units shall not be acceptable unless agreed in writing with the engineers.

10.10 Switch fuses

Where switch fuses are indicated on the schematic drawings they shall be the fused switch disconnector type using either B.S. 88 or NH type HRC fuses. The complete switch fuse assembly shall comply with EN 60947-3.

Switch fuses shall be single or triple pole double break with a separate solid neutral. The switch shall provide reliable position indication.

Fuse links shall be stationary and fully isolated when the switch is in the OFF position to allow safe changing of fuses.

A Door interlocking facility in the ON position shall be provided. It shall be possible to defeated the interlock to facilitate inspection without isolation of the load. Padlocking with up to 3 padlocks in OFF position shall be possible.

10.11 Mains Generator Automatic Load Transfer Systems

Automatic Load Transfer (ALT) Systems for transfer of the load from one “Mains” to “Generator” shall be one of the following types as specified on the schematic drawings.

- Motorized breakers or contactors with by pass facility.
- Fully integrated units.

In each case they shall comprise mechanically and electrically interlocked switching devices as indicated to prevent both devices being closed at the same time.
In each case indicator lamps or equivalent shall be provided to indicate each of the following conditions:

- Mains Available
- Mains on Load
- Generator Available
- Generator on Load

Auxiliary Volt-free changeover contacts shall be provided within the unit for relaying of the following conditions to a BMS or other alarm monitoring facility system:

- Mains Available: This should indicate that the mains is present and within acceptable limits.
- Mains on Load: This signal should be taken from an auxiliary contact of the mains switching device.
- Generator Available: This should indicate that the alternator output is present and within acceptable limits.
- Generator on Load: This signal should be taken from an auxiliary contact of the generator switching device.

10.12 ALT – Motorized Breakers or Contactors with By Pass

Automatic Load Transfer (ALT) System shall be provided as indicated on the drawings. They shall comprise contactors or motorized breakers as indicated to. The essential components of the ALT are typically as follows:

- Mains contactor or motorized breaker
- Generator contactor or Motorized breaker
- Under voltage trip – (UVT) - mains breaker
- Under voltage trip – (UVT) - generator breaker

- Phase failure relay (PFR)
- Timer - Mains available
- Timer -Generator available
- Timer - generator start/stop
- Indicator lamps
- By pass switch.

The automatic changeover contactor or breakers shall be 3-pole for 3-phase supplies or single pole for single-phase supplies. Contactors shall be DIN rail mounting and shall have an AC 23 duty rating in accordance with EN 60947-4.

The mains under voltage unit shall continuously monitor the mains supply voltage (phase to neutral) on all three phases and initiate auto-starting of the engine should this voltage fall below the pre-set level on one or more phases.

The mains under voltage sensing level shall be precisely adjustable between 80% to 100% of nominal voltage. Differential adjustments shall be provided on each of the three phases, which shall be independent of each other and of the voltage level adjustment.

It shall be possible to set the differentials to within 5 volts of the pre-set voltage level and they shall have an adjustable range of at least 10 volts.

The mains under voltage unit shall be wired in such a way that the mains contactor or breaker will open immediately upon activation of the unit.

The ALT system shall be provided by-pass switch assembly to facilitate by pass of mains or generator. The switch by-pass assembly shall comprise 5 No 3 pole switches on a common operating shaft. The switches shall be 6 position, rotary actuated, with each switch closed at only one position in the full 360 **º** as indicated in the table below.

Switch Position		**Switch Functions and Status**				
		1	**2**	**3**	**4**	**5**
		Mains Bypass	**Mains Input**	**Gen Input**	**Gen Bypass**	**Mains / Gen Output**
NORMAL	**0º**	Opened	**Closed**	**Closed**	Opened	**Closed**
OFF	**60º**	Opened	Opened	Opened	Opened	Opened
MAINS BYPASS	**120º**	**Closed**	Opened	Opened	Opened	Opened
OFF	**180º**	Opened	Opened	Opened	Opened	Opened
GEN BYPASS	**240º**	Opened	Opened	Opened	**Closed**	Opened
OFF	**300º**	Opened	Opened	Opened	Opened	Opened

10.13 ALT – Fully Integrated Units

The Fully Integrated (ALT) system shall comprise two electrically and mechanically interlocked motorized back to back load break switches. The system shall have three 3 stable positions (I, 0, II) i.e. Source 1, Off, Source 2 with manual override in both the mains and generator positions.

It shall have an integrated voltage sensing kit, programmable controller and an autonomous power source. It shall be a fully pre-engineered system and shall require only assembly, programming and connection to mains, generator and load on site. The system shall have integrated changeover logic for Normal/generator Backup applications.

The unit shall be supplied to site with the following components fully assembled on a back plate to replace the existing motorized MCCBs.

- Two back to back load break switches with bridging bars
- Motorized module
- Power supply and AMF and control module
- Handle, key and interlocking accessories.
- Door protective surround.
- Auxiliary contacts for remote alarm monitoring – See below

- Door mounted remote interface unit.
- Plug-in optional modules.
- Voltage sensing and power supply kit.

The switchgear specialist shall include for full programming of the motorized changeover switch. He shall agree all necessary set points and time parameters with regards to voltage and frequency with the engineer.

The Automatic Load Transfer (ALT) system shall be rated as indicated on the schematic drawings and shall be from the Socomec ATyS6e range.

10.14 Mechanical Interlocking of Switches and Breakers

Where indicated on the schematic drawings, mechanical interlocking of switches and breakers in the switchboard shall be provided using an approved key operated mechanical interlock system such as Castell FS Interlock or equivalent.

The system shall be specifically designed for the control of electrical switchgear and must not be defeatable by removing covers or otherwise to operate the switch or breaker actuator internally. The lock and key shall be manufactured in stainless steel.

Where a switchboard is fed from two transformers a mechanical interlock system shall be incorporated between each main incomer and the bus-section switch to prevent parallel operation of the transformers. This shall be achieved by means of a “two key three lock” mechanical interlocking system as described above.

A Key exchange unit shall be supplied where the interlock system extends beyond a simple “two key three lock” arrangement. The key exchange system shall be configured to trap and release keys in a pre-determined sequence, depending on the operating requirements of the safety interlocking system.

10.15 Residual Current Monitors

Residual Current Monitors (RCMs) shall be provided where indicated on the drawings. These non-switching devices shall continuously monitor and indicate the level of the residual current in the earthed systems (TN and TT Systems). A prewarning shall be actuated (by an LED bargraph indicator) as soon as the set residual current is exceeded. These monitors shall be rail mounted within a dedicated compartment of the switchboard. They shall be of Bender manufacture or equal and shall comply with IEC 62020.

The unit shall be provided with a volt free alarm output for remote monitoring.

10.16 Multi Function Meters

Multi function meters shall be fitted as indicated on the schematic drawings to provide digital indication of true RMS values of phase and line voltages, phase currents and real, apparent and reactive power.

The meters shall be recessed into the relevant outgoer compartment door. They shall have LCD display and individual direct access key for the following functions:

- Instantaneous and max currents values.
- Voltages and frequency.
- Active, reactive and apparent power (instantaneous and max values)
- Power factor.
- Energy over a specified period.

It shall be possible to centrally read these parameters on a PC or a PLC through an RS485 link using JBUS/MODBUS protocol. The Meters shall be also be provided with pulsed outputs for monitoring of energy usage and maximum demand values by the Building Energy Management System (BEMS).

The Multi function meters shall be from the Socomec DIRIS A20 range or equivalent.
Current transformers (CTs) shall be located in the relevant outgoer compartment and shall be securely fixed to the back plate. The nominal secondary current of all current transformers shall be 5

Ampere and shall have accuracy class 1 designation. Current transformers shall be protected to avoid damage from open circuit. Insulation shall be of the encapsulated resin type.

All control wiring shall be connected via DIN rail terminals and shall be complete with a terminal designation chart fixed to the inside of the terminal cover.

11. FINAL CIRCUIT Distribution Boards

11.1 Introduction

This section generally refers to final circuit distribution boards which are fed from the main switchboard or a sub main distribution bard. These final circuit boards and typically feed lights, sockets and small power final circuits.

11.2 Distribution Board Assembly

The form of separation for Final Circuit Distribution Boards shall be shall be Form 2 Type 2 as described in EN 60439-1 and as summarized below.
Function units are not required to be separated from each other i.e. typically modular devices mounted side by side.

Main busbars feeding individual distribution board sections e.g. lighting, power etc shall be within their own compartment partitioned from the functional units by metallic or other fire retardant material.

Submain busbars serving rows of MCBs, RCBOs etc shall be separated from functional units by means of proprietary insulated covering on the busbars.

Main busbars feeding individual distribution board sections e.g. lighting, power etc shall be within their own compartment partitioned from the functional units by metallic or other fire retardant material.

Distribution boards may form part of a “switchboard” as previously described or they may be stand alone. Where they do form part of a switchboard the enclosure shall be of the same design as the main switchboard. Bolt on cabinets shall not be acceptable.

For stand alone type distribution boards the enclosure may be formed from the same metal work system used for the switchboards or alternatively a cabinet type enclosure may be used as described below.

Cabinet type enclosure shall be of sheet steel construction minimum thickness 1.5 mm, electrolytic galvanized with raised doors and sealing profile. Glanding plates shall be supplied at top and bottom. It shall be suitable for surface wall mounting. The cabinet shall have a bake-on powder spray finish in the manufacturer’s standard colour. It shall have an ingress protection rating of at least I.P. 54.

The interior shall consist of a supporting frame, top hat rails etc. It shall be fitted with touch/flash guards manufactured from sheet steel or other heat resistant self-extinguishing materials of proprietary manufacture.

11.3 Busbars

All final circuit distribution boards shall be provided with a main busbar section. Multiple loops from the main isolator or looping from isolator to isolator shall not be acceptable.

The busbars shall be of tinned copper mounted in their own compartment. The bars shall be predrilled and fitted bolts to accept up to 25 mm² tails. The busbar assembly shall be a fully type tested system and the manufacturers shall produce short circuit test certificates upon request.

Sub main busbar serving rows of MCB etc shall be pre-insulated comb busbar type in three pole format so that three single pole MCBs can be replaced by a triple pole MCB or vice versa.

11.4 Internal Wiring

The minimum size conductor between the protective device and the outgoing terminals in the distribution Board shall be as follows.

- Lighting Section 2.5 mm²

- Socket Section 2.5 mm²
- Small Power Section 4.0 mm²

11.5 Main and Sub Main Switches

The main switch for each distribution board shall be a rotary padlockable double break type with neutral link to EN 60947-3.
Sub-switch fuses for each section shall be similar with HRC fuses where indicated or where required for back up protection of the downstream MCBs.

Covers shall be interlocked so that the switch or circuit breaker must be 'off' before the cover can be removed.

11.6 Final Circuits Shall Protective Devices

All final circuits shall be protected by MCBs or RCBOs as described in the following paragraphs.

MCBs shall comply with EN 60947-2 and shall be minimum 6kA rated and shall be 'Type B' characteristic unless otherwise specified.

Unless otherwise noted on the drawings the following shall apply in respect of outgoing protective devices.

- Lighting circuits 10 A type 'C' SP MCBs.
- Sockets etc 20A X 30 mA Type 'B' SPN - A Class RCBO

Residual Current Devices RCDs include the RCBOs and RCCBs as described below. Unless otherwise specified on the schematic drawings all RCDs shall be 30 mA sensitivity.

RCBOs (Residual current operated circuit-breaker with integral over current protection) shall comply with EN 61008 - These devices are used for the majority of applications where RCD protection is required.

RCCBs (Residual current operated circuit-breaker without integral over current protection) conforming to EN 61009 shall not be used unless otherwise agreed in writing.

The following is a summary of the different type of RCDs types and where they may be used.

Type AC RCDs ensure tripping for residual AC currents, whether suddenly applied or slowly rising. RCBOs of this type shall not be accepted unless agreed in writing with the engineer.

Type A RCDs ensure tripping for residual AC currents and pulsating DC currents, whether suddenly applied or slowly rising. Unless otherwise specified all RCBOs shall be of this type.

Type B RCDs ensure tripping for residual AC currents, pulsating DC currents and smooth DC currents, whether suddenly applied or slowly rising. These shall only be used where specifically called for on the schematic drawings

All of the above shall be manufactured by Schneider or ABB .

11.7 Contactors and Motor Starters

Contactors shall be DIN rail mounting and shall have an AC 23 duty rating in accordance with EN 60947-4.

Each motor starter shall be complete with MCB, contactor and thermal overload, selected to provide Type 2 co-ordination.

Each motor starter control circuit shall be complete with "run and trip" indicator lights and a "hand - off - auto" switch.

Each duty / standby control circuit shall also be complete with a 1 / 11 duty select switch.

Indicator lights shall be multicell LED type and shall be provided for panel live, Run & Trip status of all motors, Boiler lock out, Air flow failure, Fire interlock etc.

11.8 External Lighting Control

All external lighting distribution boards shall be fitted with an astronomical time switch which shall automatically switch on and off the lighting contactor at dusk and dawn. The units shall incorporate a digital time switch to enable programming of times to override the astronomical control element and switch off the lighting in advance of dawn.

All astronomical time switches shall be of modular design, with change-over contacts rated at 16 Amps resistive, with manual over-ride facility and 150 hours battery reserve.

11.9 Central Test Units for emergency lighting

Central test units (CTU) shall be provided within each of the lighting distribution boards for all self-contained emergency lighting systems. They shall have the following features: -

- 'On/off' control switch.
- ' ½ Hour / 3 Hour' selector switch.
- 'Emergency Lighting on Test' indicator.
- 'Test Complete' indicator.
- Interposing relays.

When the system is in test mode a 220 Volt signal shall energize one or more interposing relays to break the feeds to emergency points and shall automatically reset after the selected test period.

The interposing relays shall be multipole normally closed relays or contactors rated at 10 Amps minimum.

11.10 Change Over Panels for Dual A&B Supplies

Change Over Panels (COPs) shall be provided as indicated on the drawings to enable automatic transfer of critical loads from the A to the B supply or vice versa. The essential components of the ALT are as follows:

- Contactors
- Phase failure relay (PFR)
- Timer
- Indicator lamps
- Source select key switch.

They contactors shall be mechanically and electrically interlocked to prevent both devices being closed at the same time. They shall be 3-pole for 3-phase supplies or single pole for single-phase supplies. Contactors shall be DIN rail mounting and shall have an AC 23 duty rating in accordance with EN 60947-4.

The PFR unit shall continuously monitor the mains supply voltage (phase to neutral) on all three phases and initiate the load transfer should the supply voltage fall below the pre-set level on one or more phases.

LED type Indicator lamps shall be provided as follows:

- Supply A Available
- Supply A on load
- Supply B Available
- Supply B on load

When one of the two supply fails the load will automatically transfer to the other supply. When both supplies fail the load will automatically transfer to the first supply that becomes available.
A Source Select Key Switch shall allow either the A or B supply to be selected manually.

11.11 Pan Assembly Type Distribution Boards

This type of distribution shall be only used where it is specifically called for on the schematic drawing.

Pan Assembly units metal clad distribution board complete with 100A or 250A main switch as required. They shall be designed for surface mounting or for flush mounting using flush mounting kit.

The Busbar ratings shall be 250A for TPN boards and 125A for SPN boards. The busbar system shall have a distributed neutral allowing 2 or 4 pole switching at any outgoing way. They shall be designed, manufactured and tested to EN 60439-3.

They shall have an ingress protection IP31 to EN 60529. They shall be epoxy powder coated in the manufacturer's standard colour. They shall be from the "Isobar 4" range as manufactured by Schneider , ABB or equal and approved.

11.12 Consumer Unit Type Distribution Boards

Other than domestic application i.e. within the confines of a private residence Consumer Unit type Distribution Boards shall not be used.

Consumer units shall have IP40 degree of protection and shall be double insulated. They shall comply with IEC 60670 governing insulating enclosures for modular switchgear.

Consumer units shall be available in the colour of RAL 9016 white. Consumer units shall be for domestic or commercial locations, complete with a single door – transparent tinted. They shall be available in single, two – or three – tier models as required.

The base of each consumer unit shall be equipped with a special system of shrouding for the wall fixing holes, with integral plastic elements which shall ensure insulation substantially superior to that required by the standard.

Terminal bars (neutral and earth) shall be installed in the upper and lower areas of the consumer units. The terminal bars shall snap directly onto the base requiring neither screws nor tools and shall be installed in pairs (two terminals above and two below).

Moulded pre-cuts shall be provided inside the cover, the dimensions of which correspond to those of the trunkings most widely available commercially. Conduit fixture achieved by means of flanges supplied, which are fixed to the base of the consumer unit provided with moulded knockouts for conduits of up to 40mm in diameter.

In two-tier or three-tier consumer units (from 24 to 54 modules) it shall be possible to withdraw the chassis for wiring. The consumer unit shall also have a facility for inclining the frame to ease the task of connecting the incoming and outgoing cables.

The main switch fuse shall be shall be of Neozed design. All MCBs shall be minimum 6KA rated and shall be 'Type B' characteristic unless otherwise specified. Contactors shall be DIN rail mounting and shall have an AC 23 duty rating in accordance with EN 60947 - 4. All control wiring shall be connected via DIN rail terminals and shall be complete with a terminal designation chart fixed to the inside of the cover.

The consumer units shall be manufactured, by one of the following, Schneider or ABB Manufacturing or equal and approved.

11.13 Isolation Transformers:

Isolating transformers shall be dual wound, centre tapped to earth on the secondary side, 1:1 ratio, (230 V: 230 V). The KVA rating shall be as indicated on the drawings.
Primary and secondary over current protection shall be provided. The secondary over current protective device shall be a double pole MCB with shunt trip facility.

Earth leakage protection shall be provided by means of a suitable sensor which shall operate the shunt trip on the secondary MCB. A test button shall also be provided.

The transformer and its associated protective devices shall be housed in a suitable ventilated metal enclosure.

12. E.S.B. Metering

12.1 Introduction

It shall be the responsibility of the switchgear manufacturer to comply fully with all requirements of the latest version of the National Code of Practice for Customer Interface as published by the ESB.

12.2 E.S.B. Metering Compartments

Where indicated on the schematics the main switchboard shall contain separate compartments for WC meters and / or metering CTs. Sized in accordance with the National Code of Practice for Customer Interface.

12.3 E.S.B. Metering Panels

E.S.B. Metering switchboards shall be built in accordance with the current edition of the National Code of practice for Customer Interface.

For large commercial developments e.g. multi tenant occupied OPW office blocks with multiple CT meters or mixed WC / CT meters the panel shall be compartmented to Form 4 Type 2 and shall generally comply with the Switchboard Section of this specification

For smaller developments with multiple WC meters the panel shall be compartmented to Form 2 Type 2 and shall generally comply with the Distribution Board section of this specification

13. POWER FACTOR CORRECTION EQUIPMENT:

13.1 Introduction:

Power factor correction equipment shall comply with and conform to the current issues of the relevant I.E.C. and European Standards as follows.

IEC 60831-1 - Shunt power capacitors of the self-healing type for a.c. systems having a rated voltage up to and including 1000 V - Part 1: General - Performance, testing and rating - Safety requirements - Guide for installation and operation.

IEC 61642 - Industrial a.c. networks affected by harmonics - Application of filters and shunt capacitors.

IEC 61921 -Power capacitors - Low-voltage power factor correction banks

General Arrangement of Equipment:

Specific details of the power factor correction equipment shall be as indicated on the schematic drawings. Power factor correction equipment shall comprise capacitors and reactors assembled in a sheet steel enclosure together with switchgear, relays, protective fuses, reactive power regulators and main isolator.

The complete assembly shall be connected so as to automatically control the switching 'in' and 'out' of the capacitors to maintain the load power factor at the specified level and filter out unwanted harmonics.

13.3 Capacitors:

The capacitor unit shall comprise a suitable number of capacitor elements to achieve the required KVAR output.

The capacitor dielectric shall be zinc metalised polypropylene film to provide low losses and shall have self-healing characteristics and shall be liquid free.

Each element shall incorporate a secondary set of solid foil electrodes together with an individual element fuse link to ensure safe disconnection at the end of normal working life.

The capacitor elements shall be incorporated in a steel container with inert non toxic granular filling to surround every element. Aluminium cooler plates shall be provided to effect heat dissipation from the elements to the container.

The capacitors shall comply with the requirements of IEC 60831, Part 1 and Part 2.

13.4 Reactors:

Reactors shall be connected in series with capacitors to form a series resonant circuit, tuned so as to act as a low impedance source to the range of harmonic currents likely to prevail in the installation. Reactors shall be formed using copper conductor coils wound on laminated iron cores.

The switchgear specialist shall include for carrying out a power quality analysis on site to determine the range of harmonics on the network He shall include for doing this when the building is fully occupied.

Based on this information he shall determine the tuning frequency of the harmonic filters and select the series reactors accordingly.

He shall use a high quality power analyser and produce a report outlining his findings and recommendations before manufacture of the harmonic filters commence.

For the purpose of tendering the following harmonic distortion shall be assumed.

- 3rd – xx%
- 5th – xx%
- 7th – xx%
- 11th – xx%
- 13th – xx%

13.5 Switching:

Capacitor units shall be switched by contactors controlled by a KVAR regulator. Each switched stage shall incorporate soft start cascade switched contactor sections not exceeding 25 KVAR at 415 V, each equipped with inrush limiting devices in order to significantly reduce the inrush transients associated with power capacitor energisation. Each stage of correction shall be protected by HRC fuses.

Exact ratings and interconnecting of contactors, switchfuses, cables, etc. shall be in accordance with the power factor equipment supplier's recommendations and drawings.

13.6 Reactive Power Regulator:

The reactive power regulator shall be a microprocessor-based multi-step regulator, digital display, mounted on a hinged door of the sheet steel enclosure and shall have the following features:-

- Automatic CT polarity retrieval (to be disabled when required).
- Automatic frequency selection 50 Hz or 60 Hz.
- Settings for inductive and capacitive current.
- Setting for inductive and capacitive target power factor (cos-phi).
- Setting for operation delay.
- Operation delay shall shorten automatically with heavy over compensation.
- Plug-in connectors at rear panel.
- Separate alarm relay with volt free contact.
- Manual operation facility.
- Protective momentary no voltage reset function.
- Watchdog for eliminating possible interference problems.

13.7 Equipment Enclosure:

The complete automatic power factor correction system shall be housed either within a separate cubicle of the main switchboard or in a separate sheet steel assembly.

The capacitors shall be housed in a lower compartment, the volume of which shall be advised by the capacitor manufacturer/supplier subject to a minimum of 1000 cm^3 per KVAR.

Filtered air extract and intake grilles shall be provided at the top and bottom respectively of the capacitor compartment cover to give adequate ventilation.

A thermostatically operated extract fan shall be provided to draw air across the capacitors if required.

14. Replacement of Existing SWITCHGEAR

14.1 Introduction

This section of the specification covers requirements in relation to replacement of existing distribution boards or switchgear in buildings as may be required.

Prior to commencing the replacement of existing distribution boards the contractor shall survey the board and its associated circuits to determine the full scope of works required.

14.2 Load Monitoring

All loads served by the distribution board should be monitored using a power analyzer capable of providing the following information on a phase by phase basis.

- KW – Real Power.
- KVA – Apparent Power.
- KVAR – Reactive Power.
- Power factor.
- % Harmonic Distortion – Current.
- % Harmonic Distortion – Voltage.

The information recorded should be saved as spreadsheet files with the peak demand values highlighted in each case. Each file should be clearly identified by name of the distribution board or load as described above. A copy of the recordings should be forwarded to the engineer for analysis and recommendations.

14.3 Testing of Circuits

The contractor shall carry out the following tests on each existing circuit associated with the distribution board. Tests shall be carried out as outlined in the latest edition of the ETCI National Rules for Electrical Installations:

- Insulation Resistance Tests
- Earth Continuity
- Line Earth loop impedance.

He shall carry out a full visual inspection of the entire installation. He shall open up and inspect each distribution board, marshalling boxes, lighting and socket points etc relative to the contract works and examine the wiring and connections within. All defective parts of the installation shall be photographed and presented to the engineer for further instruction.
Recording of Survey Information
The survey information shall be recorded onto circuit designation charts using typed spread sheets with clear unambiguous information in the format indicated below. A separate chart shall be provided for each distribution board.

Dist Board Reference			**DB 2.5L**		Location		Room 5	**Test Results**		
Cct No.	Location	Load Connected	Protective Device		Wiring			Insul Res	LEL Imp	RCD Trip
			A	Type	Size mm2	Type	Cable Mangnt	MΩ	Ω	Secs
1R	Room 1	6 No 2X58W corrosion proof	10	Fuse	1.5	PVC	Steel Con & Trunk			
1S	Room 2	1 No 3kW undersink water heater	10	Fuse	2.5	PVC SWA PVC	Tray			
1T	Room 3	6 No Twin sockets	10	Fuse	4	NYMJ	Clipped direct			

14.4 Survey drawings

Using the survey drawings provided the contractor shall mark up the circuit references for all circuits associated with the replacement distribution board. These shall include lighting and emergency points, socket outlets, small power points serving water heaters, hand driers, PSUs for security systems etc. This information must correlate with the circuit designation charts referred to above

These drawings shall be handed back to the OPW for production of record drawings in electronic format.

14.5 Link Boxes

The replacement distribution board shall be designed to pick up all existing sub mains and final sub Circuit wiring in so far this is practically possible. Where it is not possible to extend existing wiring to the new the contractor shall supply and install metal clad link boxes with DIN rail terminals labelled with suitable warning notices. E.g. “Joint Boxes for Circuit N°s G5 112 – 31R and G5 112 – 3B. Switch off MCBs to isolate supplies”.

14.6 Retention of Existing Wiring

Where existing final circuit wiring serving lighting, sockets and power services is to be retained the following parameters shall not exceed without further consultation with the engineer.

- 1.5 mm² lighting circuit – 6 Amp type B MCB
- 2.5 mm² lighting circuit – 10 Amp type B MCB
- 2.5 mm² radial socket circuit – 16 Amp type B / A TYPE RCBO
- 4.0 mm² radial socket circuit – 25 amp type B / A TYPE RCBO

14.7 Colour Coding

All existing cables to be reconnected to the replacement distribution boards shall be fitted with coloured heat shrink sleeving to meet new colour coding requirements of the current ETCI.

Where it is not practical to sleeve cables the contractor shall install warning notices on all replacement distribution boards using red/white/red triplex engraved labels. A sample label should be submitted for approval on the basis of the following wording – “**Warning: Circuits wired from this Distribution Board contain the following mixed wiring colours”:**

Conductor	Pre 1990s System	1990s System	Current
Phase - L1	Red	Brown	Brown
Phase - L2	Yellow	Red	Black
Phase - L3	Blue	Yellow	Grey
Neutral	Black	Blue	Blue
Protective	Green Yellow	Green Yellow	Green Yellow

14.8 Removal of Obsolete Switchgear

The contractor shall include for the disconnection, taking down, removal from site and disposal of all obsolete switchgear, electrical fixtures, cable management systems and cabling from the site in accordance with the current WEEE (Waste Electrical and Electronic Equipment) directive 2002/96/EC.
The contractor is deemed to be familiar with these regulations and should include for full compliance within his tender submission. Any Switchgear assembles or components which may be of use to the OPW in the future shall be retained.

15. Identifications & Labelling

15.1 General

All LV switchgear shall be clearly and permanently marked to indicate the following:

- Name of manufacturer
- Nominal voltages and frequency
- Rated currents
- Serial number or other identification of the equipment
- Date of manufacture

The suggested label schedule shall be submitted to the Engineer for his approval prior to manufacture.

Danger labels shall also be provided for on interlocked covers enclosing exposed conductors stating `Danger 400 volts' in block capitals.

Where there are two or more incoming supplies, this shall be clearly indicated at each point of isolation.

15.2 Compartment Labels

Suitably engraved Traffolyte labels, white/ black/ white, 100 x 50mm minimum size, shall be screw fixed on the front of each compartment of the switch board to indicate the following:

- Function of compartment – e.g. Supply to Distribution Board G1
- Size and type of outgoing cable - e.g. 5X16 mm² XLP SWA PVC
- Max size of Fuse e.g. – Max Fuse 63A or where an MCCB is used Max thermal and magnetic settings - e.g. – Max trip Setting - I_n = 63A, I_m = In x 2.5

These labels shall be supplied by the LV switchgear manufacturer and fitted on site on completion of the works.

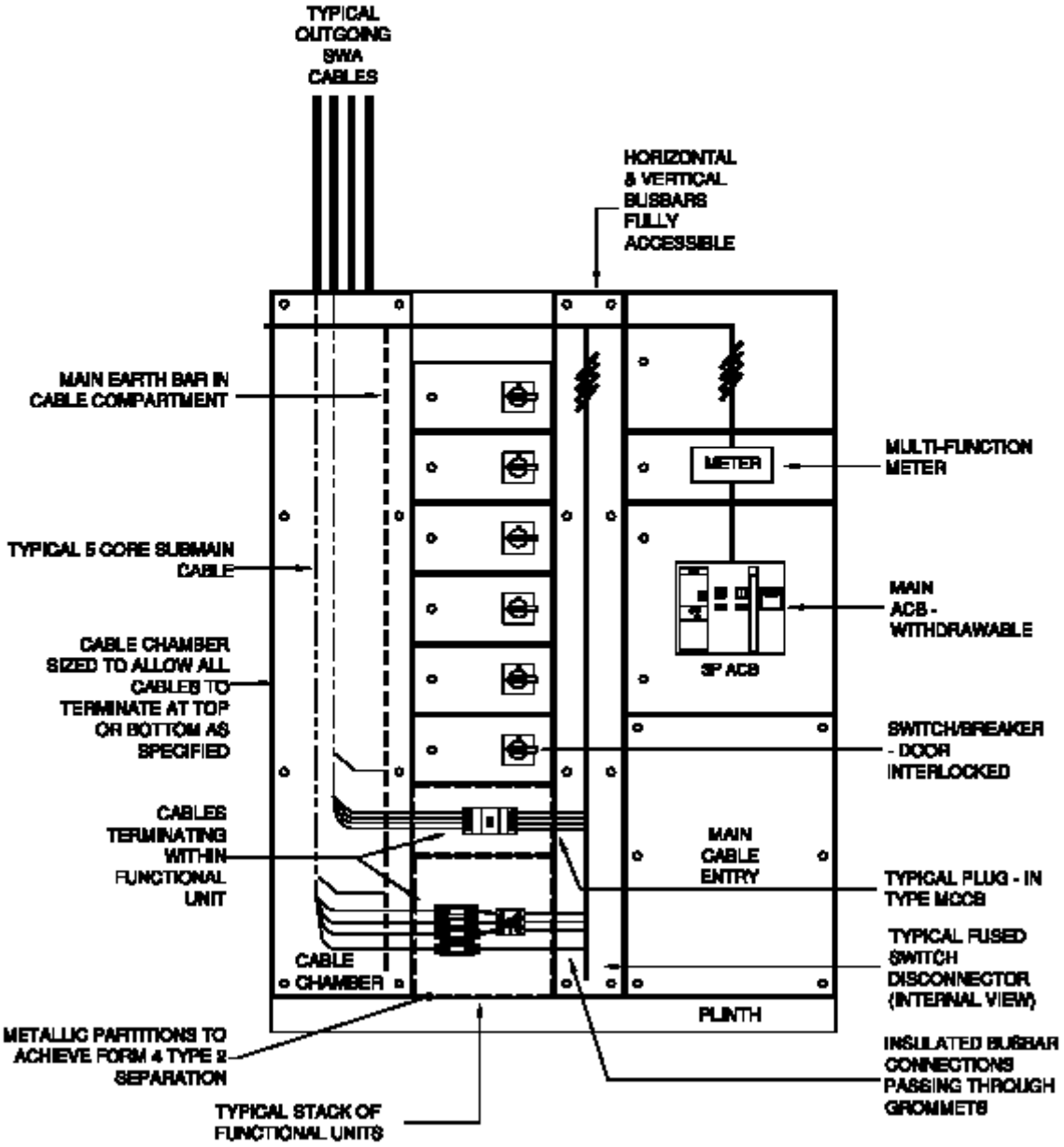
5.3 Busbar Configuration

The busbar configuration shall be indicated on the busbar compartment covers using adhesive triplex labelling material minimum 10mm wide throughout. The following colour coding system shall be used or a variation of this depending on the complexity of the system;

Essential Services	–	Red
Non-essential Services (Mains Only)	–	Green
UPS Services	–	Orange

Appendix 1 – Typical Switchboard – Form 4 type 2 Construction

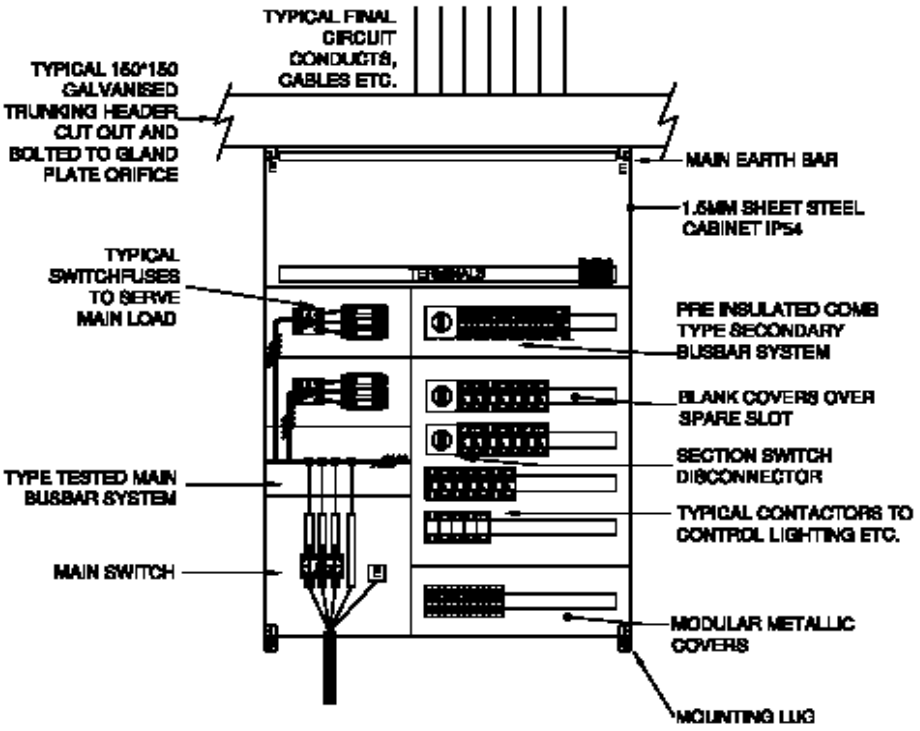
APPENDIX 1:
EXTERNAL FRONT VIEW OF TYPICAL SWITCHBOARD (MAIN OR SUB MAIN DISTRIBUTION BOARD) TO FORM 4 TYPE 2 CONSTRUCTION



Distribution boards over 100kVA shall be Form 4 / Type 2 (functional units separated from each other and busbars, cables glanded elsewhere, terminals associated with functional units to be located in the same compartment as the functional unit. Separation by metallic or non-metallic rigid barriers)

Appendix 2 – Typical distribution board – Form 2type 2 Construction

APPENDIX 2:
INTERNAL FRONT VIEW OF TYPICAL FINAL CIRCUIT DISTRIBUTION BOARD ETC TO FORM 2 TYPE 2 CONSTRUCTION



All sub-distribution boards shall be Form 2b / Type 2 (functional units and terminals separated from busbars but not from each other – separation by metallic or non-metallic rigid barriers) , except for din rail mounted protective devices (switchgear) where type 1 separation may be used (separation by insulated coverings)

17. GENERAL METHODS OF INSTALLATION LIGHTING AND POWER

17.1 General

The following descriptions of the methods of installation are intended for guidance in tendering and carrying out of installation work on the electrical systems in buildings. Job specific tender documentation will in most cases describe the method of installation. Refer to Particular Specification and Description of Work for these job specific requirements.

17.2 Cabling

Type 1
Galvanised steel trunking and conduit with pvc cables generally routed in voids and where necessary on the surface.

Type 2
Armoured cable on galvanised steel tray.
Type 2.1
XPLE LSF Armoured cable
Type 2.2
PVC/SWA/PVC Cable

Type 3
Unarmoured cable on galvanised steel tray.
Type 3.1
NYY cable on galvanised steel cable tray or ladder.
Type 3.2
NYMJ on galvanised steel tray and locally in galvanised steel tubing.

Type 4
Cable fixed directly to the building.

Type 5
Buried directly in the ground. This method of installation shall only be used for armoured cable with a waterproof oversheath.

Type 6
Formed concrete duct or void designed exclusively for the purpose of accommodating cabled services.

Type 7
Radox or similar screened composite cable in straight lengths of galvanised steel tubing. The tubing shall not be provided at the bends the radius of the cable at the bends to meet with the manufacturers guidelines as per British Standards.

17.3 Lighting Installation

The lighting installation shall be in cabling method Type 1.
The installation will generally be in ceiling voids where permanent access is provided. Where such access is not provided see below for installation details. From the local distribution board circuits – phase, neutral and earth, including emergency lighting circuits - shall be terminated at local terminal boxes (Klippon or similar). The connectors shall be din-rail mounted and shall provide connections to local switching and light fittings. The terminal boxes shall be arranged in a modular fashion to match building layout or similar regular pattern.
Galvanised tubing to luminaire connection point with the final flex connection to the luminaire through a Klix socket. There shall be one Klix unit per luminaire.
The maximum length of flex which shall be 2000mm. No flexible cables shall pass through or be routed in partitions without the express written instructions from the engineer.

Switch drops shall be in galvanised tubing or in the case of stud partitions may be in armoured cable or armoured flexible conduit as appropriate. The maximum length of flexible conduit measured from the ceiling level to the rigid conduit or trunking system shall be the sum of the ceiling void depth plus 250mm.

In situations where permanent access to the ceiling void is not provided care must be made to ensure access to all cable joints. In such circumstances a loop-in conduit system or a Type 2 method of installation as described above – armoured cable on cable tray – shall be required. All cable terminations and lighting connection points shall be within reach of ceiling openings as may exist for recessed light fittings and the like.

Where the installation is recessed in concrete or blockwork/rendering the installation shall be entirely in galvanised steel conduit.

17.4 General Services

The general service installation such as socket outlets and wiring to fixed appliances shall be as described for lighting as in the case of ceiling voids, partitions including specific limitations and restrictions as detailed.

Raised Floor Installations

In proprietary raised floor voids the cabling system shall be one of the following systems:

a) Type 2 installation as described above to local plug-in units or proprietary busbar units. Armoured flexible cables from plug-in units to floor mounted service outlet boxes. Flexible cables shall be glanded.
b) Type 3.2 Installation wired directly into service outlet boxes. NYMJ cables shall be glanded with PG glands. The maximum distance for a cable to be run unsupported shall be 400mm.

Ceiling Voids and Partitions

The standard method of installation shall be **Type 1** or **Type 2.1** unless otherwise specified.
Drops to outlets shall be in galvanised tubing or in the case of stud partitions may be in armoured cable or armoured flexible conduit as appropriate. The maximum length of flexible conduit measured from the ceiling level to the rigid conduit or trunking system shall be the sum of the ceiling void depth plus 250mm.

In situations where permanent access to the ceiling void is not provided care must be made to ensure access to all cable joints. In such circumstances a Type 2 method of installation as described above – armoured cable on cable tray – shall be preferable. All cable terminations of ceiling openings as may exist for recessed light fittings and the like.

Circuit Labels

See also "IDENTIFICATION OF ELECTRICAL SERVICES" SECTION

Each outlet for lighting, socket outlet, fused spur, floor box, etc shall be labelled indicating the distribution board or sub-board from which it is fed and the circuit number.
e.g. A socket labelled in the following manner: **SB7/12** would indicate that the socket is fed from circuit 12 on sub-board 7.
Labels shall be engraved "Traffolite" save in circumstances that the outlet is concealed in a ceiling or floor void where self adhesive paper may be used.
Outlets feeding appliances shall have such appliance indicated on the label.

All labels shall consist of black text on a white background unless otherwise stated.

17.6 Standard Cable Sizes

The following table lists standard default minimum cable sizes for inertnal wiring.
The contractor is advised to seek confirmation of cable sizes not specified in the job specific documents.

Service	Length	Max No.	Max	Cable	Protective Device

		Outlets	Loading	Size	
Lighting	**<**35 metres	**8**		**1.5sq**	**10amp C Type MCB**
	>35 metres	**8**		**2.5sq**	**10amp C Type MCB**
Sockets	**<**35 metres	**10**		**2.5sq**	**20amp B Type RCBO**
	>35 metres	**10**		**4sq**	**20amp B Type RCBO**
Hand Dryers	**<**35 metres	**1**		**4sqsq**	**16amp B Type RCBO**
	>35 metres	**1**		**6sqsq**	**16amp B Type RCBO**

17.7 Hand Dryers Installation

The contractor shall supply and install hand dryers as detailed on the drawings. Hand dryers shall be mounted 1200mm above the finished floor level except in the case of a disabled toilet where the mounting height shall be 900mm. Hand dryers shall be wired in via a recessed 13amp switched fused connection outlet with indicator light. The connection outlet shall generally be located 300mm above the finished top level of the hand dryer or adjacent to the hand dryer. There will be no more than one hand dryer per circuit. All hand dryers shall be automatic and shall be selected one of the following:

- Flowsave T3 Automatic
- Redring AD30 Automatic
- World Dryers MR48 Automatic

18. LV SWITCHGEAR AND DISTRIBUTION BOARDS

18.1 MAIN DISTRIBUTION:

The Electrical Specialist shall include for the installation of a main distribution board and attendance on E.S.B. for the installation of metering as shown on the relevant drawings.

The Electrical Specialist shall also include for the installation of the sub-distribution boards as indicated on the drawings and documents.

18.2 L.V. Switchgear.

18.2.1 Switchboards shall be of metal clad construction including all external housing and doors and internal dividers and guards. The assembly shall be a multi-compartment switchboard of 1.5mm sheet steel construction and shall be compartmented to Form 4 Type 3, IP55 rated with each compartment clearly labelled. Partition fillets shall be of sheet steel manufacture. It shall be of cubicle design with separate compartment doors for each out goer.

18.2.2 Glanding plates shall be supplied at top and bottom. It shall be suitable for over duct floor mounting. The assembly shall have a bake-on powder spray finish in the manufacturers standard colour. It shall have an ingress protection rating of at least I.P. 54.

18.2.3 The busbars shall be of bare copper mounted in their own compartment. The busbars and all associated connections shall be fully accessible throughout without having to remove switchgear. The busbar assembly shall be a fully type tested system and the manufacturers shall produce short circuit test certificates upon request.

18.2.4 Cable compartments shall be provided between the various vertical rows of switchfuses. They shall be wide enough to ensure that cables can be terminated easily and that cable-bending radii are not exceeded. Each one shall be fitted with an earth busbar.

18.2.5 Each compartment shall be door interlocked so that the switch or circuit breaker must be ‘off’ before the door can be opened.

18.2.6 Contactors shall be DIN rail mounting and shall have an AC 23 duty rating in accordance with IEC 251.

18.2.7 The main switchboard shall contain separate compartments for E.S.B. WC meters and / or metering CTs and the switchboard manufacturer shall be responsible for meeting all E.S.B. metering requirements prior to construction of the board.

18.2.8 The main switchboard and all remote area switchboards shall be equipped with surge protection units to suppress over voltages and transients due to network disturbances and or lightning strikes. These units shall be rail mounted within a dedicated compartment of the switchboard. They shall be of Furse manufacture or equal and shall comply with the latest relevant BS / IEC standard and fused at 60A. HBC

18.2.9 All ACBs, MCCBs and MCBs shall be of the same manufacture throughout. All main air circuit breakers shall be fully withdrawable. Sub-main MCCBs shall be fixed type. All MCBs shall be minimum 10 KA rated and shall be ‘Type C’ characteristic unless otherwise specified.

18.2.10 Isolation of main boards and of individual sub-boards shall be as follows:

- 1.3.10.1 Up to 250Amp switches and switch fuses
- 1.3.10.2 250 Amp to 400 Amp MCCB’S to IEC 157-1, BS4752
- 1.3.10.3 400 Amp and above MCCB’s to IEC 157-1 with rated prospective short circuit current @40 KA and tested to IEC 157-1 PL Category.

18.2.11 Automatic load transfer contactors for ESB and generator supplies shall be mechanically and electrically interlocked and shall be provided with key interlocked by-pass switches. Auxiliary switch on main MCCB/ACB will be utilized to stop the generator from starting on opening of the MCCB/ACB.

18.2.12 Switchfuses shall be HRC type using either B.S. 88 or NH type fuses. Switches shall conform to IEC 408. Switchfuses/fuse switches shall be single or triple pole double break as indicated with a separate neutral link in each compartment.

18.2.13 Earth fault relay protection shall be provided on all main circuit breakers. Each main circuit breaker shall be provided with independently powered tripping units.

18.2.14 The switchgear manufacturer shall select the circuit breakers to ensure full discrimination is achieved throughout the entire installation. He shall submit computer calculations to indicate the prospective fault levels throughout the installation along with verification that full discrimination is achievable.

18.2.15 Each switchboard shall be fitted with energy meters to provide digital indication of phase and line voltages, phase currents and real, apparent and reactive power and max demand. Meters shall be provided with pulsed outputs for monitoring by the building energy management system (BEMS).

18.2.16 All main and sub-main breakers in the switchboards shall be provided with duplicate volt-free contacts to provide ‘open’, ‘closed’ and ‘trip’ status signal to the BEMS and a remote mimic panel (for later use)

18.2.17 All control wiring shall be connected via DIN rail terminals and shall be complete with a terminal designation chart fixed to the inside of the terminal cover.

18.2.18 Switch boards shall be of the type as manufactured by those companies listed in Appendix A of this document.

18.3 Distribution Boards

18.3.1 The Electrical Specialist shall include for the supply and installation of distribution boards to serve individual areas as indicated on the drawings.
Distribution boards serving individual areas etc shall be custom-built low voltage switchgear assemblies manufactured in accordance with IEC 439, Form 2 and the ETCI Code of Practice.

18.3.2 The housing shall be sheet steel minimum thickness 1.5mm, electrolytic galvanised with raised doors and sealing profile. Glanding plates shall be supplied at top and bottom. It shall be suitable for surface wall mounting. The cabinet shall have a bake-on powder spray finish in the manufacturers standard colour. It shall have an ingress protection rating of at least I.P. 54.

18.3.3 The interior shall consist of a supporting frame, top hat rails etc. It shall be fitted with touch/flash guards manufactured from sheet steel of proprietary manufacture.

18.3.4 The main switch for each board shall be a rotary padlockable double break type with neutral link to IEC 408. Sub-switchfuses for each section shall be similar with HRC fuses. Covers shall be interlocked so that the switch or circuit breaker must be ‘off’ before the cover can be removed.

18.3.5 All protective devices for final sub-circuits shall be din-rail mounted. Integral busbar arrangements shall not be accepted. All lighting circuits shall be protected by 10 Amp type ‘C’ SP MCBs. Sockets etc shall be protected by means of 20 Amp x 30 mA SP&N type A RCBOs. Type AC RCBOs shall not be accepted. Security equipment and miscellaneous power supplies shall be protected by 16 Amp type ‘C’ SP MCBs ratings as indicated.

18.3.6 Contactors shall be DIN rail mounting and shall have an AC 23 duty rating in accordance with IEC 251.

18.3.7 All motive power distribution board sections serving extract fans shall be fitted with motor circuit breakers incorporating both magnetic release and an adjustable thermal overload release to give individual short circuit and overload protection of each motor circuit. The Engineers shall advise the overload ratings of these motor breakers.

19. WIRING TO MECHANICAL PLANT AND EQUIPMENT

19.1 In progress

The following information is intended for guidance in tendering and carrying out of installation work on the electrical systems in buildings where specific information is not supplied elsewhere in the tender documentation. Refer to Particular Specification and Description of Work or Drawings for any job specific requirements.

19.2 Power Distribution and Control Systems

Heating and Ventilation equipment shall generally be supplied and controlled from Control Panels supplied by the Mechanical Contractor.

19.3 Equipment Co-ordination

The mechanical contractor shall be responsible for taking the coordination of electrical services to mechanical plant. The electrical contractor shall liaise with the mechanical contractor on the wiring and commissioning of the mechanical equipment. He shall seek full descriptions of the equipment early in the construction contract including electrical loadings and other electrical special requirements or characteristics, locations, etc.

19.4 Power Supplies

19.4.1 Method of Installation

Unless otherwise specified these shall be as **Type.1** or **Type. 2.1** methods of as described in the power distribution section. External wiring shall be in **Type 2.1** unless otherwise specified.

19.4.2 Local Isolation

All items of equipment shall be provided with local isolators appropriately rated unless otherwise stated. Isolators shall be as follows unless specific ratings are specified elsewhere.
Isolators shall be MK or equal and approved ***unless otherwise stated***. Isolators shall be supplied suitable for three phase ***unless otherwisw stated***.

Description of Plant	Default Rating	Comment
Heating Pump	10A	
Air Handling Supply Air fan	20A	
Air Handling Return Air fan	10A	
Toilet Extract Unit	10A	Separate supply to Twin fans
Oil Fired Heating Burner	10A	
Gas Fired Heating Boiler	10A	
Domestic Cold Water Booster Pump	20A	
Domestic Hot Water Booster Pump	20A	
Fire Hose Reels Booster Pump	20A	
Hot water Circulating Pump	10A	Single Phase only

19.4.3 LV Control Control Wiring

(Building Energy Management Systems)

Cable runs up to 30 meters to single contol units such as valves and actuators may be wired in combined cable for both signal and e.l.v. For cable runs in excess of this the e.l.v. supply shall be run separately taking account of volt drop.

Equipment	Location	Height mm	Cable	Comment
Temperature Detector	Pipe	NA	Beldon 9502	
	Wall mounted	1400	Beldon 9502	
	Plantroom	1400	Beldon 9502	
	External	1400	Beldon 9502	
Humidity Detectors	Duct	NA	Beldon 9502	
	Wall mounted	1400	Beldon 9502	
Combined Temperature Detector and Local Control Adjustment	For disabled use	1200	Beldon 9502	
Pressure Sensor	Duct/Pipe	NA	Beldon 9502	
Air Quality Sensor	Duct		Beldon 9502	
	Wall			
Damper Actuator			Beldon 9502	
			Beldon 9502	
Heating Control Valve				
			Beldon 9502	

19.4.4 Protection of Control Cables

The electrical contractor shall provide for the mechanical protection of all control cables both internally in the building and externally by way of metal covers on cable trays, metal conduit, or armoured cable trays as appropriate.

In addition external control cables shall be UV protected throughout.

The contractor should note that armoured cable is the preferred option for external cable and that any other protection system shall provide an equivalent level of protection throughout the entire length of the cable.

19.4.5 Local Ventilation Fans and other Equipment

Small local ventilation equipment indicated in electrical layout drawings shall be fed from the local lighting circuit through a local switched fused unit. Control shall be either through the local light switch, through a separate on/off switch, a presence detector or other sensing device. Unless otherwise specified control shall be though a separate local switch. Delay on or off timers if required shall generally be incorporated in the fan.

20. Emergency Lighting Installation

20.1 Emergency Lighting

The entire emergency lighting system shall be designed and installed such that a central test unit (CTU) is capable of testing each emergency luminaire and/or circuit. The CTU shall be capable of providing testing as per IS EN 3217 : 2103

Where an ATS system is installed it shall meet the testing requirements of IS EN 62034.

Emergency lighting luminaries mounted in each lift shaft and associated lift car shall be connected to a Tridonic e-touchBOX capable of providing testing as per IS EN 3217.

Emergency lighting completion certificates shall be provided as detailed in IS3217 : 2013

Commissioning and certification of the emergency lighting system shall be carried by the manufacturer the emergency light fittings.

All luminaires shall be so designed such that they may be installed and fixed easily to required surfaces. All luminaires shall provide areas for easy cable access and have internal cable ways if required. All emergency fittings i.e exit signs, conversions, bulkhead fittings, LED fittings, twin spots, etc are to be from a single manufacturer and shall be to OPW specification for emergency lighting.

The manufacture shall be NEL, Emcon, Profile, Ventilux or Lighting Solutions.

All emergency luminaries shall be capable of providing the required light output for a minimum duration of 3 hours.

The emergency lighting system and components shall comply with the latest revision of the following standards:

IS 3217	Code of Practice for Emergency Lighting
IS/EN 1838	Lighting Application - Emergency Lighting
IS/EN 50171	Central Power Supply Systems
IS/EN 50172	Emergency Escape Lighting
IS/EN 62034	Automatic Test Systems for Battery Powered Emergency Escape Lighting
BS1101	Incandescent lamps
BS 1853	Fluorescent lamps
BS 3676	Switches
IS/EN 60924	DC Supplied Electronic Ballasts for Tubular Fluorescent Lamps –

General and Safety Requirements

IS/EN 60925	DC Supplied Electronic Ballasts for Tubular Fluorescent Lamps - Performance

Requirements

IS/EN 60622	Sealed Nickel –Cadmium Prismatic Rechargeable Cells-General Requirements And Test Methods
IS/EN 60896	Stationary Lead Acid Batteries-General Requirements and Tests, Value regulated type
IS/EN 60920	Ballasts for Tubular Fluorescent Lamps-General and Safety Requirements
S/EN 61048	Capacitors –General Requirements and
IS/EN 61049	Capacitors- Performance Requirements
IS/EN 60155	Starters for Tubular Fluorescent Lamps
IS/EN 60061	Lamp Caps and Lampholders
IS/EN 60400	Lampholders for Tubular Fluorescent Lamps and Starter holders
IS/EN 60357	Tungsten Halogen Lamps

IS/EN 60432	GLS Filament Lamps
IS/EN 60901	Compact Fluorescent Lamps
IS/EN 61199	Compact Fluorescent Lamps
IS/EN 61195	Fluorescent Lamps
IS/EN 6074	Isolating Transformers and Safety Isolating Transformers
BS 8519	Selection & Installation Of Fire Resistant Power & Control Cables
IS/EN 60598-1	Luminaires General Requirements & tests.
IS/EN 60598-2	Particular Requirements Luminaires For Emergency Lighting
IS/EN 61347	Lamp Control Gear

20.2 Conversions

All inverters utilised shall be fully enclosed type (either metal or plastic can).

All conversions shall wherever possible, be integral to the original luminaire only following specialist assessment, investigation and test, to ascertain the suitability for conversion from an electrical, electronic, mechanical, thermal, EMC, serviceability and safety viewpoint. In the event that integral conversions cannot be undertaken due to any of the above reasons, remote conversions are acceptable of the piggyback enclosure type if, and only if, access to the emergency lighting equipment can be made without removal of the original luminaire from the ceiling, wall or floor. In the event that the piggyback conversion option cannot be undertaken due to the above reason, remote conversions are acceptable of the remote enclosure type if, and only if, the interconnecting wiring between luminaire and remote gear is suitably protected mechanically and is fire rated as defined in the standards – Suitable protection shall be provided by a fully enclosed flexible conduit for routing interconnecting wiring or by a appropriate flex. The interconnecting wiring shall be suitability sized in relation to C.S.A. (Cross Sectional Area) for the required load and distance travelled to minimise volt drop between source and load to 3% and is also electrically suitably rated for the required purpose in terms of voltage and high frequency and/or DC characteristic.
All conversions shall not affect the Ingress Protection Classification (IPXX) of the original luminaire and shall not affect the photometric performance of the original luminaire and shall also not affect the Safety Classification of such luminaire (Class I, II, III).

Overall responsibility of re-certification of the original luminaire following the conversion process specific to the EMC and LV Directive, Ingress Protection Classification, Safety Classification and performance criteria shall be the responsibility of the company undertaking the emergency conversion.

All cables entering and leaving the remote enclosure shall be glanded using glandes of appropriate size and make. Strain relief shall also be provided to the cables entering the lighting fittings. Cable ties or knotting of cables are not considered suitable measures for securing cables or providing strain relief and shall not be used.

All conversions shall be undertaken off site and shall undergo complete performance and safety tests upon completion.

<u>Emergency Lighting Conversions – LED Modular Fittings.</u>

The lumen output from the fitting must be at least 15% of the rated output in emergency mode and uniformly across the fitting.

All emergency lighting status indicators shall be mounted in the surround / trim of the fitting or behind the diffuser where the depth of the fitting permits. The emergency lighting status indicator shall be visible from floor level. Where a lighting manufacture provides fittings with an option for a cut out / blank for mounting the emergency lighting status indicators these shall be used.
Where piggy back remote conversions are undertaken the enclosure housing the control gear, batteries etc shall be fitted with rubber feet of a suitable size and quantity to reduce movement / slippage of the enclosure.
All OPW Approved Manufacturers for Emergency Lighting shall be capable of providing a Technical Data Sheet for the converted fitting upon request. The data sheet shall confirm at a minimum, for the specific emergency lighting conversion, the following:

- Compliance With: IS. EN.60598-2-22
- Conformity: CE Marking Directive, EMC Directive, LVD Directive, RoHS Directive, WEEE Directive
- Emergency Lighting Lumen Output
- Normal Lighting Lumen Output:
- Fitting Mode of Operation
- Emergency Lighting Duration
- Battery Type

20.3 Batteries

All batteries utilised in emergency light fittings shall be high temperature Sintered Plate Nickel-Cadmium (NiCD) or Nickel-Metal Hydride (NiMH), Secondary Cell type, Rechargeable.
All batteries shall be high temperature (55deg) and shall have the rated temperature indicated on the battery casing. All batteries shall be mounted within fittings and remote packs using battery holders to ensure that no part of the battery casing is in contact with the fitting or remote pack casing.

All battery packs used in emergency lighting luminaires shall be fully encapsulated and come complete with battery disconnect male/female connector(s) to aid isolation and service. All chargers and changeover controls shall be fully automatic and failsafe upon power failure or resumption of supply.

20.4 Sealed Lead Acid (SLA) Batteries:

All rechargeable Sealed Lead Acid (SLA) batteries used in emergency light fittings shall be maintenance free and of a sealed leak proof construction. All batteries shall be valve regulated to prevent excess build up of gas. Valves shall automatically reseal upon venting. All batteries shall be capable of operating in any orientation and meeting the required duration of 3 hours for emergency lighting at the end of five years of usage.

The Operating Temperatures for SLA batteries used in emergency lighting shall be as follows:

Charge – 15°C to 50°C
Discharge – 20°C to 60°C

All batteries used in emergency lighting (NiCD,NiMH,SLA etc) shall be dated with the date of installation.

20.5 Lamps

All lamps utilised as part of the emergency lighting system shall be suitable for the required purpose and be of major brand name manufacture only. All lamps shall be professional long life variants.

All double-ended lamps shall be capable of being run in emergency mode in any orientation. I.e. are not dependant on the cold end of the lamp being fitted in the luminaire in one specific position.

No “pinking” of the lamps in emergency mode shall be accepted.

In all emergency lighting luminaries the LED status indicator light shall be visible while the luminaire operates under normal lighting supply.
i.e it shall be possible to see a fitting is an emergency luminaire when it is switched on and operating under normal supply.

All lamps operating whilst supplies are available shall be at a ballast of unity. No under-running of lamps is allowable by combination mains/emergency ballasts in normal operation – the only exception to this applies to integral conversions in small form luminaries where use of a standard ballast would lead to a temperature within the fitting that would exceed the rated temperature of components - see table below for details. The emergency lighting supplier shall confirm in writing the fitting types. using combination ballasts with the OPW engineer for the project prior to production of conversions.

20.6 Metals and Plastics

All metals and plastics utilised as part of the emergency lighting luminaires shall be suitable for the required purpose.

20.7 Overload and Short Circuit Protection:

All emergency luminaires shall incorporate separate protection for each incoming supply line, to include the unswitched and switched supplies, integrally, within the luminaire by means of suitable fused terminal block(s) to aid safety, isolation and discrimination functions. All fused terminal blocks for the purpose of connection to the supply network shall be suitable sized for the connection in each terminal of at least 2 No. 1.5mm² cables or 1 No. 4.0mm² cable.

20.8 Exit Signs

Decorative Blade Type: All exit signs of the decorative hanging blade variety which use top lit illumination shall have the running man, arrow and door symbols. The background colour of the blade shall be green and the running man, arrow and door symbols, shall be white. All diffuser material either blade type or normal to be ploycarbonate.

All exit signs shall be maintained LED type using LED's only. All LED's operating when the normal supply is available and in emergency mode, shall be at a ballast of unity. No under-running of LED's is allowable by combination mains/emergency ballasts in normal operation.

Wiring within the exit sign shall not be loose or hanging and shall not be visible when the exit sign is illuminated

20.9 Inverter Modules – All Emergency Lighting Luminaires

All inverter modules used in emergency lighting luminaries shall be fully encapsulated and provide for overload and short circuit protection via fused terminal block(s).

All inverter modules shall be continuously rated and suitable and/or specific to the emergency lamp in question. The BLF shall be clearly indicated for the specific lamp used. All invertors shall have reverse polarity protection to protect against damage to the inverter if batteries are connected incorrectly (i.e reverse polarity).

All inverter modules used in emergency lighting luminaires shall be fully encapsulated by metal or plastic can such that no components or conductive surfaces at L.V. or higher tension are accessible upon removal of louver, diffuser and/or gear tray for preventive or remedial maintenance purposes. All chargers and changeover controls shall be fully automatic and failsafe upon power failure or resumption of supply

Emergency Lighting Inverter Modules for emergency lighting luminaries mounted in the lift shafts and lift cars shall have a DALI Interface and an automatic test function and be suitable for linear and compact fluorescent lamps and compatible with all electronic ballasts and the Tridonic e-touchBOX.

LAMP TYPES FOR CONVERSIONS	REQUIRED MINIMUM BLF IN EMERGENCY MODE	CONVERSIONS IN SMALL FORM LUMINAIRES USING COMBINATION BALLLAST MINIMUM BLF MAINS OPERATION / MINIMUM BLF EMERGENCY MODE
T5 8W	**0.27**	
T5 14W	**0.16**	
T5 21W	**0.14**	
T5 24W	**0.13**	
T5 28W	**0.13**	
T5 35W	**0.10**	
T5 39W	**0.07**	
T5 54W	**0.06**	
T5 55W(circular)	**0.07**	
T580W	**0.05**	
T8 18W	**0.12**	
T8 36W	**0.10**	
T8 58W	**0.07**	
TC-DD/2D 16W	**0.24**	**0.90 / 0.18**
TC-DD/2D 28W	**0.16**	**0.90 / 0.12**
TC-DD/2D 38W	**0.12**	**0.90 / 0.09**
TC-D/DEL 10W	**0.21**	**0.90 / 0.13**
TC-D/DEL 13W	**0.26**	**0.90 / 0.12**
TC-D/DEL 18W	**0.21**	**0.90 / 0.15**
TC-D/DEL 26W	**0.14**	**0.90 / 0.11**
TC-T/TEL 18W	**0.15**	**0.90 / 0.15**
TC-T/TEL 26W	**0.15**	**0.90 / 0.10**
TC-T/TEL 32W	**0.11**	**0.90 / 0.09**
TC-T/TEL 42W	**0.07**	**0.90 / 0.07**
TC-T/TEL 57W	**0.05**	**0.90 / 0.05**
TC-L 18W	**0.16**	
TC-L 24W	**0.15**	
TC-L 36W	**0.11**	
TC-L 40W	**0.10**	
LED's	**1 (Unity)**	
Tungsten/ Tungsten Halogen	**1 (Unity)**	

Table Of Required Minimum Ballast Lumen Factor (BLF) For All Conversions

Note: If conversions are to be undertaken for lamps that are not included on the above list please contact the OPW Mechanical & Electrical Engineering Section for approval of required BLF

20.10 Light Emitting Diode (LED) Fittings – (Fittings Supplied By The Emergency Lighting Supplier Excluding Exit Signs)

All LED's used, unless otherwise stated, shall be based on a full cone distribution of between 100 and 70 degrees.
All LED fittings shall utilise LED's that provide the following minimum efficacy: **45 lumens/Watt – Usable Into The Room**.
All LED's shall be rated for operating at 25degC ambient room temperature and a Tc(max) 75 degC
All LED's used, unless otherwise stated, shall be Warm or Neutral White.

20.10.1 Emergency Lighting Lift Shafts and Lift Cars

All power cables serving the emergency lighting luminaires and the TRIDONIC Etouchbox shall be PVC/PVC in steel conduit. The Dali Bus serving the emergency lighting luminaires and the TRIDONIC Etouchbox shall be wired in Belden 8719 2x1.5mm2 Twisted & Screened Pair.

20.10.2 Labelling Of Emergency Lighting Fittings

Each emergency light/luminaire and exit sign shall be labelled. The label shall be clearly visible from floor level so that a fitting can be clearly identified. The printed text on the label shall be as follows: **floor number / emergency luminaire number** .
e.g **02 / 17** would indicate emergency luminaire number 17 on the second floor.

The electrical specialist shall supply upon completion of the project a logbook for the emergency lighting system for inclusion with the O&M manuals. The logbook shall contain a list of all emergency lighting luminaries for the project by location, label number and type, included also shall be A3 NTS drawings of the building showing the location of the as installed emergency luminaries c/w label numbers

21. DATA AND TELEPHONE INSTALLATION

21.1 General

The Contractor shall supply and install a data and telephone system as detailed in the drawings, specifications & detailed estimate.
In the installation of Class E/Cat-6 data & Cat-3 Voice Panel networks all equipment supplied shall be from a single manufacturer i.e. cables (copper & fibre), patch panels, jacks, patch cords, ports, outlets etc.
Cables shall be installed in accordance with this specification, manufacturer's recommendations and best industry practices.
Manufacturers systems supplied must have independently certified permanent link and channel compliance to the cat-6 standards. Manufacturers must have Independent certificates for testing and compliance of patch panels, jacks, cable and patch cords to Class E/Cat-6 standards. All components supplied must be interoperable with other Class E/Cat-6 compliant components and backward compatible with existing Class D/Cat-5E installations.

The entire installation shall be carried out using a Cat-6 system from one of the following manufacturers: **Amp, Leviton, HellermanTyton, Krone, Nexans** (LANmark 6 Solution) **Systimax**.or **Belden** . The installation shall be carried out by an approved installer for the specific system used. The installer shall be trained & certified in the installation, termination and testing of fibre optic and copper cables.

A manufacturer's 20 year system performance warranty shall be provided.

The Installation is to be carried out in accordance with the following standards including all current amendments and addendums.

- EIA/TIA 568B1,2,&3 (Cat-6)
- EN 50174-2 (Installation Planning & Practices Inside Buildings)
- EIA/TIA-526-14 (Optical Power Loss – Multimode Fibre Cable)
- EIA/TIA-455-60 (Measurement of Fibre Or Cable Length Using ODTR)
- EIA/TIA-604-12 (Fibre Optic Connector Intermateability Standards)
- ISO/IEC 11801 (Classification of Optical Fibres & Attenuation Limits Only)
- ISO/IEC TR 14763-3 (Testing Of Fibre Optic Cabling)
- BT CW1308 (Telephone Cable Internal)
- BT CW1128 (Telephone Cable External)
- BT CW1198 (Telephone Cable External)

21.2 Installation Procedures

Items Particular To All Installations

Cable runs should be concealed where possible and only run on the surface in areas where user access is restricted.
Where cables or conduits are installed in plaster or concrete liable to damp conditions, precautions should be taken against corrosion.
Cables should be labelled at any point where they enter or leave concealment.
Cable routes should always be parallel with or perpendicular to walls.
Where cables must pass through walls the holes should be sleeved and the cables must enter and exit these holes at 90 degrees.
All cable runs must follow pre-defined routes.
All cable runs must be free from tension along the entire cable length.
Where cable runs must bear some stress, supports must be used to distribute the strain.
Where a number of cables need to be run on the surface, trunking or conduit should be installed. At no point shall cable(s) rest on acoustic ceiling grids or panels.
Excess slack may be neatly coiled and stored in the ceiling above each drop location when there is not enough space present in the outlet box to store slack cable.
Cables shall be dressed and terminated in accordance with manufacturer's recommendations and/or best industry practices.
Voice jacks, unless otherwise noted in drawings, shall be located in the bottom position(s) of each faceplate. Voice jacks in horizontally oriented faceplates shall occupy the right-most position(s). Modem jacks shall be considered the last voice jack in the sequence. Data jacks shall occupy the top

position(s) on the faceplate. Data jacks in horizontally oriented faceplates shall occupy the left-most position(s).
Cables shall be installed in accordance with manufacturer's recommendations and best industry practices.
Cables shall not be installed in damp conditions and until such time as the building is properly weathered. Any cable exposed to water shall be replaced by the contractor prior to final acceptance at no cost to the OPW.
Cable raceways shall not be filled greater than the EN 50174 maximum fill for the particular raceway type; generally do not exceed 50% of the capacity of a raceway. Cable bundles should not exceed the height of the sidewalls of the tray or basket.
Cables shall be installed in continuous lengths from origin to destination. All cable runs must be free from bridges, taps and splices unless specifically addressed in the tender documents. Where cable splices are allowed, they shall be in accessible locations and housed in an enclosure intended and suitable for the purpose.
The cabling system and support hardware shall be installed so that it does not obscure any valves, fire alarm conduit, boxes, or other control devices. Any cable damaged or exceeding recommended installation parameters during installation shall be replaced by the contractor prior to final acceptance at no cost to the OPW. Cable runs are on the basis that no cable length shall exceed 85metersoutlet to patch panel; if it likely that 85 meters shall be exceeded than the contractor shall inform the OPW in time to take corrective action.
Cables shall be identified by a self-adhesive label in accordance with section T08.5 "Labelling". The cable label shall be applied to the cable behind the faceplate on a section of cable that can be accessed by removing the cover plate. Pulling tension on 4-pair UTP cables shall not exceed 110 Newtons for a single cable or cable bundle.

21.2.1 Surface Cable Runs

The cables should be firmly fixed to the surface at a minimum distance of every 300mm.
On vertical cable runs the cables should be firmly fixed to the surface at a minimum distance of every 400mm.
All surface cable runs should use cable tray, lined basket or trunking where possible.
If cable routes are on rough or uneven surfaces the above fixing distances should be reduced.
All cables shall be secured using Velcro tie wraps

21.2.2 Floor Distribution - Cable Bundles

Where cable bundles run in a raised floor environment they should be run on cable tray or in lined basket wherever possible.
Max. 24 cables to the bundle.
Adhere to power segregation distances.
Ensure cable bundles are properly supported and sleeved when passing through-holes in walls/floors/ceilings.
Any tray or metallic trunking used must be earthed.
All cables shall be secured using Velcro tie wraps

21.2.3 Ceiling Distribution - Cable Bundles

Within a suspended ceiling cable bundles should be properly suspended.
Do not lay cables direct onto the ceiling tiles.
Do not tie cable bundles to the ceiling suspension wires.
Cables should be suspended on a catenary wire if not tray or other supports.
Max. 24 cables to the bundle.
Cables shall not be attached to ceiling grid or lighting support wires. Where light support for drop cable legs are required, the contractor shall install clips to support the cabling. All cables shall be secured using Velcro tie wraps

21.2.4 Trunking and Conduit

All metallic conduit or trunking used must be earthed/bonded.
Bushes should be used at all cable exit points.
The ends of all conduit and trunking must be capped or sealed.

Enough space should be left in any trunking or conduit for the addition of new cables. Where possible a draw wire should be left in suitable routes are available.

21.2.5 Bend radius: As a general rule the following bend radii apply

For UTP and STP use 4 times cable diameter Installed & 8 times the cable diameter at installation.
For Fibre Optic, 50 Pair and greater telephone cables, use 10 times cable diameter.
These radii should be adhered to when there is no specific information available about a particular cable, but, where they exist, manufacturer's specifications should always be followed.

21.2.6 Power and Communications Cable Segregation

All cable runs must be the following minimum distances from power lines:
-127mm from power lines of <kVA (e.g. fluorescent lighting)
-305mm from power lines of <2-5kVA
-610mm from power lines of >5kVA or transformers/motors.
Where this segregation is not possible the communications cables must installed in separate trunking or conduit.
If metallic trunking or conduit is used it must be earthed and bonded in accordance with the IEE Wiring Regulations (16th Edition - BS 7671).
Where communication cables must cross power cables, they should do so at 90 degrees and non-conductive spacers should be used at the crossing point.

21.2.7 Fire Barriers

Where any cables pass through a fire barrier the requirements of the IEE Regulations for Electrical Installations (16th Edition -BS 7671) must be adhered to.
Separating distances can be reduced where cables pass through fire barriers as long as it is for no more than 0.5m either side of the barrier.
When cables pass through fire barriers in this way, power and communications cables should be installed in separate metal trunking or conduit.

21.2.8 Terminations/Wiring Sequence

All Cat-6 outlets and patch panels shall be wired as per the EIA/TIA 568B sequence as shown below, unless otherwise stated.

T568B Sequence

Pin No.	1	2	3	4	5	6	7	8
Colour	White/ Orange	Orange	White/ Green	Blue	White/ Blue	Green	White/B rown	Brown

All RJ12 outlets shall be wired according to the same sequence as the RJ45 outlets with the White/Orange and Brown leads disconnected. Any wire pairs not used in RJ12 terminations should be tied back neatly and be sufficiently long for re-use at a later date.

Pin No.	1	2	3	4	5	6
Colour	Orange	White/ Green	Blue	White/ Blue	Green	White/B rown

Wiring Sequence for RJ12 Outlets

Pair untwist at the termination shall not exceed 6mm for Category-6 connecting hardware. The max, strip-back of the PVC Sheath must not exceed 13mm when the termination is complete. All outlets shall have LSA or 110 punch down insulation displacement connections.

21.2.9 Fibre Optic

Each fibre optic cable shall be terminated in a 24-port rack mounted enclosure providing protection to the terminated fibres. The fibre optic patch panel(s) shall each be capable of containing 24 SC or MT-RJ connectors in a 1U enclosure. The jacks shall be 50 micron,

multimode connectors, capable of terminating either 250 micron coated or 900 micron buffered fibres. The connectors shall meet the intermateability requirements of TIA/EIA-604-12.

21.2.10 Fibre Optic Cable Terminations

Fibre slack shall be neatly coiled within the fibre termination panel. No slack loops shall be allowed external to the fibre panel(s).
Each cable shall be individually attached to the respective termination panel by mechanical means. The cables strength member(s) shall be securely attached the cable strain relief bracket in the panel.
Each fibre cable shall be stripped upon entering the termination panel and the individual fibres routed in the termination panel.
Each cable shall be clearly labelled at the entrance to the termination panel. Cables labelled within the bundle shall not be acceptable.
Dust caps shall be installed on the connectors and couplings at all times unless physically connected.

21.2.11 Cables

Cat-6

Cabling shall be 23/24 AWG, 4-pair UTP, with a LSZH jacket. Cable jacketing shall be lead-free. Cables shall meet the performance requirements for the relevant standards.

21.2.12 Voice Backbone

Internal
The Cable shall consist of 0.5mm diameter annealed copper conductors, PVC insulated, polyester taped with a white LSZH sheath.
The cable shall comply with BT CW1308 requirements.

External
Cable shall consist of 0.5mm diameter plain copper conductors, colour coded polyethylene insulation, petroleum jelly filled and a black polyethylene sheath. The outer sheath shall be made from tough, durable polyethylene which is also UV and sunlight resistant. The cores are to be bedded in petroleum jelly to protect against the ingress of moisture.
The cable shall comply with BT CW1128 requirements.

21.2.13 Harsh Environments

Cable shall consist of 0.5mm diameter plain copper conductors, colour coded polyethylene insulation, petroleum jelly filled, polyethylene bedding, galvanised steel wire armour and a black polyethylene or external grade PVC sheath.
The cable shall comply with BT CW1198 requirements.

Fibre Optic Backbone & Building Links.
This shall be a manufacturer send to end solution and all components used shall be cover by the manufactures 15 year system performance warranty.

21.2.14 Internal

Twelve-core 50/125 micron fibre optic multimode cable shall be utilized to provide backbone connectivity for the data network. The fibre optic cable shall be categorized as OM3 and classed as OF-300 as per ISO 11801. Each fibre shall have a core of 50 microns plus a cladding; plus a coating. Each of the coated fibres shall be surrounded by aramid strength members and a LSZH jacket.
The cable shall provide a maximum attenuation of 3.5 dB/km @ 850 nm and 1.5 dB/km @ 1300 nm. The minimum bandwidth of the cable shall be 2000 MHz/km @ 850 nm and 500 MHz/km @ 1300 nm.

21.2.15 External

A suitable external multimode cable shall generally consist of single loose tubes, gel filled, with a maximum of twelve 50/125 micron fibres per tube. Fibres shall be separated into colour coded groups surrounded by a polyethylene core tube which will be surrounded by water blocking tape plus non-metallic strain relief/strength members with a HDPE jacket. Attenuation and bandwidth characteristics are the same as those specified for internal fibre optic cables The fibre optic shall be categorised as OM3 and classed as OF-300 as per ISO 11801.

21.2.16 Harsh Environments

A suitable external multimode cable shall generally consist of single loose tubes, gel filled, with a maximum of twelve 50/125 micron fibres per tube. Fibres shall be separated into colour coded groups surrounded by a polyethylene core tube which is surrounded by water blocking tape. A steel armour shall surround the water blocking tape; the cable shall have steel wire strain relief/strength members and the cable jacket shall be HDPE. Attenuation and bandwidth characteristics are the same as those specified for internal fibre optic cables The fibre optic shall be categorised as OM3 and classed as OF-300 as per ISO 11801.

21.3 Comms Cabinets

All Comms Cabinets shall be 19" free standing 800mm wide by 1000mm deep 42u high and shall each be equipped with the following:

Secure lockable front perforated steel front door. Door hinging shall be easily reversed to function as either left hand side or right hand side opening. Metal rear door and lift off metal side panels.

1 No 8 way power distribution units(PDU). Each PDU shall have 8 No IEC C13 outlets and shall be rated to 30amp 240V / AC. Each PDU shall be fed from the comms room distribution board or UPS(please refer to particular specification or drawings). Each PDU shall be fed from a separate circuit, no other outlets/equipment shall be fed form this circuit. Only one phase shall be present in each comms cabinet. Each PDU shall be vertically mounted within the comms cabinet. Each Power Distribution Unit (CDU) shall have local input current monitoring with LED display.

Quick release lockable doors and quick release lockable side panels.

1u height marking on 19" mounting profiles

Adjustable front and rear 19" mounting profiles

Open base for cable access. Full height vertical cable management with full height cable management system channels 2No – one each side adjacent to the front mounting profiles

Sliding Shelves for servers (6 No Per Cabinet) etc

1U 24 Port RJ45 Class E/Cat-6 Patch Panels- Data patch panels for termination of field wiring.(quantity required to be determined by number of Class E/Cat-6 cables)
1 U Horizontal Cable Management for every 2U of patch panels

Cable tidy panels, baying kit, castors , earth straps etc

All cables shall be secured using Velcro tie wraps

All comms cabinets are to be earth bonded in accordance with the Manufacturer's requirements and the ETCI wiring rules.

All coms cabinets shall be Excel floor standing cabinets – Equipment Series – Perforated Steel Door

All equipment racks shall be augmented with horizontal and vertical management hardware, both horizontal & vertical, to properly dress all cables and patch cords. Patch panels shall be wired to T568B.The front of each module shall be capable of accepting labels. Each port shall

be capable of accepting an icon to indicate its function. Patch panels shall terminate the building cabling on LSA or 110 punch down insulation displacement connectors.

Patch Cords of 1M length. – 1 N° per number of data outlets (50% Blue & 50% Red)+
Patch Cords of 2M length. – 20% of the number of data outlets – (50% Blue & 50%)

21.4 Labelling

Each data and voice cable shall be labelled at both the patch panel and outlet end at a distance of approximately 150mm from the terminations.

All label printing will be machine generated using indelible ink ribbons or cartridges. Self-laminating labels will be used on cable jackets, appropriately sized to the OD of the cable, and placed within view a distance of approximately 150mm from the terminations. Outlet labels will be the manufacturer's labels provided with the outlet assembly.

The Labelling convention will be as follows:-

- Hub Number/Number of Hubs on Site/Patch Panel Row/Position on Patch Panel
- For example 1/1/D2/16 indicated the data outlet in question is connection to hub 1 on row D2 and position 16 of the patch panel. The second digit indicates that there is only a single hub on site.
- The installer should adhere strictly to this numbering scheme (unless otherwise instructed) as it is intended to facilitate accurate cable and outlet identification which will form part of the certification documentation to be delivered upon completion of the project.

21.5 Testing

21.5.1 Cat-6

All cables are to be tested in accordance with this document to prove compliance with the relevant standard and best industry practices. If any of these are in conflict, the Contractor shall be responsible in bringing any discrepancies to the attention of the engineer or his representatives for clarification and/or resolution.
Testing of the shall be carried out using either a :
a) Fluke DTX-1800 Level IV tester with up to date software
or
b) Psiber Data WireXpert WX4500-FA Level IV tester with up to date software

The following tests shall be carried out on each cable:

1 Wiremap	8 NEXT	15 Return Loss@Remote
2 Length	9 NEXT@Remote	16 PSNEXT
3 Propagation Delay	10 ACR	17 PSNEXT@Remote
4 Delay Skew	11ACR@Remote	18 PSELFEXT
5 Attenuation	12 PSACR	19 PSELFEXT@Remote
6 ELFEXT	13 PSACR@Remote	
7 ELFEXT@Remote	14 Return Loss	

21.5.2 Fibre Optic Cable

Each cable shall be tested to verify installed cable length. Each fibre strand shall be tested with an optical power meter and light source to verify attenuation. The following attenuation limits for multimode fibre shall apply to all installations. These values must be confirmed by field attenuation testing.

Attenuation Limits For Multimode Fibre Optic Cable:

		Max Attenuation [dB]	
Cable System	Length(M)	850 nm	1300 um
Horizontal	90	2.5	2.2
Building Link Or Backbone	500	2.55	1.95

21.5.3 Attenuation

Multimode optical fibre attenuation shall be measured at 850 nanometers (nm) and 1300 nm using an LED light source and power meter. For cabling systems that only contain hardware at the local and remote ends, it is only necessary for the measurement to be made in a single direction. However, where the cabling contains intermediate connecting hardware (splices or connectors) it should be tested from both directions.
In order to achieve a defined launch condition for testing multimode fibre systems, the use of a mandrel as a mode filter shall be used. The mandrel must meet the requirements defined in IEC 61300-3-4 and shall be used with the test cords. IEC 61300-3-4 defines mandrel mode filtering by applying 5 coils around a 20mm mandrel for 62.5/125 micron or applying 5 coils around a 18mm mandrel for fibre type 50/125 micron.

If the test results do not meet the attenuation limits of ISO/11801, the link should be investigated by using an Optical Time Domain Reflectometer (OTDR) in order to identify the failing components.

21.6 Test Results

Test results shall be printed directly from the test unit or from a download file using an application from the test equipment manufacturer. The printed test results shall include all tests performed, the expected test results and the actual test result achieved. The test equipment by name, manufacturer, model number and last calibration date will also be provided. When repairs and re-tests are performed, the problem found and corrective action taken shall be noted, and both the failed and passed test data shall be collocated and presented.
A hard copy as well as an electronic copy (pdf format on CD or pen drive) of all test results nd information requested, is to be supplied upon completion to form part of the O&M manuals.

22. FIRE DETECTION AND ALARM INSTALLATION

22.1 FIRE DETECTION AND ALARM SYSTEM:

22.1.1 Introduction

The main fire alarm panel shall be complete with an autodialler and modem for connection to a central monitoring station. The autodialler shall have a facility to have up to 3 separate different pre-recorded messages. The panel shall have an integral modem as required to facilitate the above.
The fire alarm system shall be designed, installed, commissioned and handed over to conform with the requirements of latest version of IS 3218.

22.1.2 Standards

The equipment supplied and the entire installation shall comply with the latest edition of the following Standards and Codes of Practice:

Building Regulations TGD (B) – Fire Safety
IS 3218:2013 – Code of Practice for Fire Detection & Alarm Systems
EN 54-1 – Fire Detection & Alarm Systems - Introduction
EN 54-2 – Fire Detection & Alarm Systems - Control & Indicating Equipment
EN 54-3 – Fire Detection & Alarm Systems - Sounders
EN 54-4 – Fire Detection & Alarm Systems - Power Supplies
EN 54-5 – Fire Detection & Alarm Systems - Point Heat Detectors
EN 54-7 – Fire Detection & Alarm Systems - Point Smoke Detectors
EN 54-11 – Fire Detection & Alarm Systems - Manual Call Points
EN 54-12 – Fire Detection & Alarm Systems - Optical Beam Smoke Detectors
EN 54-13 – Fire Detection & Alarm Systems - Compatibility of System Components
EN 54-17 – Fire Detection & Alarm Systems - Short-Circuit Isolators
EN 54-18 – Fire Detection & Alarm Systems - Input / Output Devices
EN 54-20 – Fire Detection & Alarm Systems - Aspirating Smoke Detectors
EN 54-21 – Fire Detection & Alarm Systems - Alarm Transmission Equipment
EN 54-23 – Fire Alarm Devices - Visual Alarm Devices
EN 54-27 – Fire Detection & Alarm Systems - Duct Smoke Detectors
EN 54-29 – Fire Detection & Alarm Systems - Multi Sensor Fire Detectors
EN 50200 – Fire Resistant Cabling
ET 101 – National Rules for Electrical Installations
BFPSA – Code of Practice for Aspirating Smoke Detectors
Fire Safety Design Strategy for the Complex

22.1.3 Working Drawings

Prior to commencement of wiring, the Fire Alarm Specialist shall prepare schematic wiring details of the fire detection and alarm system and shall submit these to the Engineer for approval. The Electrical Specialist/Installer shall wire the fire alarm system in accordance with the Fire Alarm Specialist's working drawings as approved by the Engineer.

22.1.4 Protection Category

The protection category for the building shall be Category L1 in accordance with I.S. 3218 – 2013 unless otherwise stated.
It shall be the responsibility of the Electrical Specialist/Installer and his selected Fire Alarm Specialist to thoroughly examine the Engineer's proposal to ensure that the layout of equipment, as indicted on the drawings and as detailed in the Specification, complies with the relevant protection category of IS 3218, the Building Fire Strategy and that the wiring details are compatible with the equipment to be supplied. The Fire Alarm Specialist and/or Electrical Specialist/Installer shall inform the Engineer in writing of any discrepancies found.

22.1.5 Fire Strategy

The system shall operate so that on activation of any one smoke detector or alarm call point

22.1.6 Control and Indicating Equipment (CIE)

- The CIE shall be of the analogue addressable type and shall be of Open Protocol design subject to meeting the requirements specified below. The protocol that shall be used for the fire detection and alarm system is Apollo Discovery.
- The CIE shall comply with the requirements of EN 54-2.
- The CIE shall be the central processing unit of the system, receiving and analysing signals from fire sensors, providing audible and visual information to the user, initiating automatic alarm response sequences and providing the means by which the user interacts with the system. The CIE shall be manufactured by Morley or Advanced Electronics .
- The CIE shall be capable of fully supporting the following protocols:
  Apollo Xplorer
  Apollo XP95
  Apollo Discovery
  Hochiki ESP
- The requirements for protection of the programme against unauthorized access, corruption processor monitoring etc. shall comply fully with the requirements of the current version of IS 3218.
- The CIE shall have a facility to enable the testing of sounders, strobes and alarm notification equipment without activating any fire alarm interfaces.
- The CIE shall be capable of detecting and indicating changes in detector sensitivity and shall constantly monitor detection circuits and sounder circuits and, in the event of a fault occurring, initiate an alarm. To aid maintenance, facilities shall be provided to scan all the detection devices to determine their operating condition. Details of devices requiring maintenance shall be indicated on the panel.
- The CIE shall continuously monitor the operation of all devices on the system, and shall be capable of providing the following functional conditions:
  - Fire alarm condition
  - Fault warning condition
  - Disabled condition
  - Test condition
  - Quiescent condition
- The CIE shall be capable of indicating simultaneously any combination of the above conditions
  1. The CIE shall be equipped with an alphanumeric display unit and integral printer which shall automatically display details of the alarm status and the location of detection devices which have entered an abnormal condition. A buzzer shall sound automatically in the event of an alarm and may only be silenced on acceptance of the alarm. An alphanumeric keypad shall be provided to allow access for all programming and maintenance routines. Entry shall be at four levels by means of the appropriate passwords and restrictions.
  2. The central processing unit shall continuously store in memory details of alarm conditions. It shall be possible to print the entire memory on request.
  3. The FACP shall incorporate a real time clock to enable events to be referenced against time and date.
  4. The detection devices shall be suitable for wiring on a loop system with each device on a loop holding a separate address. The panel shall be capable of controlling a number of detection loops and sounder circuits with a minimum of 126 addresses per loop and shall be supplied complete with loop cards as required.
  5. The system shall monitor each loop and sounder circuit for open circuits, short circuits and earth faults. The system shall interrogate each address at intervals not exceeding 5 seconds to determine it's status and classify it into 'normal', 'pre-alarm', 'alarm' and 'fault' conditions.
  6. Alarms shall be enunciated on the display panel in two ways: -
- The loop and device number shall be on a segment display.
- A real language text message for the location shall appear on an LCD display, minimum 40 characters.
  7. The real language text message LCD display shall indicate the time, date, number of alarms active, type of message and an 18 character, minimum, customer-selected message.

8. The CIE shall be complete with an integral printer which shall record all events and panel operations.
9. The CIE shall indicate by address and text message the first alarm in a series of alarms until the first alarm has been reset. Subsequent alarms shall illuminate the appropriate LED indicator and have the printer record this alarm. A scroll button shall be provided to allow scrolling through the addresses and message displays of subsequent alarms. The display shall always revert to the first alarm until it is reset.
10. The CIE shall be complete with control push button to carry out the following functions: -
    - Evacuate
    - Silence Alarm
    - Scroll Display
    - Lamp / Display Test
    - Printer Feed
11. The addressable fire alarm control panel microprocessor shall have event memory to store details, including time and date, of the last 100 events that have occurred. It shall be possible to print out the entire memory upon request.
12. The panel shall have a permanent alphanumeric keypad to allow for full programming and maintenance routines.

13. The CIE shall be fed from a 13amp-fused connection. The spur shall be label “Fire Alarm Panel” using a “Traffolyte” label. The spur feeding the main fire alarm panel shall be fed from the main board; no other devices shall be on this circuit.
14. The CIE shall incorporate a standby battery and charger unit to comply with the requirements of EN 54-4 in relation to maximum alarm load. It shall give 72 hours standby.
15. If the battery and charger for the CIE are contained in a separate cabinet, at least two transmission paths shall be provided. The cables used for the transmission paths shall be correctly sized Enhanced Fire Resistant Cable meeting the requirements of PH120 Classification in accordance with the requirements of EN 50200.
16. The Fire Alarm Specialist shall be responsible for calculation the “maximum alarm load” to ensure compliance with the relevant section of the latest version of IS 3218. The duration of the emergency supply source shall be 48 hours in normal quiescent condition after which sufficient reserve shall remain to power all alarm devices and interface units to meet the requirement of the fire strategy.
17. The housing containing the CIE shall be of metal construction and shall be capable of being surface or semi-flush mounted. It shall complete with cable knock-outs in sufficient quantity to accommodate all likely cabling requirements. The housing shall afford a minimum ingress protection to IP40 and it shall not be possible to open the FACP without the use of a special tool or key.
18. The CIE is to be complete with separate DIN rail mounted connection terminals for field wiring. Field wiring is not to be directly connected to PCBs within the panel.
19. The detection device loops shall be two wire bi-directional starting from and returning to the control panel. The panel shall be capable of addressing a minimum of 99 addressable field devices. Each device shall have a unique address and be interrogated at intervals not exceeding 5 seconds.
20. One fault in any transmission path (TP) shall not affect the correct functionality of any other transmission path.
21. If more than 32 devices are installed on any one-transmission path than any one fault shall not affect more than 32 devices.
22. The maximum number of devices on any one detection circuit loop shall be as prescribed by the specific equipment manufacturer, but shall not exceed 120 devices.
23. A Maximum 480 points only shall be lost in case of one system fault (i.e. main processor fault).
24. All equipment connected to the system addressable loop, either directly or via interfaces, shall be proofed against electrical noise, high frequency pulses and electromagnetic influences from other equipment.
25. The control panel shall have a minimum of 4 sounder circuits expandable up to 16 by the addition of expansion boards.
26. The control panel shall have a minimum of 4 volt-free change over contacts with the programmability to assign any output to one or more detection devices. Typically

these shall be used to activate communicators, door release systems, ventilation plant shut-down, smoke extract systems etc.

22.1.7 Access to Software

27. The selected equipment must leave the OPW with complete freedom of choice in terms of selecting a Fire Alarm Maintenance Provider to maintain the system in the future. The Fire Alarm Specialist must submit all access codes and programming information to the OPW as part of the Operations and Maintenance manual for the project.

22.1.8 Circuit Wiring

28. The detectors and break glass units shall be installed on a loop principal, allowing each device on the loop two transmission paths (i.e. loop in, loop out). No “T” connections shall be permitted on the system unless agreed in writing with the Engineer.
29. Sounders shall be wired on a separate loop to detector and break-glass units. Each Alarm Zone will be fed from Sounders supplied from two separate independent loops.
30. All cables used in the Fire Detection and Alarm system shall, as a minimum, meet the classification for Standard PH120 Cable (when tested in accordance with IS EN 50200, including the modifications as set out in Annex E.2) unless otherwise stated.
31. Loops of detectors or sounders shall employ a separate and distinct route for the feed and return paths, i.e. four-core or multi-core cable shall not be employed to carry both the feed and return cable cores.
32. Where it is required to link individual building fire alarm panels then the link cabling shall be 12-core PH120 rated fibre optic cable, as Leoni Fiber Connect U-DQ(ZN)HWH or equal and approved.
33. Wiring to other items of plant or control panels shall be carried in the same manner as wiring to sounder circuits. Other plant items include:
    - Slam Shut Valve control panels.
    - AHU equipment for use in smoke venting.
    - Door access systems.
    - Fire suppression systems

22.1.9 Short Circuit isolators

34. Short Circuit isolators shall be included through out the system to isolate faults by automatically opening the loop either on side. Short Circuit isolators may be included as integral part of the detection or alarm devices or they may be independent units.
35. Short circuit isolators shall comply with EN54-17.
36. As a minimum isolators should be included so that no more than ten detection devices are lost during a fault condition. Loop driven sounders should not be effected by such faults. As an absolute minimum isolators shall be included as an integral part of al break glass units and all fire sounders.
37. Short circuit isolators shall be installed at every location where fire alarm cabling crosses from one fire compartment to another.

22.1.10 Manual Call Points

38. Manual call points shall utilise flexible plastic elements and shall comply with EN 54-11. Where finishes permit, manual call points shall be flush mounted using standard 86 mm square switch box of 35 mm depth. Elsewhere manual call points shall be surface-mounted using the manufacturer's standard back box.
39. Where they are viewed from the side (e.g. in corridors) they shall present a side profile area of not less than 750 mm2. They shall be labelled 'Fire' and shall give concise instructions for operation. The call point shall be capable of being tested, without removing the element, by insertion of a special test key.
40. Where necessary the manual call points shall be mounted in a weatherproof housing, affording protection to IP 66.
41. All manual call points shall be red in colour
42. Break glass units shall be mounted at 1200 mm to centre of the box above finished floor level.
43. The addressable break glass units shall monitor and signal to the CIE the status of a switch operated by a “break glass” assembly. The addressable break glass units shall be provided with an integral red LED to indicate activation.

22.1.11 Smoke Detectors – Point Type

44. The point type smoke detectors shall have analogue outputs and shall be individually addressable. They shall be suitable for mounting on a common mounting base and shall comply with EN 54-7.

45. The mounting base shall be manufactured from self-extinguishing plastic and be provided with terminals to accommodate 1.5mm² cables. Detectors shall be suitable for surface mounting on to round conduit BESA boxes. Removal of detectors from mounting bases shall not break the connection to the next device on the circuit, however such action shall initiate a fault condition.
46. A remote indicating LED must be capable of being connected to the mounting base to operate in conjunction with the detector or group of detectors.
47. The ionisation smoke detectors shall be capable of detecting visible and invisible combustion gases emanating from fires, using a dual ionisation chamber in which the air is ionised by a single radioactive source. The radioactive source used shall be AM 241 of one microcurie or less.
48. The photoelectric smoke detectors shall be capable of detecting visible combustion gases emanating from fires and shall employ the forward light-scatter principle.
49. The point-type photoelectric smoke detectors shall be equally sensitive to a wide range of combustible materials.
50. The design of the point-type photoelectric smoke detector sensing chamber shall be optimised to minimise the effect of dust deposit over a period of time. The chamber cover shall be removable for ease of cleaning or replacement.
51. The smoke detectors shall be designed to have high resistance to contamination and corrosion and shall include RFI screening to minimise the effect of radiated and conducted electrical interference.
52. The smoke detectors shall be suitable for operation in air speeds of up to 10m/s and shall incorporate screens to minimise contamination by dust and small insects.
53. The smoke detector shall incorporate two LED's, clearly visible from the outside, to provide indication of alarm activation.
54. In locations where the detector is not readily visible, remote indicator units shall be provided.

22.1.12 Heat Detectors

55. The heat detectors shall have analogue outputs and shall be individually addressable. They shall be suitable for mounting on a common mounting base and shall comply with EN 54-5.
56. The mounting base shall be manufactured from self-extinguishing plastic and be provided with terminals to accommodate 1.5mm² cables. Detectors shall be suitable for surface mounting on to round conduit BESA boxes. Removal of detectors from mounting bases shall not break the connection to the next device on the circuit, however such action shall initiate a fault condition.
57. The heat detectors shall be capable of detecting rapid rise in temperature and/or fixed absolute temperatures.
58. The heat detectors shall employ two heat-sensing elements with different thermal characteristics to provide a rate of rise dependent response.
59. The heat detectors shall be designed to have high resistance to contamination and corrosion and shall include RFI screening to minimise the effect of radiated and conducted electrical interference.
60. The heat detector shall incorporate two LED's, clearly visible from the outside, to provide indication of alarm activation.
61. In locations where the detector is not readily visible, remote indicator units shall be provided.
62. Heat detectors shall not be installed on escape routes.

22.1.13 Anti-Ligature Smoke Detectors

63. The anti-ligature smoke detectors shall be designed for flush mounting into the building structure and shall comply with EN 54-7.
64. The anti-ligature detectors shall operate on the light-scatter principle utilising infra red LEDs within the detector body to create a virtual detection chamber.
65. The exposed face of the anti-ligature detectors shall consist of a 150mm x 150mm x 2mm thick stainless steel plate with detection windows which shall be secured to the

ceiling using tamper proof fixings. The design of the plate shall be such that it cannot be used as an anchor point for a ligature.

66. The anti-ligature smoke detectors shall incorporate coloured LEDs to indicate Normal, Fault and Fire conditions.
67. The anti-ligature smoke detectors shall be self monitoring and shall self-adjust automatically in response to contamination of the detector. The detector shall generate a fault signal in the event that the contamination prevents the detector from operating normally and in the event of an attempt to tamper with the detector, e.g. by covering the detector windows.
68. The anti-ligature smoke detectors shall be Apollo Plateau Vandal Resistant or equal and approved.

22.1.14 Multi Sensor Detectors

69. The multi sensor detectors shall have analogue outputs and shall be individually addressable. They shall be suitable for mounting on a common mounting base and shall comply with EN 54-5, EN 54-7 and EN 54-29.
70. The mounting base shall be manufactured from self-extinguishing plastic and be provided with terminals to accommodate 1.5mm² cables. Detectors shall be suitable for surface mounting on to round conduit BESA boxes. Removal of detectors from mounting bases shall not break the connection to the next device on the circuit, however such action shall initiate a fault condition.
71. The multi sensor detectors shall contain an optical smoke sensor and a thermistor heat sensor within a single housing and whose outputs are combined to give the final analogue value.
72. The design of the point-type multi-sensor photoelectric smoke detector sensing chamber shall be optimised to minimise the effect of dust deposit over a period of time. The chamber cover shall be removable for ease of cleaning or replacement.
73. The multi sensor detectors shall shall incorporate screens to minimise contamination by dust and small insects.
74. The sensor should be able to operate in the following modes:
    1. Combination Mode.

The sensor should be able to operate as a Photoelectric sensor but when the ambient temperature reaches 40º C or above, the thermal elements should be capable of sensing the 'Rate of Rise' and adjust the sensitivity of the photoelectric element automatically. The sensitivity of the photoelectric should be increased via an internal algorithm.

    2. Photoelectric Mode

The sensor should be able to return the analogue value for the photoelectric element during a normal polling sequence. The sensor should also be able to signal to the CIE if the thermal sensing element exceeds a fixed temperature threshold.

    3. Thermal Mode

The sensor should be able to return the analogue value for the thermal element during a normal polling sequence. The sensor should also be able to signal to the CIE if the photoelectric sensing element exceeds a pre-defined threshold.

75. The multi-sensor should have the capability of monitoring both sensing elements, if either or both of the elements fail it should be reported and displayed at the CIE.
76. The multi-sensor detectors shall incorporate two LED's, clearly visible from the outside, to provide indication of alarm activation.
77. The multi-sensors shall be designed to have high resistance to contamination and corrosion and shall include RFI screening to minimise the effect of radiated and conducted electrical interference.
78. In locations where the detector is not readily visible, remote indicator units shall be provided.

22.1.15 Duct Smoke Detectors

79. Smoke detection within ventilation ductwork shall be provided by means of purpose designed enclosures to accommodate standard smoke detectors and bases.
80. The enclosures shall be mounted externally on the duct and shall have a transparent cover to allow viewing of the installed detector head and LED and shall have an integral smoke test port to enable the detector to be tested without introducing smoke into the ventilation duct.
81. Sampling and exhaust tubes shall extend into the ventilation duct from the smoke detector enclosure which shall cause air from the duct to be drawn through the

smoke detector enclosure without the use of external fans. The sampling tube shall span the full width of the duct to ensure complete coverage of the airflow.

82. The duct detector unit shall be suitable for use in ducts up to 3,000mm and with airflow speeds from 0.5 m/s to 20 m/s.

22.1.16 Aspirating Type Smoke Detection Systems

83. The system shall consist of high performance laser based particle detection system based on the principal of forward light scatter, a high efficiency aspirator and a sampling pipe system designed to sample air from within the protected area. The system shall allow the following:
    - Programming of four smoke threshold alarm levels (no alarming is provided)
    - Time delays
    - Faults including airflow, detector, power and filter as well as an indication of the urgency of the fault
    - Seven configurable relay outputs for remote indication of alarm and fault conditions
84. The aspirating smoke detection system shall comply with the requirements of EN 54-120 and the British Fire Protection Systems Association (BFPSA) Code of Practice for Aspirating Smoke Detector Systems.
85. The detector, filter and aspirator shall be housed in a single purpose designed metallic cabinet and shall be arranged in such a way that air is drawn from the protected area through the Dual Stage Filter and Detector by the Aspirator.
86. The aspirator shall be a purpose-built rotary vane air pump. It shall be capable of allowing for multiple sampling pipe runs up to 300 ft. (91m) each, with a response time not exceeding 90 seconds.
87. Resistance to unwanted alarms is of paramount importance. The system shall incorporate advanced statistically based signal processing techniques proven to reduce unwanted alarms. Each detector shall utilise a system of Artificial Intelligence to ensure a consistent level of protection by constantly varying its operating parameters to match environmental changes within the protected area.
88. The detector shall incorporate a dual technology system for the automatic discrimination of signals from non-fire related sources such as dust. The system shall automatically adjust itself to eliminate any deterioration in performance caused by a build up of contamination.
89. The detector shall continuously monitor all internal and external components, and signal warning in the event of any malfunctions including; filter contamination, detection chamber operation, air flow in sampling pipes outside normal limits, microprocessor functioning correctly, power supply, etc.

22.1.17 Smoke Sampling Pipe Network for Smoke Detector, Aspirating Systems

90. The pipe layouts as indicated on the engineer’s drawings are notional. The Commissioning Provider shall use the architectural plans and sections of the building to determine the quantity of pipe and fittings required.
91. The sampling pipe network shall be arranged to provide optimum efficiency. The response time for the least favourable sampling point in the system shall not exceed 90 seconds and the system shall be balanced so that the volume of air drawn from the last sampling point shall not be less than 70% of the volume from the first sampling point. The Fire Alarm Specialist shall submit: details of the pipework design showing the proposed layout and this design shall be supported by computer-generated calculations showing response times, suction pressures and balance details of each sampling point.
92. The Fire Alarm Specialist shall install the system in accordance with the manufacturer's installation and instruction manual.
93. The main sampling pipes shall be red ABS of 20mm or 25mm diameter and shall be identified as a Fire Detection Sampling Pipe at intervals not exceeding the requirements of the BFPSA Code of Practice for labelling sampling pipe. The far end of each trunk or branch pipe shall be fitted with an end cap and drilled with a hole appropriately sized to achieve the performance as specified and as calculated by the system design. All joints shall be air tight and made by using solvent cement, except at entry to detector mounting box. All pipe shall be supported at not less than 1200 centres.
94. Sampling Holes of at least 2mm diameter shall be separated by intervals not more than 9m intervals along the length of the pipe. These intervals may vary according to

calculations. Each Sampling Point shall be identified in accordance with the BFPSA Code of Practice. Consideration shall be given to local regulations and manufacturer's recommendations in relation to the number of Sampling Points and the distance of the Sampling Points from the ceiling or roof structure and forced ventilation systems.

95. Where false ceilings are installed, the sampling pipe shall be installed above the ceiling, and Capillary Sampling Points shall be installed on the ceiling and connected by means of a capillary tube. The minimum internal diameter of the Capillary tube shall be 10mm the maximum length of the Capillary tube shall be 3600mm unless the manufacturer in consultation with the engineer have specified otherwise. The Capillary tube shall terminate at a Ceiling Sampling Point. The performance characteristics of the Sampling Points shall be taken into account during the system design. A conventional tee fitting shall be provided in the main sampling pipe for each capillary sampling point.
96. Air Sampling Pipe Network Calculations shall be provided from a proprietary sampling pipe aspiration modelling program.
97. The Commissioning Provider shall visually check all pipes to ensure that all joints, fittings, bends, sampling points, etc. comply with the specification. He shall check the system to ensure the following features are operational and programmed in accordance with the specification.

22.1.18 Photo-Electric Beam Detection Systems

98. Photoelectric beam detection systems shall consist of a combined Infra-Red transmitter – receiver unit and a reflector and shall comply with the requirements of EN 54-12.
99. The system shall be suitable for operation across distances of up to 50 metres.
100. The system shall incorporate a visible spectrum laser for initial alignment and thereafter the detector head shall continuously align and compensate for any building movement.
101. The system shall automatically compensate for gradual contamination of the lenses to reduce the risk of false alarms and shall generate a fault signal in the event that the contamination prevents the detector from operating normally.

22.1.19 Interface Units

102. Fire alarm input / output units complying with the requirements of EN 54-18 shall be provided to interface the fire alarm system with other mechanical and electrical systems throughout the complex.
103. The Fire Alarm Specialist shall include fully for all necessary interface units, input/output units, relays and power supplies to implement the fire safety strategy as described elsewhere in this specification. They shall be typically used to initiate the following:
    - Ventilation plant shut down
    - Closing of Fire doors
    - Opening of Smoke vents in all areas
    - Closing of Gas slam shut valves
    - Automatic muting of PA system
    - Switching off Lifts
104. Interface units shall be provided to monitor the following ancillary fire safety systems in the building in the event of a fire. Detection of alarm status in such systems shall display details of the fault and activate a sounder within the CIE in the main security control room.
    - Computer Room Fire Suppression System
    - Kitchen Canopy Fire Suppression System
    - Sprinkler Systems – refer to separate section of this specification
    - Gas detection systems
105. The Fire Alarm Specialist shall liaise with all specialist/suppliers to ensure the systems to be interfaced are compatible.

22.1.20 Monitoring Of Sprinkler Valves & Plant

106. The fire detection system shall monitor the various sprinkler plant alarm facilities in accordance with the requirements of B.S. 5306, Part 2, 1990, Section 5 and as described elsewhere in this specification.

107. Local monitoring panels shall be supplied and installed as part of the fire alarm system to monitor each and every sprinkler valve on the installation. These monitoring panels shall be complete with LEDs to provide status indicator for fire and fault conditions of all valves. They shall be complete with addressable zone monitoring units as required for monitoring the valve micro switches and for interfacing with the fire detection loop.

22.1.21 Sounders

108. Fire alarm sounders shall be the electronic type with an output of 106 dB at 1 meter and shall comply with EN 54-3. They shall have a red flame retardant housing. The Fire Alarm Specialist with cooperation from the Electrical Specialist/Installer shall ensure that the sound cannot be easily confused with other alarm sounders in the building.
109. Sounders shall be suitable for surface mounting on round conduit BESA boxes and shall be complete with skirts which shall conceal the conduit box. They shall be mounted at approximately 2600 mm above floor level.
110. The number, type and location of all sounders shall be as indicated on the drawings. Where sounders are provided the Fire Alarm Specialist shall be responsible for ensuring that sounders shall provide the minimum sound levels required in the relevant “Audibility of Alarms” section of the latest version of IS 3218.
111. Should the Fire Alarm Specialist decide that it is not possible to achieve the required sound level using the number and/or layout of sounders shown, without using sounders with unacceptably high output levels, then the Fire Alarm Specialist shall advise the Engineer of any additional sounders considered necessary and indicate their preferred location.
112. As noted elsewhere in this document the fire strategy for the complex does not include for the provision of sounders throughout in accordance with the requirements of IS 3218.
113. The sounder adjacent to any CIE may have a reduced output e.g. in a security room, reception desk etc. to allow normal voice communication to continue.

22.1.22 Strobe lights

114. Strobe lights shall be installed as indicated on the drawings. They shall be heavy-duty, self-contained, high intensity warning beacons constructed from high impact resistant polycarbonate and complying with the requirements of EN 54-23. They shall be coloured red and labelled “Fire” They shall be 24 VDC operated.
115. They shall be capable of emitting high intensity strobe light bursts to indicate an alarm condition with or without the sounders operating.

22.1.23 Door Holders

116. Door holders shall comprise a wall or floor mounted 24V D.C. electro magnet with door mounted swivel plate armature. These units shall generally be mounted at low level or door head level. Floor types shall be complete with floor mounting bracket.
117. Door closer/hold-open devices shall comprise an over door closer with an integral 24V D.C. electro-magnetic door hold-open device. These shall be supplied and erected by the Main Contractor unless otherwise stated.
118. The electro magnets shall be fed from a central door release relay unit incorporating a 220 V A.C. to 24 V D.C. transformer/rectifier unit, individual circuit fuses, and a relay, the coil of which shall de-energise upon receipt of a fire alarm signal thereby switching off the 24 V supply to the electro magnets.

22.1.24 Zone Chart

119. A Zone Chart shall be permanently fixed beside the main CIE and each repeat indicator panel. The Zone Chart shall contain the information as required in the current version of IS 3218.

22.1.25 Repeat Indicator Panels

120. Repeater panels shall be similar in design and appearance to the main CIE and shall comply with the requirements of EN 54-2.

121. Repeater panels shall have an alphanumeric display and LEDs to repeat all text messages and indicators which are displayed on the main CIE and shall incorporate a full duplicate set of controls as are installed on the main CIE.
122. They shall be powered locally and shall contain their own standby battery unit.
123. The system shall be designed and configured so that a fault or damage on a repeater panel shall not have any adverse effect on the operation of the main CIE.

22.1.26 Automatic Receiving Centre (ARC)

124. The fire alarm system shall be monitored by a 24 hour x 7 day Automatic Receiving Centre via a digital communicator between a fire alarm system and an ARC. The requirements for relaying of a fire signal to the remote station shall comply fully with the relevant section of the latest version of IS 3218.
125. The Fire Alarm Specialist shall supply and install a dedicated digital communicator for the fire alarm system.
126. The digital communicator shall be equipped with the facility to connect to the Public Switched Telephone Network (PSTN) via a hard-wired connection and also a GSM network via a SIM card (to be supplied by OPW).
127. The Electrical Specialist/Installer shall be responsible for the supply and installation of a dedicated telephone line back to the incoming telephone line distribution frame and for all necessary interface with the telecommunications services provider.
128. The telephone line shall be enhanced fire resistance cable of PH 120 classification to IS EN 50200 and shall be monitored for open and short circuit fault conditions.

22.2 TESTING AND COMMISSIONING OF FIRE ALARM SYSTEM

22.2.1 Introduction

The Fire Alarm Specialist shall include for the complete testing, pre-commissioning, commissioning, certification and handover of the fire alarm system in accordance with IS 3218. This should include the following, as a minimum:

- Inspection and testing of the wiring installation for correct polarity, insulation resistance and earthing.
- Testing and recording the operation of all detection devices.
- Testing and recording the operation and audibility of all sounders and alarm devices.
- Testing and recording operation of all CIE, control panels, repeat indicators, and digital communicator etc.
- Testing and recording the operation of the fire strategy prior to demonstration to the engineer and client including all necessary consultation, site meetings etc. as required with other specialists.
- Programming the system and setting up text messages and displays to Client's requirements.
- Programming the system to implement the fire strategy
- Final testing and certification and verification of operation of the fire strategy
- Instructing Client's agent in the operation and maintenance of the system.
- Handover of all test records, certificates, log books, manuals etc.
- Checking the complete installation to ensure detectors have been installed in all areas as indicated on the contract drawings and that the design intent has been met

22.2.2 Fire Alarm Strategy

129. The fire alarm system shall be programmed or configured to provide an agreed safety strategy in the event of the fire.
130. The Fire Alarm Specialist shall include fully for all necessary interface units, input/output units relays and power supplies to implement this strategy.
131. The Fire Alarm Specialist in conjunction Electrical Specialist/Installer shall be responsible for liaising with all other specialists such as lift companies, Sprinkler companies, smoke vent system suppliers, BMS Contractors, mechanical contractor etc. to determine the appropriate method of interface and for carrying out a complete

testing of all interfaces prior to demonstration to the engineers for acceptance and handover.

132. Unless otherwise specified, activation of Evacuate Mode will be on the basis of:
- Investigation time elapsing without manual intervention following activation of a single smoke / heat detector
- Or activation of a second smoke / heat detector
- Or activation of a manual call point

133. In tandem with the above the following shall typically occur:

134. All ventilation plant in the effected building shut down via MCC
- Smoke vents open in all areas via direct interface with each ASV controller
- Gas slam shut valves close via direct interface and by failing supply to valve solenoid
- Automatic mute facility activated in the music / PA system
- Lifts switch off via direct interface with Lift MCC. Refer to details above.
- Fire signal relayed to Alarm Receiving Centre (ARC) via the Digital Communicator

135. The Fire Alarm Specialist shall produce a site specific Fire Strategy Verification Document to verify and record the operation of the Fire Safety Strategy. Each action in the document shall be signed by the Commissioning Engineer and countersigned by the Electrical Specialist/Installer as a witness.

136. A cause and effect strategy for the different buildings is appended to the rear of this document and outlined briefly in the following paragraphs.

22.2.3 Control of ventilation systems in the event of fire
Ventilation plant in a building will shut down via the interface with the MCC in the Plant Room if smoke is detected anywhere in that building.

22.2.4 Smoke Fire Damper (SFD) in the event of fire
The SFDs shall automatically close under the circumstances described in the Cause and Effect Strategy.

22.2.5 Atrium Automatic Smoke Vents (ASV) in the event of fire
Atrium Smoke Vents shall automatically open under the circumstances described in the Cause and Effect Strategy.

22.2.6 Stair Automatic Smoke Vents ASVs
Stair AOVs will only open if smoke is detected within the associated stairwells.

22.2.7 Automatic Opening Vents for smoke control
Automatic opening vents and doors (for provision of make up air for smoke control) shall automatically open under the circumstances described in the Cause and Effect Strategy.

22.2.8 Kitchen and Servery Fire Screens
Kitchen and servery fire screens will drive to the closed position if smoke is detected within the servery area. They should be supplied via a UPS circuit.

22.2.9 Control of Lifts In The Event Of Fire
If the lift is travelling when the fire alarm is activated it shall continue to a designated floor and switch off via a direct fire alarm interface with Lift Control panel as follows:
- Fire signal from the ground / main exit floor - lift to go to the nearest floor above.
- Fire signal from any other floor - lift to go to the ground / main exit floor.

137. If the lift is stationary when the fire alarm is activated then the lift shall simply switch off.

138. In either case the car and landing doors shall close but shall remain openable from the car control panel at all times.

139. The Fire Alarm Specialist shall liaise directly with the lift supplier to determine wiring details for the interface with the fire alarm system.

22.2.10 Control and Monitoring of Gas

140. Where Gas detection systems and associated slam shut valves are to be installed in the building, they shall be controlled and monitored as follows.

141. In the event of gas being detected by the gas sniffer, the gas monitoring panel shall switch off the supply to the slam shut valve causing it to close. It shall also provide a “volt free” signal to the Fire Alarm System which shall be indicated as a “fault” on the Fire Alarm panel.

142. In the event of fire being detected, the Fire Alarm System shall break the supply to the slam shut valve by means of interface unit and relay.

23. SECURITY SYSTEMS : CCTV , ACCESS CONTROL & INTRUDER ALARM

The security specialist shall be responsible for the supply, installation and commissioning for all CCTV , Access Control & Intruder Alarm systems and equipment in accordance with the requirement of this specification and as indicated on the drawings

23.1 CCTV SERVICES INSTALLATION:

23.1.1 Standards

The materials, components and completed installations shall conform as applicable with the following standards, including all amendments, current at the time of tendering.

The system shall comply fully with EN 50132-7:1998 CCTV surveillance systems for use in security applications and EN 50132-5:2001 Video Transmission.

The CCTV installation shall also comply with the following:

CCIR report 624-4 (1990)	Characteristics of television systems
CCIR recommendation 567-3 (1990)	Transmission performance of television circuits designed for use in international connections
EN 50081-1 (1992)	Electromagnetic compatibility — Generic emission standard — Part 1: Residential, commercial and light industry
EN 50130-4 (1995)	Alarm systems - Part 4: Electromagnetic compatibility -+ Al 1998 Product family standard: Immunity for components of fire, intruder and social alarm systems
EN 50130-5 (1998)	Alarm systems - Part 5: Environmental test methods
EN 60065 (1998)	Audio, video and similar electronic apparatus – Safety requirements (IEC 60065:1998, mod.)

EN 60068-1 (1994)	Environmental testing - Part 1: General and guidance (IEC 60068-1:1988 + corr. Oct.1988 + A1:1992)
EN 60950 (2000)	Safety of information technology equipment (IEC 60950:1999 + corr. 2000, mod.)

All wiring shall comply fully with the latest and current ETCI Wiring Regulations.

23.1.2 Wiring & Containment

The contractor shall be responsible for the supply, installation and commissioning for a CCTV Security System in accordance with the Office of Public Works guidelines to meet with requirements for the building.

The contractor shall be required to install the conduits and cabling associated with the CCTV Systems. The cabling will be terminated and the CCTV Systems components and outlets/detector devices shall be supplied, fitted, tested and certified by the contractor.

All CCTV System cables installed by the electrical contractor shall be fully tested for continuity prior to acceptance by the security contractor. Cable faults shall be identified and repaired by the electrical contractor by replacing the faulty cable in it's entirety.

The CCTV system cabling shall generally use the existing ELV compartment section of cable basket systems, however, where over capacity, the electrical contractor shall include for a network of 50 x 50mm ELV trunking and steel conduit system which can be sealed closed following the installation of the intruder alarm cables.

The electrical contractor shall note that all CCTV system wiring to individual peripheral items such as cameras and monitors shall be wired in a home run star radial network topology from the main panel.

All cabling used in the CCTV system shall be wired in RG59 co-axial cable in accordance with the specialist contractors requirements with local power supplies for equipment as noted on the drawings.

All cameras shall be wired directly to the digital video recorder which is located as indicated on the drawings or unless otherwise stated in the comms room of each building.

All work shall be done in a thorough and conscientious manner according to industry standards and shall be subject to inspection and acceptance.

The contractor shall be responsible to co-ordinate the electrical(LV) and CCTV Systems(ELV), that they will not share the same conduit, trunking compartments, channel or sleeve .The ETCI Regulations (and definition of low voltage) shall be adhered to in this respect. Separate conduit systems shall be provided for each system as noted on the drawings.

23.1.3 Camera Lens Selection

The size of an object (target) on the monitor screen should have a relation to the operator task, e.g. identification, recognition, detection or monitoring. It shall be the responsibility of the CCTV contractor to select the most suitable lens to achieve the level of viewing specified. These viewing levels shall be as follows and shall indicate the height of the target (person being monitored) relative to the height of the monitor screen.

a) for identification the target should represent not less than 120% of screen height.
b) for recognition the target should represent not less than 50% of picture height.
c) for detection of an intruder the target should represent not less than 10% of picture height.

d) for crowd control (monitoring) the target should represent not less than 5% of picture height. Figure 1 gives an indication of the relative sizes of a person (target) on screen.

When selecting the lens the following should also be taken into account:

a) The lens field of view (indicated in the manufacturer's nominal figure tables) may be reduced by any over scan in the display device;
b) The illumination of the sensor in the camera is defined by the aperture number of the lens and its transmission number, which is dependent on the design of the lens;
C) Internal lens reflections and ghosting can significantly impair the image;
d) Some zoom lenses are subject to ramping whereby the effective aperture number of the lens increases as the focal length is increased.
e) Accuracy of the preset shots if fitted.

NOTE: Having selected the camera-lens combination, it is recommended that, for difficult scenes, a camera of the type selected should be evaluated in conditions similar to those to be encountered at the installation.

23.1.4 Internal camera installation

All cameras shall be of the mini dome type or fixed type and strategically mounted to view the designated area of concern.

Cameras locations are indicated on the tender drawings.

23.1.5 External camera installation

Cameras shall be capable of functioning at lighting levels of 0.4 lux or higher

All external cameras shall be installed to monitor the building peripheries and general open areas within each site complex. The cameras shall be positioned in such locations so as to monitor general pedestrian and vehicular traffic.

External fixed cameras shall be focused directly on external doors. Cameras locations are indicated on the tender drawings.

All external cameras shall be recorded at 25 frames per second (FPS)

23.1.6 Monitoring and recording

The recording of all images shall be stored on a Digital Video Recorder(s) (DVR). The DVR's shall be located as indicated on the drawings, or unless otherwise stated, in the comms room of each building. Each of the DVR units shall have an IP module for connecting it to the LAN (Local Area Network).

All cameras shall be recorded at 25 frames per second (FPS).

The DVR shall be capable of 25 frames per second live and 25 frames per second in playback at D1 resolution (720x526 PAL) and shall be capable of 30 days storage

Event logging will be required for the CCTV installation.

All monitors shall be colour 19" High Definition 1080 x 720p LCD monitors for viewing DVR multi-screen all monitors shall be supplied with low profile wall mounting brackets to suit.

A monitor shall be located at each DVR.

A second keyboard/control unit and 2 no 19" monitors(1 split screen & 1 live view) will be required at the reception desk or as indicated on the drawings.

Video input and output cables installed should have the following characteristics:

- The source and load impedance of a transmission system shall be 75 Q on the unbalanced coaxial input and output
- The return loss in the inputs and outputs shall be 20 dB from 0.1 MHz to 5 MHz.

The cameras shall record all images in the field of view for 5 seconds pre-motion and 5 seconds post motion in the designated area.

The type of cable chosen should have a characteristic impedance of 75 Ohms. For long cable runs amplifying or amplifying plus video equalising equipment may be required to meet the above performance. The contractor shall advise if amplifying equipment is required and clearly indicate this equipment in there return form of tender.

The transmission equipment shall be connected and adjusted in accordance with the manufacturer's recommendations, for the recommended cables and up to their maximum specified length. Unless otherwise specified in the tests, the system shall operate at nominal input and output levels and terminated in a standard load impedance of 75ohms ± 5 %.

The contractor shall supply and install all CCTV monitors through out.

23.1.7 CCTV system equipment

Cameras:

Each camera shall comply with the following.

General:

Each camera must have loop through facility.

External Full Function (PTZ):

Each full function camera shall comply with the following or equal and approved

- Colour to black and white external full function dome, 540 TV lines high resolution
- Cameras shall be capable of operating at lighting levels of 0.45 lux colour @ F1.4 & .015 lux balck & white @ F1.4.
- Review HAD 1/4" CCD integrated camera. Lens, F1.4, 3.4-91.8mm, zoom 27 X optical and 10 X electronic, 3 X auto focus. 80 presets, preset speeds 360degree/sec pan preset speed and 200- degree/sec tilts.
- Manual speeds, Pan 0.1-80 degree/sec, 150 degree turbo, Tilt 0.1-40 degree/sec, subject to variable speed controller, non-variable speed controller, speed is 20 degrees/sec, complete with IWM wall mount wall brackets.

Internal

- High resolution 600 TV lines colour mini internal surface dome, vari-focal 1.2-10mm, 3 axis gimble, voltage 24v AC or 12v DC.
- Cameras shall be capable of operating at lighting levels of 0.1 lux colour @ F1.2 & .05 lux balck & white @ F1.2 or higher.
- Each dome camera shall be housed in a vandal resistant enclosure.

External:

- High resolution 600 TV lines colour mini internal surface dome, vari-focal 1.2-10mm, 3 axis gimble, voltage 24v AC or 12v DC.
- Cameras shall be capable of operating at lighting levels of 0.1 lux colour @ F1.2 & .05 lux balck & white @ F1.2 or higher.
- Each dome camera shall be housed in a vandal resistant enclosure.
- Each fixed camera shall have infa red lights that have adjustment (horizontal & vertical) that is independent form the camers

All cameras shall be as manufactured by either : Bosh , Pelco , Samsung, Panasonic, CBS Ganz

Digital Video Recorders

All Digital Video Recorder (DVR) shall be either:
Pelco, Bosh, Samsung, Panasonic

Comm.'s Cabinet for CCTV Equipment.

The security specialist shall provide 1No. 47U, 600X 800 comm.'s cabinet compete with extractor fans, 10 way PDU, fixed and a sliding shelf's, cable management trunking and lockable glass door.

The security specialist shall provide 2 No. APC smart controlled 1Kva, 800 watt UPS.

CCTV equipment shall be installed within the comms cabinet unless otherwise stated.

23.1.8 AUTOMATIC NUMBER PLATE RECOGNITION (ANPR) SYSTEM:

N/A

23.2 ACCESS CONTROL SYSTEM:

23.2.1 Standards

The materials, components and completed installations shall conform as applicable with the following standards, including all amendments, current at the time of tendering.

The system shall comply fully with EN 50133-1:1997 alarm systems - access control systems for use in security applications part 1: system requirements

The Access Control System installation shall also comply with the following:

EN 50081-1 (1992)	Electromagnetic compatibility - Generic emission standard -Part 1: Residential, commercial and light industry
EN 50081-2 (1993)	Electromagnetic compatibility - Generic emission standard -Part 2: Industrial environment
EN 50082	Series Electromagnetic compatibility - Generic immunity standard
EN 55022 (1994)	Limits and methods of measurement of radio disturbance characteristics of information technology equipment (CISPR 22:1993)
EN 60950 (1992)	Safety of information technology equipment, including electrical business equipment (IEC 950:1991, modified)
IEC 68-1 (1988) + Al (1992)	Environmental testing - Part 1: General and guidance (harmonized as EN 60068-1:1994)
IEC 68-2-1 (1990)	Environmental testing - Part 2: Tests - Tests A: Cold (harmonized as EN 60068-2-1:1993)
IEC 68-2-2 (1974) + IEC 68-2-2A (1976)	Basic environmental testing procedures - Part 2: Tests- Tests B: Dry heat (harmonized as EN 60068-2-2:1993)
IEC 68-2-6 (1982) + Al (1983) + A2 (1985)	Basic environmental testing procedures - Part 2: Tests - Fc and guidance: Vibration (sinusoidal) (harmonized as HO 323.2.6 S2:1988)
IEC 68-2-18 (1989)	Environmental testing - Part 2: Tests - Test R and guidance: Water
IEC 68-2-63 (1991) EN 60068-2-63:1994)	Environmental testing - Part 2: Test methods - Test Eg: Impact, spring hammer

IS EN 12453:2000	Industrial,Commercial & Garage door & gates -safety in use of power operated doors -requirements
IS EN 12445:2000	Industrial, Commercial & Garage door & gates -safety in use of power operated doors – Test Methods
IS EN 12635:2002+A12008	Industrial, Commercial & Garage door & gates - Installation and use
IS EN 12604:2000	Industrial, Commercial & Garage door & gates – Mechanical aspects requirements
EN13241-1:2003	

23.2.2 Wiring & Containment

All wiring shall comply fully with the latest and current IEI and ETCI Wiring Regulations.

The contractor shall be required to install all the conduits and cabling associated with the Access Control Systems. The cabling will be terminated and the Access Control Systems components and outlets/reader devices shall be supplied, fitted, tested and certified by the contractor.

All Access Control System cables installed by the electrical contractor shall be fully tested for continuity prior to acceptance. Cable faults shall be identified and repaired by the electrical contractor by replacing the faulty cable in its entirety.

The access control cabling shall generally use the ELV compartment section of cable basket systems, alternatively if over capacity the electrical contractor shall include for a network of 50 x 50mm ELV trunking and or conduit system which can be sealed closed following the installation of the cables.

The electrical contractor shall note that all access control system wiring to individual peripheral items such as shall be wired in a home run star radial network topology from the main panel.

All cabling used in the access control system shall be Beldon 9504 and 8 line cabling proprietary cable.

All work shall be done in a thorough and conscientious manner according to industry standards and shall be subject to inspection and acceptance.

The contractor shall be responsible to co-ordinate the electrical and access Systems, that they will not share the same conduit trunking compartments etc., channel or sleeve with low voltage electrical apparatus. The ETCI Regulations (and definition of low voltage) shall be adhered to in this respect. Separate conduit systems shall be provided for each system as noted on the drawings.

23.2.3 Security classification

System Type 1

Access control system shall have the following security classification: class 2 (Proximity Chip & Pin Readers, Touchpad Release, Audiovisual stations with handset release)

Proximity cards shall be included with the system , 150 no cards shall be included for unless otherwise stated.

System Type 2

Access control system shall have the following security classification: class 2 (Proximity Chip Readers, Touchpad Release, Audiovisual stations with handset release)

Proximity cards shall be included with the system , 150 no cards shall be included for unless otherwise stated.

System Type 3
Access control system shall have the following security classification: class 1 (Keypads & Touch Pad Release, Audiovisual stations with handset release)

23.2.4 Access control system strategy for main building doors

Door Access System Type 1
The access control system should be 'proximity' type using cards & PIN. Each door must have individual control capabilities and user groups should be set up on the system to authorise different user types. The system shall be Act 4000 series.

The security specialist shall provide for access control to doors as indicate on the design drawings. Each access controlled door shall be provided with the following equipment;

- ACT 4000 master door controller located on the secure side of door
- ACTpro DESFire EV1 1050 (MIFARE DESFire EV1) reader
- Touch Pad release
- 12 Volt fail open Abloy 8141 Solenoid locking device c/w all necessary cylinders fittings and accessories. All mortise locks shall be supplied and installed with an insert fire sleeve to the fire hour classification of the door.
- Arch 2 (double door) or Arch 1 (single door) full door width transom housing c/w mag lock on the secure side of door
- Green Break glass unit on the secure side of door (for mag locks only)
- Local 12 Volt 2 amp power supply unit for single doors and 12Volt 3 amp for double doors.
- Fire alarm I/O interface

Door Access System Type 2
The access control system should be 'proximity' type using cards. Each door must have individual control capabilities and user groups should be set up on the system to authorise different user types. The system shall be Act 4000 series.

The security specialist shall provide for access control to doors as indicate on the design drawings. Each access controlled door shall be provided with the following equipment;

- ACT 4000 master door controller located on the secure side of door
- The ACTpro DESFire EV1 1030 (MIFARE DESFire EV1) reader
- Touch Pad release
- 12 Volt fail open Abloy 8141 Solenoid locking device c/w all necessary cylinders fittings and accessories. All mortise locks shall be supplied and installed with an insert fire sleeve to the fire hour classification of the door.
- Arch 2 (double door) or Arch 1 (single door) full door width transom housing c/w mag lock on the secure side of door
- Green Break glass unit on the secure side of door (for mag locks only)
- Local 12 Volt 2 amp power supply unit for single doors and 12Volt 3 amp for double doors.
- Fire alarm I/O interface

Applicable To Both Type1 & Type 2 Door Access Systems

Doors With Mag Locks:

- The incoming (secure side) of the door shall be controlled by a proximity card reader.

- The recessed touchpad release & recessed emergency break glass units (green in colour) shall be installed on the out going side of the controlled door and so maintaining the main escape route.

- The full door width transom panel shall be capable of with standing a minimum force of not less than 300lbs per square inch.

- The access control system will automatically de-energise and fail open in the case of confirmed fire alarm activation.

Electronic Motor Door Locks (solenoid locking device):

- Function: a pull outside, inside handle or handle and pull: door can be opened by pushing or pulling when the electrical control is on (e.g. timer, reader, push button). Inside handle opens the lock always.

- The access control system will automatically de-energise and fail open in the case of confirmed fire alarm activation.

The system to be installed shall use ACT4000 controllers complete with IP module. The systems shall be Actwin PRO two licence user.

The ACT4000 controller unit will be located shall be located as indicated on the drawings. The controller unit will be linked to a maximum of 16 door expanders. The controller and the expander will be linked by a RS485(beldon9504) twisted pair cable.

The wall mounted proximity reader shall be the ACT pro 1040 unit and will be served by 8 core screened cable. The ACT cards shall be non-shell type with additional magnetic strip for time and attendance, 150 cards shall be provided as part of this contract.

ACTWin Pro two licence user. shall be provided on 1 No. PC. The PC shall be located in the main comms room unless otherwise instructed. The security contractor shall provide 1 No. PC suitable for running the required security software.

The minimum requirements for the PC shall be as follows:

- Processor: PC based on the Intel 1156 or 2011 processor
- Operating system: Genuine Windows 7 Professional
- Memory: 4 GB DDR3 RAM 1666MHz
- Harddrive: 1TB SATA 2 Hard Drive (7,200rpm)
- Monitor: 19" HD 1080 x 720p Analogue Flat Panel Monitor
- Network Card: Integrated 10/100 NIC
- Graphic Card: AMD HD 5850 or higher
- Sound Card: Integrated Audio
- Optical Drive / Writer: 32x DVD+/-RW Drive

23.2.5 Door Access System Type 3

- The ACT10 Digital Keypad
- Touch Pad release
- 12 Volt fail open Abloy 8141 Solenoid locking device c/w all necessary cylinders fittings and accessories. All mortise locks shall be supplied and installed with an insert fire sleeve to the fire hour classification of the door.
- Arch 2 (double door) or Arch 1 (single door) full door width transom housing c/w mag lock on the secure side of door
- Green Break glass unit on the secure side of door (for mag locks only)
- Local 12 Volt 2 amp power supply unit for single doors and 12Volt 3 amp for double doors.

- Fire alarm I/O interface

Doors With Transom Mounted Mag Locks:

- The incoming (secure side) of the door shall be controlled by a ACT10 recessed keypad.
- The recessed touchpad release & recessed emergency break glass units (green in colour) shall be installed on the out going side of the controlled door and so maintaining the main escape route.
- The full door width transom panel shall be capable of with standing a minimum force of not less than 300lbs per square inch.
- The access control system will automatically de-energise and fail open in the case of confirmed fire alarm activation.
- all final exit doors to external areas shall have a push bar or paddle c/w microswitch to release the transom mounted mag lock.

Electronic Motor Door Locks: (solenoid locking device):

- The incoming (secure side) of the door shall be controlled by a ACT10 recessed keypad
- Function: a pull outside, inside handle or handle and pull: door can be opened by pushing or pulling when the electrical control is on (e.g. timer, reader, push button). Inside handle opens the lock always.
- The access control system will automatically de-energise and fail open in the case of confirmed fire alarm activation.

The security specialist shall provide for access control to doors as indicate on the design drawings. Each access controlled door shall be provided with the following equipment;

23.2.6 Intercom System

Comelit Powercom one button surface Colour audio video intercom call unit complete with CCD camera, audio duplex speaker plus White light LED lighting for night viewing.

Comelit Powercom one button surface Colour audio video intercom call unit complete with CCD camera, audio duplex speaker plus White light LED lighting for night viewing automatic switcher. Internal Monitor Location; Security room Desk Mount.

Comelit Planux hands-free internal colour LCD screen audio video handset complete with Door release button. Planux weighted Desk mount bracket

The entire system shall be fully commissioned and certified by the security specialist in accordance with industry standards and the requirements of this specification.

The contractor shall include for the testing and commissioning of the complete installations and for demonstration of the functions to the client's representatives and for 1 year full maintenance and call-out service of same from date of handover

23.2.7 Access control system strategy gates, barriers

<u>Gate System Type 1</u>
Access control shall be provided using traffic barrier arms with chain skirt. Access shall be provided by proximity card readers and an audio visual intercom unit linked to a

handset located as indicated on the drawings. The Audio Visual intercom unit shall be vandal proof external units with colour/monochrome cameras installed

There will be an access control pillar to facilitate standard height vehicles (e.g. cars and motor bikes)

A suitable external proximity card reader to match the type installed within the building , mounted on pillar will operate the traffic barrier arm with chain skirt. The pillar shall be made of 316 stainless steel .

The traffic barrier arms shall have an opening speed of not more than 4 seconds.
The boom arm will be elliptical tube bar with luminous indicating markers along its complete length. Boom arm shall be shock resistant.

The traffic barrier system shall utilise a photocell and an in-ground induction loop detector as method of preventing the traffic barrier arm from lowering on vehicles.

A traffic barrier arm (for exiting traffic) shall be linked to an induction loop located in the ramp way on the side used by exiting traffic. When vehicles drive over the loop the barrier arm will open to allow egress from the carpark.

Gate System Type 2
Access control shall be via gates using motorised gates on rollers. **(The motorised gates shall be provided on a separate contract)**. Access shall be provided by a ACT 10 digital keypad & Comelit Powercom one button surface Colour audio video intercom call unit complete with CCD camera, audio duplex speaker plus White light LED lighting for night viewing. mounted on a 316 stainless steel pillar. All handset for the gate shall be located as indicated on the drawings . All Audio Visual intercom units shall be vandal proof external units.

The access control pillars shall facilitate standard height vehicles (e.g. cars and motor bikes)

Each motorised gate shall be linked to an induction loop located in the ground. When vehicles drive over the loop the motorised gate shall open.

Note: The motorised gates shall be provided on a separate contract, however it is the responsibility of the security contractor to link to the motorised gate systems so that keypads & handsets provided under this contract operate the motorised gates. All cabling required (except mains) shall be installed by the security contractor.

23.2.8 Stainless steel pillar

Pillars shall be 1.4m high stainless steel (316) rectangular 200x200mm . The pillar shall have smooth radius corners and be complete with a angled top surface of no less than 30degree angled slope. Any external weatherproof intercom unit will be mounted on the vertical side at 1100mm above finished floor level to the top of the intercom unit. Any external card reader shall be suitable for external use and shall be mounted directly below the intercom unit with a maximum of 50mm and a minimum of 20mm clear space between other units.

The contractor shall include in their costs for fully dimensioned drawings including plans & elevations of the pillar for approval prior to manufacturer

General:

The Automated Gate Specialist shall include in his tender for the entire installation as indicated on the drawings and detailed in the Specifications .

The installation shall meet the requirements and follow the recommendations of the ETCI National Wiring Rules, the IEE Wiring Regulations (Latest Edition) and all other relevant codes and standards as detailed in this Specification.

The Automated Gate Specialist shall test the installation on the completion of the work. The test record sheet is to be included in the O&M Manuals. Should the installation fail to fulfil the requirements of the above regulation the Automated Gate Specialist shall at his own expense alter, amend and retest until such requirements are met, carrying out the test in the presence of the Engineer or his representative. On completion of the installation a certificate shall be given by the Automated Gate Specialist to the Engineer.

Automatic Gates

NA

23.3 INTRUDER ALARM

The contractor shall be responsible for the supply, installation, test and commissioning for an Intruder Alarm Security System in accordance with IS EN 50131 standard for the building as indicated on the attached drawings. The systems shall generally comprise the following:

- A central intruder Alarm Panel (up to 128 inputs HKC or Europlex Cnet 200 , up to 512 Eurplex Cnet 300)
- Microwave/PIR movement detectors throughout (DualTEC - DD477AM)
- Combined contact/inertia sensors.
- Remote key pads.
- External SAB units
- Internal sirens (Aritech - AS270)
- Digital communicator linked to central monitoring station.

Wiring

The contractor shall be required to install the conduits, trunking and cabling associated with the Intruder Alarm Systems. The cabling will be terminated and the Intruder Alarm Systems components and outlets/detector devices shall be supplied, fitted, tested and certified by the Contractor.

Wiring shall be in LSF sheathed 0.75-sq.mm 8-core proprietary intruder alarm cable manufactured by Aritech from each point back to the intruder alarm panel or nearest alarm station in an electrical riser. External alarm cabling shall be Poly/Poly 12 core cable. All intruder alarm system cables installed shall be fully tested for continuity prior

to acceptance. Cable faults shall be identified and repaired by the contractor by replacing the faulty cable in its entirety. Replacement of cables or time costs associated with shall be at the contractors' expense

The intruder alarm cabling shall generally use existing ELV compartment section of cable tray systems, alternatively if over capacity, the electrical contractor shall include for a network of 50 x 50mm ELV trunking and conduit system which can be sealed closed following the installation of the intruder alarm cables.

The Intruder Alarm contactor shall allow for a full demonstration of the system to the client on completion of the installation and 2 days training on site.

The electrical contractor shall note that all intruder alarm system wiring to individual peripheral items such as door contacts, PIR's etc shall be wired in a home run star radial network topology to the local expander of the main panel.

All work shall be done in a thorough and conscientious manner according to industry standards and shall be subject to inspection and acceptance.

The electrical contractor shall be responsible to co-ordinate the electrical and Intruder Alarm Systems, hat they will not share the same conduit trunking compartments etc., channel or sleeve with low voltage electrical apparatus. The ETCI Regulations (and definition of low voltage) shall be adhered to in this respect. Separate conduit systems shall be provided for each system as noted on the drawings.

23.3.2 Installation

The security contractor shall be responsible for the supply, installation, test and commissioning of a Intruder System in accordance with IS EN 50131-1 2006 standard in compliance with the NSAI certification scheme for the building. On completion of the project the security systems supplier shall provide an NSAI certificate of compliance.

The central intruder alarm panel shall located as indicated on the drawings. Remote keypads shall be located as indicated.

The system shall have a monitored power supply feature on both the mains and the battery and shall indicate the status on the keypad(s).

The intruder alarm system shall be configured in a number of zones allowing the system to be deactivated in certain areas while leaving other areas protected.

The main system power supply shall be integral with the main control panel and shall comply with the requirements of IS 50131 : 1998. The security specialist is responsible for determining whether additional power supplies are required for the correct operation of the system and shall include for same with his tender.

The system design proposal for the supply installation, test and commissioning of an intruder alarm incorporates movement detectors, door contacts internal and external audible alarms with external strobe, and alarm transmission system signalling to a remote alarm receiving centre.

The alarm system shall be configured so as the entry/exit from the premises is through the rear or front entrance doors. The keypad locations at final entry/exits are to be provided at secure positions within the building, to be used for setting/unsetting of the intruder alarm system.

Anti masking Dual-tech microwave/ passive infra red detectors supplied by Aritech type dual technology DD477AM or similar are to be located as per the drawing mounted at a height of 2.3metres approximately in the corner of the each area and or room to detect movement in the area unless stated otherwise.

All external entry doors shall be provided with an Aritech GS711 or similar surface mounted shock sensors/magnetic contact for each door leaf located on the secure side of door to detect the opening of the door.

This panel shall be provided with keypad and battery backup in accordance with security standards. This panel will be located as indicated on the drawing.

The time allowed for initiation of the setting procedure to the final set of the intruder alarm system is a maximum of 45 seconds (exit time).

The time allowed for initiation of the un-setting procedure to fully unset the intruder alarm system is a maximum of 30 seconds (entry time).

A Microwave/PIR movement detectors shall be positioned adjacent to all alarm keypads directed towards the door. This detector shall not facilitate or confirm alarm activation.

The system on activation will send a coded message to a central station and also activate both internal and external sounders.

The front and rear entrance areas shall be provided with a 12 Volt internal siren as provided by Aritech reference AS270.

The building shall be provided with an external self actuating sounder complete with strobe light and battery backup as supplied by Aritech located in a prominent wall location at minimum of 4m above ground level.

The flashing strobe light is designed to continue to operate after the audible alarm switches off automatically.

The audible alarm is designed to sound for a period of no longer than 15 minutes and shall rearm a max of 3 times after which the system shall shut down.

If the telephone company line is cut/signalling path lost, the sounder is to operate immediately when an alarm is present in the set condition or on a personal attack condition. If the wires are cut or the unit is removed from the wall, the sounder is to sound immediately. This unit shall incorporate a blue flashing light to give visual identification.

Under the Control of Noise Order it is an offence to create a noise nuisance. Accordingly the external sounder must switch off automatically after 20 minutes. This is also a requirement of the Local Authorities Act, which empowers authorised officers of the Local Authorities concerned to seek a warrant to enter premises to silence an alarm causing annoyance.

Under the Control of Noise Order, the security specialist is required to inform the Garda and Local Environment Health Authority that an active audible system has been completed for this project within 48 hours of the installation.

The quantities and locations of services nodes to be determined by the security contractor and agreed with the electrical contractor on site.

Interface units shall be provided as necessary to link the intruder alarm system with the CCTV system and access control system.

The system shall be connected to a remote monitoring centre via a digital V90 DTV communicator or similar complete with power supply and battery backup in accordance with security standards. The digital communicator shall report in SIA. The digital communicator shall be located within the main control equipment as indicated on the drawing.

The intruder alarm system shall be provided with radio back-up complying with IS 50131-5-3 : 2005 in the event of encountering problems with the wired telephone system in connecting to manned security monitoring station.

The security specialist shall include for 12 months remote monitoring of the intruder alarm system with his tender.

The security specialist shall provide for a separate working phone on the incoming telephone lines which should be located adjacent to the digital communicator. This telephone line should be ex-directory and or unidirectional. The alarm transmission will transmit a digital code number to a receiver unit at the remote 24 hour alarm receiving centre whenever an alarm is generated.

The premises shall be provided with Sequential Alarm Confirmation which requires that two independent detectors installed as part of the Intruder alarm system will need to be activated before the system will signal a confirmed alarm (Garda calling system) to the alarm receiving centre.

The sequentially confirmed alarm activations must also be within the confirmation time. The security specialist and client to confirm the time frame within which two independent activations must occur. On receiving a sequentially confirmed alarm at the Alarm Receiving Centre the Gardai will be notified.

The entire system shall be fully commissioned and certified by the security specialist in accordance with industry standards and the requirements of this specification.

23.3.2 Commissioning and hand-over

Prior to handing over the system to the customer, a qualified person should perform an inspection and test comprising of:

- The visual and functional check of all parts of the CCTV, Access Control & Intruder alarm system's installation. The basis for the functional check should be the test specification for the system developed from the operational requirement and system specification.
- The visual test covers the standard of workmanship of the installation, the functional quality of the equipment and their compliance with the system specification.
- The functional test includes checking the functional compatibility of the components of the installation.
- Inspection tests may be carried out on parts of the installation as they are completed.
- Confirmation that the operator manual and documentation for the system is complete.
- The performance specification and results from performance testing together with a signed inspection report.
- Recommended maintenance schedule for the system if no maintenance contract has been agreed.
- The contractor shall provide sufficient training to ensure correct operation of the system. 2 Days on site training should be allowed for each building at dates to be agreed with the occupiers.
- The contractor shall include for the testing and commissioning of the complete installations and for demonstration of the functions to the client's representatives

Upon completion of the project, the OPW will perform a final inspection of the installation with the Contractor's Project Foreman. The final inspection will be performed to validate

that all security systems were installed as defined in the drawing package, and that the installation meets the aesthetic expectations of the OPW

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System Documentation

The following section describes the installation, administration, testing and as-built documentation required to be produced and/or maintained by the contractor during the course of the installation:-

23.3.4 As-Built Drawings:

The installation contractor will be provided with 2 No. sets of drawings at the start of the project. One set will be designated for as the central location to document all as-built information as it occurs throughout the project. The central set will be maintained by the Contractors Foreman on a daily basis, and will be available to the Technical Representative upon request during the course of the project. Anticipated variations from the build-to drawings may be for such things as cable routing and actual equipment placement. No variations will be allowed to the planned termination positions of equipment unless approved in writing by the Owner.

The Contractor shall provide the central drawing set to the owner at the conclusion of the project. The marked-up drawing set will accurately depict the as-built status of the system including locations, equipment cable routing and all administration labelling for the equipment. In addition, a narrative will be provided that describes any areas of difficulty encountered during the installation that could potentially cause problems to the security system.

23.35 Test Documentation:

Test documentation shall be provided in a three ring binder(s) within three weeks after the completion of the project. The binder(s) shall be clearly marked on the outside front cover and spine with the words ATest Results@, the project name, and the date of completion (month and year). The binder shall be divided by major heading tabs, horizontal and backbone. Each major heading shall be further sectioned by test type.

The test document shall detail the test method used and the specific settings of the equipment during the test.

When repairs and retests are performed, the problem found and corrective action taken shall be noted, and both the failed and passed test data shall be collocated in the binder.

Test results may be provided in a software format if prior agreement is made with the tender issuer.

Upon receipt of the test documentation, the OPW reserves the right to perform spot testing of a representative sample of the cabling system to validate test results provided in the test document. OPW testing will use the same method employed by the contractor, and minor variations will be allowed to account for differences in test equipment. If significant discrepancies are found, the Contractor will be notified for resolution

23.3.6 Maintenance

Where special test instruments and tools are required for maintenance, this should be stated in the maintenance plan provided by the security contractor. Any special requirements or recommend test intervals should be stated in the maintenance plan.

24. OPERATION & MAINTENANCE MANUALS (O&M)

24.1 Introduction

The LV Switchgear Specialist shall include for operations and maintenance O&M manuals including "as-installed" schematic drawings for issuing to the OPW upon completion of the works.

The term maintenance manual shall be deemed to include all necessary maintenance and operating instructions and record drawings for the entire installation.

24.2 Applicable standards

In general the preparation of O&M manuals should be based on the following generic guideline documents:-

- BS 4884 Parts 1 & 2 Specification for Technical Manuals
- BSRIA Technical Note TN1/84– Guidelines for Building Services Operating and Maintenance Manuals
- BSRIA Application Guide 187– Operating & Maintenance Manuals for Building Services Installations
- BSRIA Technical Note T/1286– Fault Finding Procedures in the Building Services Industry

24.3 O&M retention fund

In addition to any retention specified in the contract conditions, a further 5% of the contract value shall be retained on the final payment certificate pending handover of the approved O&M manuals to the client. The value that the contractor has allowed for the O&Ms in his tender will have no bearing on the amount retained.

Where the contractor fails to submit manuals in the agreed format described below or by the agreed date, the O&M retention fund will be used to pay for a third party to complete the manuals on the contractors behalf.

24.4 Approval Procedure

A draft maintenance manual shall be issued to the Engineers for approval at least one months in advance of the intended date of practical completion.

Prior to submitting this manual the contracts manager shall confirm in writing that he has crossed checked the manual against the requirements of this section of the specification and that in his or her opinion it is ready for inspection and approval by the engineers.

The Contractor shall carry out any amendments requested by the Engineers and resubmit the manual for final approval. Any subsequent checking of the manual beyond that stage will be subject to a charge by the engineers to be calculated on a time basis.

24.5 Final Approved Copy of O&M manual

The Contractor shall hand over two “hard” copies of the approved of the O&M manual to the client along with 2 No copies on CD containing the full contents of the manual in electronic format. He shall instruct the client’s staff in the operation and maintenance of the various components forming the installation. All as installed drawings on the CD’s shall be issued in PDF and AutoCAD format.

24.6 Hard Copy Format

The hard copy of the manual shall comprise one of more A4 lever arch ring binder files, endorsed with the project details and contractors name and address. Where there is more than one manual required, each one shall be identified by a reference e.g. “Volume 3 of 4 – Security Systems”. The contents of each other volume shall be indicated on the front page with the actual volume highlighted for clarity

A typed index shall be included at the start of each manual. Proprietary numbered cardboard dividers shall be provided to separate the various sections of the manual.

Transparent cellophane envelopes shall be provided to hold copies of the "as-installed" drawings and any other items, which cannot be punched.

24.7 Electronic Copy Format

The electronic copy of the manual shall be presented on one or more CDs and shall follow the same indexing as the hard copy. The CDs shall be fitted with proprietary adhesive labels with the project details printed. The CDs shall be contained in a plastic CD pocket within one of the ring binders referred to above.

25. IDENTIFICATION AND MARKING OF ELECTRICAL SERVICES

25.1 General

Provide for the supply and installation of labels and notices as required by ETCI Regulations and IEE Wiring Regulations on electrical and mechanical systems generally as follows:

Identification of all main and sub-distribution equipment:

- Main incomer
- Generator protective device and changeover equipment
- Sub-mains protective devices
- Power factor protective devices and associated equipment etc

Sub-distribution Boards and Panels

Sub-distribution boards and panel devices

Warning Notices, voltages in excess of 230volts.

All outlets (distribution board, device number, circuit number)

Earth electrode connections

Bonding connections

Exceptional Areas – Warnings and Notices

Earth free areas

Electrical separation

25.2 Label and Notices – Materials

Materials should be adequate to show no appreciable wear in the lifetime of the equipment with a minimum expected life of 20 years

Boards and Panels, Warning Notices – Engraved thermosetting plastic laminate
– Colour White on Black

Local Outlets – Engraved thermosetting plastic laminate
- Colour Black on White

Warning Notices – Engraved thermosetting plastic laminate
- Colour White on Red

Fixing of labels shall generally be proprietary adhesive except external labels shall be stainless steel screw fixed. Please note that the integrity of the IP rating should not be affected by any fixings.

26. Specialist Suppliers

26.1 General Requirements

Specialist suppliers shall be required to be approved by the Engineer.

26.2 Approval process

In order to facilitate tendering Specialist Suppliers have been approved and named in the tender documentation. The contractor may submit alternative suppliers for approval and these shall be assessed on the criteria set out below. The contractor shall not assume approval, or final consideration of the submission for approval, in the tender period or post tender period prior to award of tender.

26.3 Selection Criteria

The general criteria for the selection of specialist suppliers shall be as shown below. In some instances particular additional criteria may be set for individual suppliers.

The equipment proposed shall be fully compliant with the technical requirements of the general and particular specifications. Equipment that is not compliant shall not be accepted and there shall be no other consideration of the proposal in the event of non compliance of the technical requirements. In addition to the technical requirements specialist suppliers shall be required to meet a minimum standard of 70% under each and every heading in order to be accepted as a supplier.

The information submitted for consideration shall be relevant to the area of specialisation and not drawn from other areas of a multi-faceted company.

26.3.1 Standard Criteria for Selection of Special Suppliers

1. **Technical Compliance.** The equipment proposed shall be fully compliant with all technical requirements of the general and specific specifications. (Full compliance required)

2. **Technical Competence**. The Supplier shall be required to submit detailing technical competence relevant to the equipment to be supplied and the complexity of the project.

3. **Resources.** The supplier shall provide details of all the resources relevant to the area of specialisation within the company. The resources shall be adequate for the requirements of the project.

4. **Experience.** Evidence of relevant experience of the company and individual staff shall be required.

5. **Maintenance and support service.** The Specialist supplier shall be required to provide full details of maintenance and support service as may be required in the lifetime of the equipment to be supplied.

6. **Similar Projects.** Evidence of similar projects shall be provided and which have been successfully completed in the most recent three years. In general at least three similar projects shall be required.

26.3.2 Turnover

The Specialist Supplier shall provide details of audited financial statements showing turnover in the most recent three years available. Where group accounts or accounts including other areas of business are submitted details of the turnover for the particular area of the specialisation shall be required.

Marks shall be applied equally except for Technical Competence and Similar Projects, which shall be double weighted.

26.3.3 Electrical Specialist Equipment and Supplier Schedules

Equipment	Supplier	Installer
MV Switchgear	• ABB • Schneider	
MV Transformer	• ABB • Schneider	
LV Main Distribution Board	• BMC • Control Equipment • Anord	
LV Sub- Distribution	• BMC • Control Equipment • Anord	
Generator	• FG Wilson • PSE	
UPS	• Ardilaun Electrical Services • BMC • FG Wilson	
CCTV	• Cameras: Bosh , Pelco , Panasonic, CBS Ganz, Panasonic • DVR: Dowshu, Bosh, Samsung	G4S, Chubb, Screen, Coleman Electronics
Access Control	• System ACT Pro	
Intruder Alarm	• Europlex • HKC	
Audio Visual		
Lightning Protection		
Lighting	• As per Lighting Schedule	As per Lighting Schedule
Emergency Lighting	• Emcon • Lighting solutions • NEL • Profile • Ventilux	
Lighting controls	• Advanced electronics	
Fire Alarm (Apollo discovery protocol)	• Morley or Advanced (Panel) • Apollo (Heads)	Chubb Fire Technology Ireland G4S Coleman Electronics
Suppression Systems	• Automatic Fire and Integrated Solutions	

Data Cabling Systems	• Systimax • Brand Rex • Krone • Amp • Nexans • HellermanTyton	Approve with certified system installation
Data Cabinets/Racks	• Excel	
Dado Trunking (Plastic) Dado Trunking (Aluminium)	• Schneider • MK • Schneider (Thorsman)	
Floor Boxes	• Thorsman • Cableplan	
Disables Refuge Call Systems	• Baldwin Boxall	Sound Production Or equal & approved
Disabled Toilet Systems	• Baldwin Boxall Intercall 600 nurse call system	Sound Production, or equal & approved
Induction Loop System	• Current Thinking	Sound Production, or equal & approved
Intercoms	• Legrand	
Hand-dryers	• Flowsave T3 Automatic • Redring AD30 Automatic • World Dryers MR48 Automatic	Flowsave Redring World Dryers

26.3.4 Electrical Specialist Equipment and Supplier Lighting Schedule

Fitting Type Reference (Please also refer to drawings for details)	Description	Supplier

27. COMMISSIONING

27.1 PRE-COMMISSIONING

During the course of the works the Contractor shall carry out on an on-going basis the pre-commissioning of the works and shall assemble all necessary handover material which will be required at hand-over.

The pre-commissioning shall be sufficiently thorough and systematic so as to identify together with normal site inspections any obvious installation deficiencies, design errors or omissions.

The Contractor shall be responsible for the rectification of the defective work. Any problems which result from design or omissions shall be referred to the Engineers.

27.2 ELECTRICAL - VERIFICATION AND CERTIFICATION

The contractor shall carry out all inspections and tests as required by the National Rules for Electrical Installations, Fourth Edition.

28. SCHEDULE OF EQUIPMENT - MAINTENENCE

The electrical, mechanical & lift equipment schedules shall be filled out and sent to the OPW M&E Project Engineer or his representative 2 weeks prior to the handover of the project. The schedules shall detail the equipment installed for the works carried out.

Please refer to Separate Maintenance Schedule document