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4.1.1.0 General

- 4.1.1.1** All materials referred to in this Bill shall be subject to the Architect/Engineers approval.
- 4.1.1.2** All materials and workmanship not otherwise described shall be of a quality not less than that set out in the relevant British Standard Specifications and/or Codes of Practice where such exist.
- 4.1.1.3** All equipment put forward by the electrical domestic sub-contractor shall be in full compliance with the Low Voltage Directive 73/23/EEC, Electromagnetic Compatibility Directive 89/336/EEC and with the Electromagnetic Compatibility Regulations 1992 and shall be marked with the CE symbol.
- 4.1.1.4** All references in this Preamble and Technical Specifications to British & Irish Standard Specifications and Codes of Practice shall be taken as the relevant Irish Standard equivalent and shall mean those last issued, together with all amendments, on or before the Date of Tender.
- 4.1.1.5** Although the term "as described" is not used in item descriptions, this shall be deemed to be implied and the rates shall include for materials and workmanship being in accordance with this Preamble.
- 4.1.1.6** The electrical domestic sub-contractor must base his tender on the items specified and shall strictly adhere to the Preamble in all respects, but may submit when tendering, for consideration by the Architect/ Engineers, an equivalent item of equipment or plant but only in the appropriate Appendix. The Employer shall, under no circumstances be liable to pay the electrical domestic sub-contractor for any items of equipment other than those specified unless prior written permission has been obtained from the Architect/Engineers in accordance with this Clause.
- 4.1.1.7** The electrical domestic sub-contractor shall fully comply with the requirements of the Construction, Design and Management Regulations and provide information as requested by the Project Planning Supervisor all as detailed within the Pre Tender Health and Safety Plan. Should risk assessments be required for any operation these shall be submitted to the Engineer/Planning Supervisor 10 working days prior to that operation being carried out.
- 4.1.1.8** All M&E equipment, computer hardware and software supplied or installed by the electrical domestic sub-contractor shall be fully Year 2000 compliant and shall comply with British Standard PD 2000/1. The electrical domestic sub-contractor is to provide written confirmation to the Client of such compliance.
- 4.1.1.9** Testing of all M&E equipment, computer hardware and software is to include the three standard test procedures listed at Schedule 2000 appended hereto. These are:
- a) Basic Equipment Test
 - b) Full Equipment Test

c) British Summertime Test

4.1.2.0 Information to be Provided by Contractors at the time of Tender

4.1.2.1 In addition to any other information requested and unless specifically discounted within the general contract conditions applicable to this tender, the following information must be detailed in the appropriate appendix by the electrical domestic sub-contractor at the time of tender.

4.1.2.2 Electrical domestic sub-contractors shall detail the manufacturer's name and catalogue reference or type, and the expected delivery date for all items of plant and equipment on which their tender offer is based from the approved list in Schedule No. 4.

4.1.2.3 Electrical domestic sub-contractors shall detail in Schedule No.4 of this specification, their selected domestic Sub- Contractors for domestic Sub-Contract Works.

4.1.3.0 Site Conditions

4.1.3.1 Electrical domestic sub-contractors should visit the site to gain knowledge of the accessibility and of conditions affecting labour, carriage, unloading and storage of materials.

4.1.3.2 Electrical domestic sub-contractors shall satisfy themselves as to the staging, scaffolding, tools, storage, accommodation etc., required for the proper execution of the Contract, with respect to the Main Contract and site conditions.

4.1.3.3 Any claims by the electrical domestic sub-contractor arising from lack of knowledge of the above-mentioned conditions will be disallowed.

4.1.4.0 Duties of the Contractor for this Contract

4.1.4.1 The electrical domestic sub-contractor shall deliver to site, unload, store and hoist and place in position, erect and connect, watch and protect during the Contract, test, commission and set to work all installations, materials, components and plant as specified and as shown on the drawings.

4.1.4.2 The electrical domestic sub-contractor shall provide all transport, lifting tackle, scaffolding, staging, ladders, tools, plant, work benches, welding equipment, electrical supplies for tools, temporary lighting, test equipment and all other equipment, workshops, stores etc., required for the proper installation of all the works, except where stated in the Conditions of Tender or Main Contractor's Preliminaries as being supplied elsewhere.

4.1.4.3 The electrical domestic sub-contractor shall provide all necessary tools and labour for the expeditious carrying out of the works including all carriage to the

Site and shall provide all labour and appliances for the testing of the installations on completion, as required by the Engineer.

4.1.4.4 The electrical domestic sub-contractor shall be responsible for the proper working of the installations to the complete satisfaction of the Engineer, and shall be responsible for compliance with all tests specified or reasonably required by the Engineer.

4.1.4.5 The electrical domestic sub-contractor shall check the sizes of all the plant and equipment on delivery, and as the Contract proceeds, taking into account any additions or deletions, which may be made by the Engineer. The electrical domestic sub-contractor shall notify the Engineer immediately of any discrepancy.

4.1.5.0 Site Delivery

4.1.5.1 The electrical domestic sub-contractor shall be responsible for the off-loading and storing of his plant and equipment in connection with this Contract. The location of stores, plant or equipment shall be as indicated by the Main Contractor.

4.1.6.0 Erection of Plant

4.1.6.1 The erection of all plant and equipment included in the works, shall be the sole responsibility of the electrical domestic sub-contractor, who shall carry out any special instructions given, or recommended, by the manufacturer. In the absence of any instructions, the electrical domestic sub-contractor shall apply to the Architect or Engineer if in doubt. Should any faulty erection of equipment affect the working efficiency of the plant, the electrical domestic sub-contractor shall be bound to make good at his own expense.

4.1.7.0 Regulations

4.1.7.1 Unless instructed to depart there from the complete installation covered by the Contract shall conform to the requirements of -

- a. The Regulations for Electrical Installations with the latest amendments issued by the Institution of Electrical Engineers (16th Edition).
- b. The Regulations and requirements of the Supply Authority.
- c. The Workplace (Health, Safety and Welfare) Regulations 1992.
- d. The latest relevant British Standard Specifications.
- e. The Building Standards Regulations with all amendments.

- f. The Health and Safety at Work Act, and all amendments to date of tender.
- g. Construction (Design and Management) Regulations 1994
- h. Control of Substances Hazardous to Health (COSHH) Regulations 1998
- i. Control of Asbestos at Work Regulations 1987
- j. Provision and Use of Work Equipment Regulation 1998
- k. Lifting Operations and Lifting Equipment 1998

4.1.7.2 The electrical domestic sub-contractor shall include for all tests and the provision of all test equipment deemed necessary to meet the above requirements.

4.1.8.0 Electricity Supply

4.1.8.1 The electricity supply for the installations will be 415 volts, 3 phase, 4 wire, 50 Hz, unless stated otherwise elsewhere.

4.1.9.0 Service Charge

4.1.9.1 The electrical domestic sub-contractor shall serve all notices upon the Supply Authority for the testing and shall pay all fees in connection therewith including any additional charges for re-testing.

4.1.10.0 Approval

4.1.10.1 The words "Approved", "Approval" and "Suitable" wherever they occur throughout this Specification shall respectively have the following meanings, "Approved" in writing by the Engineers, "Approval" in writing and "Suitable" in the opinion of the Engineers.

4.1.11.0 Samples

4.1.11.1 The Engineer reserves the right to request that the electrical domestic sub-contractor shall provide a sample properly labelled of any materials and products described in this Specification or as specified by the Engineer.

4.1.11.2 Such samples shall be submitted to the engineer for his comment at his offices or elsewhere as directed, with all parts left loose, so that they may be taken apart for internal inspection by hand without the necessity of using spanners, screwdrivers or wrenches.

4.1.11.3 The Engineers may require such samples to be subjected to tests designed to ensure compliance with British Standard and other relevant Specifications and requirements of this Preamble.

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- 4.1.11.4** The electrical domestic sub-contractor shall provide the facilities and apparatus for such tests and carry them out in the presence of the Engineers. The electrical domestic sub-contractor shall also replace the samples where necessary.
- 4.1.11.5** Samples shall be liable to be retained for the purpose of comparison with future deliveries, but any or all of the samples shall be returned to the electrical domestic sub-contractor should he so request after their purpose has been served.
- 4.1.11.6** All costs associated with the samples shall be borne by the electrical domestic sub-contractor.
- 4.1.12.0 Patent**
- 4.1.12.1** The electrical domestic sub-contractor shall save and indemnify the Employer against all claims, cost or expense in connection with any patented, copy- righted or protected article supplied by the electrical domestic sub-contractor or his Sub- Contractor and used on or in connection with the works and any payments or royalties payable in one sum or by instalments shall be included in the Contract Price and paid by the electrical domestic sub-contractor to whosoever they may be due.
- 4.1.12.2** In the event of any such claims being made on the Employer, in connection with such patented articles, he shall immediately notify the electrical domestic sub-contractor who shall, at his own expense, conduct any negotiations or litigation in connection with such claims.
- 4.1.13.0 Warranty**
- 4.1.13.1** It shall be deemed that Warranty on the plant equipment and installation shall commence at the date of Practical Completion of the Contract Works (Building Works and Services Installations) unless specifically otherwise agreed by the Engineer.
- 4.1.14.0 Proprietary Goods and Materials**
- 4.1.14.1** Where goods and materials of a particular manufacture are stated in the Preamble, the rates shall be held to include for the specific goods or materials stated. Similar goods or materials of a different manufacture may only be quoted provided their use does not affect other items or quantities and prior approval in writing has been given by the Engineer.
- 4.1.15.0 Quality of Materials**
- 4.1.15.1** All materials shall be of the respective kinds described in the Specification. No substitute for the specified or approved materials will be permitted without the Engineers' written permission.
- 4.1.15.2** It shall be the electrical domestic sub-contractor's responsibility to ensure that all materials comply with the Specification in respect of delivery, manufacture, finish and performance. The electrical domestic sub-contractor will be called upon to
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remove from the site, any work, materials or goods that do not comply with this Specification.

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- 4.1.15.3** In any instance where the Engineer is not satisfied with workmanship or the method employed by the electrical domestic sub-contractor, then the Engineer reserves the right to have the work made good in accordance with the Specification and Bill of Quantities at the electrical domestic sub-contractor's expense.
- 4.1.16.0 Co-operation and Integration with Other Trades**
- 4.1.16.1** In positions where other services e.g. mechanical, plumbing, etc., are to be installed in the vicinity of services to be installed by the electrical domestic sub-contractor, he shall ensure that the order of installation of his services in relation to the other services complies strictly with the requirements of the Main Contractor's programme and planning requirements.
- 4.1.16.2** The Working Drawings shall be provided by the electrical domestic sub-contractor, based on the Contract Drawings, together with site sizes and the necessity of arranging access to all services for maintenance, and to establish the inter-relationship of services in confined spaces. Builderswork drawings shall be provided by the electrical domestic sub-contractor with full knowledge of the inter-relationship of all services.
- 4.1.16.3** The exact position in the works of the above items relative to grid lines, floors, beams, ceiling, walls and other structural items and any other services in this Contract is the responsibility of the electrical domestic sub-contractor.
- 4.1.17.0 Asbestos Based Materials**
- 4.1.17.1** No Asbestos based materials shall be used on the contract unless by specific instructions from the Architect/Engineer. Where the electrical domestic sub-contractor encounters any Asbestos based materials or materials, which he suspects might contain Asbestos he shall leave the material undisturbed and immediately advise the Architect/Engineer or his representative.
- 4.1.17.2** Although the electrical domestic sub-contractor is required to comply with the general requirements of the Health and Safety at Work Act (and similar legislation) particular attention is drawn to the hazards associated with Asbestos Based Materials. The electrical domestic sub-contractor shall, in addition, satisfy himself by references to the appropriate Statutory Authority that no risk exists.
- 4.1.18.0 Temporary Lighting and Power**
- 4.1.18.1** The low voltage for temporary lighting shall be made available to the electrical domestic sub-contractor during his works, for which he shall supply his own leads.
- 4.1.18.2** The electrical domestic sub-contractor shall make his own arrangements for power for site use, unless otherwise provided by the Main Contractor, and these arrangements shall comply with the latest British Standard Code of Practice for Distribution of Electricity on Construction and Building Sites.
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- 4.1.18.3** All equipment used by the electrical domestic sub-contractor shall be suppressed to comply with BS.800, as to cause no interference with radio or television in the surrounding area.
- 4.1.18.4** The electrical domestic sub-contractor shall assure himself that all necessary electrical supplies are available for the complete safe installation of the Contract Works.
- 4.1.19.0** **Prevention of Frost Damage**
- 4.1.19.1** The electrical domestic sub-contractor shall allow for taking all necessary precautions against frost damage to the installation and will be held responsible for any damage incurred to the installations, due to freezing up or other reasons, until such time as the installations have been officially accepted by the Architect/Engineer.
- 4.1.19.2** The cost involved in repairing frost damage, or otherwise, shall be borne by the electrical domestic sub-contractor.
- 4.1.20.0** **Removal of Rubbish and Cleaning of Ducts, Plant Rooms, etc**
- 4.1.20.1** The electrical domestic sub-contractor shall at all times keep the site free from obstruction and rubbish insofar as they are a direct result of carrying out the Contract Works and he shall remove from the site at his own expense, all surplus materials and temporary works which were brought on to the site by the electrical domestic sub-contractor as soon as these are no longer required on site. On completion of the works, the Contractor shall leave the site in a clean and tidy condition, to the satisfaction of the Architect/Engineers.
- 4.1.21.0** **Inspection and Tests at Manufacturer's Works**
- 4.1.21.1** Works tests shall be carried out such that due consideration is given to the conditions under which the equipment is required to function. The test certificates shall give all details of such tests.
- 4.1.21.2** All plant shall be subject to inspection and/or test at the Manufacturer's works, as may be required by representatives of the Engineer, Insurance Office or other body duly appointed by the Client.
- 4.1.21.3** The following items of equipment may be inspected at the manufacturer's works prior to despatch.
- (a) Control Panels
 - (b) Air Handling Units
 - (c) Boilers
- 4.1.22.0** **Test Certificates - Plant and Equipment**
- 4.1.22.1** Manufacturers or other Test Certificates are to be provided in duplicate for all electrical equipment.
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4.1.23.0 Name Plates and Labels

- 4.1.23.1** All apparatus supplied for the works, i.e. accelerators, fans, etc., shall give the manufacturer's name, date of manufacture, shop number, type and working conditions, etc., together with all other particulars which will aid identification for the ordering of spare parts. Any item on which this is omitted will be rejected.

4.1.24.0 Ordering of Materials

- 4.1.24.1** All materials and equipment shall be provisionally ordered upon acceptance of the Tender. The electrical domestic sub-contractor must not delay completion of any part of the works, by delays in ordering or, delivery of materials or products.

4.1.25.0 Handling and Storing Materials and Products

- 4.1.25.1** The electrical domestic sub-contractor shall -
- Deliver, off-load, store and transport about the Works all materials and products in the manner recommended by their manufacturers.
- Provide adequate safe, covered storage and protection for all new materials and products.
- Protect threads by means of purpose made caps.
- Protect cables from physical damage and seal ends.
- 4.1.25.2** Where materials and products cannot be stored in dry buildings, they shall be raised clear of the ground and supported. They shall be protected from damage by frost, water and building work with covers or other appropriate means. Materials and products must not be stored by placing directly on earth or any other damp or corrosive surface.
- 4.1.25.3** Materials and products shall be adequately coated to prevent damage by oxidation, etc., and this coating shall be maintained until ready for final finishing.

4.1.26.0 Painting and Anti-Corrosion Treatments

- 4.1.26.1** All components requiring anti-corrosive treatment shall be painted or shall be treated by other "metal coating" method.
- 4.1.26.2** All welding, drilling, punching, cutting and bending of the metal component shall preferably be done before the protective treatment coating is applied. All coatings applied shall be entirely suitable for the material to which it is applied and to the conditions to which it will be subjected to in service.
- 4.1.26.3** All components requiring metal protective coatings shall be manufactured from hot-dip zinc coated sheet steel complying with BS.2989 and galvanised steel tube

and tubing to BS.1387. Where galvanising/silverplating coatings are specified these shall comply to BS.729 and BS.4921 respectively.

- 4.1.26.4** All components requiring painting shall be thoroughly cleaned removing all mill scale, weld scale and corrosion and finally degreasing.
- 4.1.26.5** All paints shall be low lead-free type, with primers having good adhesion, good rust covering power, rust inhibiting and grain flowing properties. Gloss paint shall be machine finished paint having high adhesion and high resistance to solvents, mineral oils, cutting oils, detergents, chipping and impact damage.
- 4.1.26.6** All paints shall be manufactured by one of the scheduled firms and supplied by one Manufacturer, even if the painting is done off site. The paint shall be delivered to site in sealed containers labelled with the following information.
- 1) Type of Paint
 - 2) Brand Name
 - 3) Manufacturers batch reference
- 4.1.26.7** Work described as painted shall be given one coat of primer and two coats of glass machine finished paint. Work described as primed shall be given one coat of primer.
- 4.1.26.8** Damage to metal coated/painted work shall be repaired to the satisfaction of the Engineer or the component replaced.
- 4.1.27.0** **Fixing to Building Fabric**
- 4.1.27.1** Components and equipment shall be fixed firmly to the building fabric using screws or bolts, as specified, of the maximum size permitted by the fixing holes.
- 4.1.27.2** Screw-fixings to solid brickwork or concrete shall be made using substantial proprietary metal or plastic plugs, ensuring that both plug and screw are well embedded into the masonry behind any applied finish. Screw fixing to sheet metal shall be made using sheet metal screws.
- 4.1.27.3** Through-the-wall bolt-fixings shall consist of a bolt sufficiently long to pass through the wall, spreader plate under the head and a nut and washer.
- 4.1.27.4** Bolt-fixings to solid brickwork, blockwork or concrete shall be made using self-drilling anchors. Bolt-fixings to hollow backgrounds shall be made using toggle bolts or expanding plastic rawlnuts.
- 4.1.27.5** Bolt-fixings to structural steelwork shall be by means of clamps and adapters of the Lindaptor pattern, installed in the manner recommended by their manufacturer.
- 4.1.27.6** The following operations must not be carried out without the permission of the Structural Engineer or Clerk of Works. Failure to observe this requirement may

result in the Contractor having to make good the damage to structural steel, reinforced concrete, facing brick and other materials at his own expense.

- 1) Cutting of holes in structural steelwork
- 2) Welding on structural steelwork
- 3) Drilling of holes in reinforced concrete
- 4) The use of cartridge operated tools

4.1.28.0 Fixing Height

4.1.28.1 Except where particular items are expressly mentioned elsewhere in the specification or shown on the drawings the following fixing heights above finished floor level to the underside of equipment shall be taken as a general guide.

Item of Equipment	Height of Centre
Lighting Switch	1350 mm.
Switch Socket (Standard)	400 mm.
Switch Socket (Worktops)	1050 mm.
Fire Alarm Push	1350 mm.
Fire Alarm Sounders	150 mm. (below ceiling level)
Distribution Board	2000 mm.

4.1.28.2 Before commencing the installation the Contractor shall obtain confirmation of the dimensions given.

4.1.29.0 Position of Points

4.1.29.1 The positions of all points and equipment shown on the drawings shall be assumed correct for Tender purposes.

4.1.29.2 The electrical domestic sub-contractor shall ensure by referring to the Architect's detailed drawings that all accessories are located to suit fitments, benches, etc., and the equipment served by the accessory.

4.1.29.3 The exact position of all points is to be confirmed with the Engineer on site prior to installation.

4.1.30.0 Inspection of Equipment Delivered and Fixed on Site

4.1.30.1 The electrical domestic sub-contractor shall inspect all plant and equipment immediately on delivery and shall not accept any of it, which is damaged.

4.1.30.2 Any plant, equipment and accessories found to be unduly marked by tools or damaged, corroded or distorted by any cause, shall be rejected by the Engineer and must be replaced by the electrical domestic sub-contractor at his own expense.

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- 4.1.30.3** Any damage considered repairable must be notified to the Engineer for inspection before any remedial work commences. Remedial work shall only be carried out on the authority of the Engineer.
- 4.1.30.4** The electrical domestic sub-contractor shall be responsible for protection of his work during the execution of the Contract.
- 4.1.31.0** **Interruption of Existing Services**
- 4.1.31.1** The electrical domestic sub-contractor shall not, unless he has received the written permission of the Engineer, interfere with, or interrupt in any way, the operation of any existing services such as Gas Mains, Water Mains, Sewers, Drainage, Electricity Cables, etc., and in the case of the work of Statutory Authorities or Private Owners, without also having received permission of such Authorities or Owners.
- 4.1.31.2** The electrical domestic sub-contractor shall be responsible for any damage to such services caused by the electrical domestic sub-contractor's personnel and equipment and shall make good any such damage at his own expense, to the satisfaction of the Engineers, Authorities or Owners, as the case may be.
- 4.1.32.0** **Connecting to Existing Services**
- 4.1.32.1** The electrical domestic sub-contractor shall notify the Engineers in writing, giving a minimum of seven days notice, of his intention to connect into or isolate any of the existing services and await his approval for so doing.
- 4.1.32.2** The electrical domestic sub-contractor shall include for all overtime and other additional payments necessary to ensure that the interruption to existing services are carried out with the minimum possible inconvenience. The electrical domestic sub-contractor shall work without pause until the services are back to a normal situation.
- 4.1.33.0** **Notice Prior to Cover**
- 4.1.33.1** The electrical domestic sub-contractor shall provide, no later than 1 month prior to Practical Completion of each section of the works, two paper prints, of Record Drawings for comment. Once comment has been given the electrical domestic sub-contractor shall prepare and provide CAD copies of each drawing on 3½" diskette or CD-ROM. Drawings should be prepared on AutoCAD Version 13.0 or greater.
- 4.1.33.2** Any work, which is covered or hidden before inspection by the Engineers, shall, where required by the Engineers, be uncovered and subsequently made good at the expense of the electrical domestic sub-contractor.
- 4.1.33.3** Where pressure testing is required for pipework, ducts, etc., this shall be carried out in accordance with the relevant section of this Preamble, prior to covering.
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- 4.1.33.4** The electrical domestic sub-contractor shall provide within each Plant Room a plant schematic showing all items of plant including pipework, valves, etc. The drawing shall be cross-referenced to a Valve Schedule indicating valve numbers, size, type and service. The schematic shall indicate the flow pattern of the relevant service. The schematics and valve charts shall be protected by a plastic laminated cover.
- 4.1.34.0 Maintenance Equipment and Special Tools**
- 4.1.34.1** Four weeks prior to the Date of Practical Completion the electrical domestic sub-contractor shall provide for approval, one "Draft" set of Operating and Maintenance Instructions for all of the installations included in this Contract. Upon approval, three complete sets shall be made available at the date of handover to satisfy the requirements of the Health and Safety Regulations. These sets shall be adequately bound into volumes with board covers to withstand continual usage, each indexed, divided and appropriately cover titled to the Engineer's approval. The receipt of these Instructions at the date of hand over shall be a requirement of Practical Completion.
- 4.1.34.2** The spanners, tools, etc., supplied under this clause shall not be used during the erection of the plant, otherwise they will be rejected.
- 4.1.34.3** All heavy parts of plant shall be provided with some convenient means of slinging or handling during erection or overhaul, and items requiring extraordinary arrangements for removal for maintenance purposes shall be clearly identifiable, and the Client's maintenance staff instructed on the procedures required carrying out such works.
- 4.1.34.4** Each set shall also contain manufacturer's data and maintenance leaflets specific to all items of plant and equipment used on the project, fully detailed drawings showing the construction of such plant and equipment and full detailed internal and external wiring diagrams for all electrical equipment.
- 4.1.34.5** The manual shall also contain outline design data of all plant, pump and fan curves, test and performance data, test certificates, valve schedules, schedules of Record Drawings and reduced copies of all Record Drawings. Certification shall include, but not necessarily be restricted to:- pressure test certificates on pipework and ductwork systems, commissioning results, asbestos removal and air test results, chlorination certification, fire hose reel tests, automatic controls and temperature flow at taps.
- 4.1.35.0 Spare Parts**
- 4.1.35.1** Any spare parts ordered within the course of the Contract works must be strictly interchangeable with and suitable for use in place of the corresponding parts supplied with the plant.
- 4.1.35.2** Spare parts shall comply with the Specification and must be suitably marked and numbered for identification and prepared for storage by greasing or painting, as appropriate, to prevent deterioration.
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- 4.1.35.3** A list of Spares recommended for one year's operation must be submitted by the electrical domestic sub-contractor for inclusion in the Operation and Maintenance Manual.
- 4.1.35.4** The minimum spare parts to be provided by the electrical domestic sub-contractor shall be, where applicable, as follows:
- (a) Lamps and tubes - 10% of total supplies to be provided
 - (b) Spare overloads and contacts for starters (one for each type of starter)
- 4.1.36.0 Tender Drawings**
- 4.1.36.1** The drawings listed in the schedule accompany this Preamble and form part of the Tender Documents. They shall be read in conjunction with the Preamble and with each other. All drawings shall remain the property of the Architect/Engineer and shall be returned after completion of the Tender.
- 4.1.37.0 Contract Drawings**
- 4.1.37.1** The Engineers shall provide to the electrical domestic sub-contractor copies of the Contract Drawings showing the general arrangements of the installation.
- 4.1.37.2** The electrical domestic sub-contractor shall satisfy himself as to the accuracy of the information shown on the Architects or Engineers drawings, and whenever possible, dimensions, levels and positions must be checked on site, for use in the preparation of his own drawings.
- 4.1.37.3** Materials should not be solely ordered from the drawings or Preamble and any discrepancy between these should be referred in writing to the Architect or Engineer for clarification.
- 4.1.38.0 Working Drawings**
- 4.1.38.1** It shall be the electrical domestic sub-contractor's responsibility to provide the working drawings listed in the various sections of this document and he shall include in his price the cost of preparing the drawings and supplying the number of copies stated. They shall be supplied in good time to meet the agreed programme for this work, the period being agreed at the commencement of the Contract.
- 4.1.38.2** The electrical domestic sub-contractor may use any of the tender drawings to meet the requirements listed, but he must clearly mark those "Installation drawings", and accept full responsibility for them as such.
- 4.1.38.3** Working drawings shall include:
- a) General layout drawings of the complete works
 - b) Detailed layouts showing the location of all equipment including cable, cable tray, conduit, trunking in switch rooms and plant rooms
 - c) Assembly drawings of all factory built equipment and site built assemblies

- d) System diagrams and circuit wiring diagrams for all installations and equipment.

4.1.38.4 Where requested in the bill of quantities or elsewhere in the contract documents, the electrical domestic sub-contractor shall prepare detailed layout drawings showing final connections to equipment and sectional layouts in risers, floor and ceiling voids.

4.1.38.5 As soon as practicable, and in any event to allow adequate time for Engineers comments and to comply with the requirements of the Contract programme, such drawings in duplicate shall be submitted to the Engineer for comment, giving full details of dimensions. The electrical domestic sub-contractor shall ensure that adequate space is provided for servicing and maintenance of all equipment.

4.1.38.6 If during the progress of the Contract, modification is required to be made to the work, the electrical domestic sub-contractor shall submit drawings in which all information required is contained in order to make such modifications. These drawings in duplicate shall be submitted to the Engineer for comment early enough to ensure that the modifications can be undertaken in time to avoid any delay in the Contract completion date.

4.1.38.7 The electrical domestic sub-contractor shall be responsible for any discrepancies, errors or omissions in the above-mentioned drawings, whether these drawings have been commented on by the Engineer or not. Comments given by the Engineer to any drawing shall in no way relieve the electrical domestic sub-contractor from his liability to complete the works in accordance with this Document or exonerate him from any of his guarantee.

4.1.38.8 The Engineer reserves the right to amend, or add to the Drawings as may be necessary or expedient.

4.1.39.0 Approval of Drawings

4.1.39.1 The electrical domestic sub-contractor shall submit to the Engineer, for approval, drawings, giving all information, including dimensioned layouts, of the following equipment prior to manufacture:-

- a) Main Switchboard
- b) Sub-Main Switchboards
- c) Final Sub-Circuit Distribution Boards.
- d) Control Panels.
- e) Emergency Lighting, Battery Cubicles, Switchgear, etc
- f) Any other factory or site built assemblies.

4.1.39.2 Should the Engineer require modification to the submitted drawings the electrical domestic sub-contractor shall re-submit them for approval with the modifications incorporated at no additional expense.

4.1.39.3 Drawings should be submitted early so that equipment can be manufactured and delivered in good time for the completion of the contract on programme. It should be noted that the engineer should review and give approval/make comments on

the drawings within 10 days of receipt. This should be taken into account when programming the preparation of drawings. Submission of drawings to be to an agreed timetable set at the commencement of the Contract by the Engineer.

4.1.39.4 All other working drawings as specified above shall be submitted to the Engineer prior to the relevant installation taking place.

4.1.40.0 Manufacturer's Drawings

4.1.40.1 As soon as practicable, and in any event to allow adequate time for Engineer's comments and to comply with the requirements of the Contract programme, the electrical domestic sub-contractor shall provide to the Engineer for comment duplicate copies of Manufacturing Drawings for all items of plant and equipment listed in Schedule No. 5 attached to this document.

4.1.40.2 In addition, the electrical domestic sub-contractor shall submit to the Engineer with these drawings all relevant pump curves, fan curves, details of noise criteria, weights, electrical loadings, etc., and electrical connection diagrams.

4.1.40.3 Manufacture of relevant items of plant and equipment shall not commence until the Engineers comments on the relevant Manufacturing Drawing have been obtained.

4.1.40.4 3The Engineer reserves the right to amend, or add to the drawings as may be necessary or expedient.

4.1.41.0 Builderswork Drawings

4.1.41.1 As soon as practicable, and in any event to allow adequate time for Engineer's comments and to comply with the requirements of the Contract programme, the electrical domestic sub-contractor shall provide to the Engineer for comment duplicate copies of fully dimensioned drawings to an approved scale, of builderswork requirements in connection with this Contract. Drawings shall show details of plinths, holes, tray and trunking supports, etc.

4.1.41.2 The electrical domestic sub-contractor shall provide to the Engineer full particulars of loadings including moments, and dimensions and positions of foundations and plinths, and/or fixings necessary for the support and accommodation of all equipment to be supplied under this Contract, so that adequate provision may be made. Builderswork drawings shall be fully dimensioned showing location of holding down bolts, details of anti-vibration mountings, secondary steelwork for switchgear, etc.

4.1.41.3 All dimensions affecting accommodation and installation of the plant, and equipment supplied under this Contract, and points at which services other than those covered under this Contract are required shall be clearly indicated on drawings to be submitted to the Engineer by the electrical domestic sub-contractor, prior to issue to the Main Contractor.

4.1.41.4 The electrical domestic sub-contractor shall be responsible for any discrepancies, errors or omissions in the above mentioned drawings whether these drawings

have been comment on by the Engineer or not. Comments given by the Engineer to any drawing shall in no way relieve the electrical domestic sub-contractor from his liability to complete the works in accordance with this document or exonerate him from any of his guarantee.

4.1.41.5 The Engineer reserves the right to amend, or add to the Drawings as may be necessary or expedient.

4.1.42.0 Progress Drawings

4.1.42.1 The electrical domestic sub-contractor shall keep on site one full set of white prints of the Working Drawings showing the progress of all work in connection with this Contract.

4.1.42.2 These drawings, which shall be maintained in clean condition, shall be kept up to date on a weekly basis, and all pipe lines, tray and trunking, positions of equipment and apparatus, including all modifications and/or variations, shall be clearly recorded by the electrical domestic sub-contractor on the drawings as they are installed.

4.1.42.3 The electrical domestic sub-contractor shall make the above drawings available at any time for inspection by the Architect/Engineer.

4.1.42.4 The electrical domestic sub-contractor shall provide to the Engineer, for the Employers use, duplicate copies of the Progress Drawings no later than two weeks prior to the Date of Practical Completion.

4.1.43.0 Record Drawings

4.1.43.1 The electrical domestic sub-contractor shall provide, no later than 1 month prior to Practical Completion of each section of the works, two paper prints, of Record Drawings for comment. Once comment has been given the electrical domestic sub-contractor shall prepare and provide CAD copies of each drawing on 3¹/₂" diskette. Drawings should be prepared on AutoCAD Release 14.0 or greater.

4.1.43.2 The "As Installed" drawings shall show the following:

- a) 1:100 or 1:50 scale drawings and a system diagram of the complete installation showing all switchgear and distribution with the appropriate code letters and identification marks.

The system diagram shall record the values of prospective short circuit current and earth fault loop impedance at the origin of the installation.

- b) The location of the Supply Authority connection provided within the Sub-Contract whether carried out by the electrical domestic sub-contractor or by the appropriate Authority, together with the points of origin and termination, size and type of cables.

- c) The layout, location and extent of all luminaires showing the type in accordance with the schedule of luminaires, all electrical outlets, telephones, alarm circuits, isolators, starters, motors, appliances, distribution boards and any other outlet, or system installed under the Sub-Contract.

The detailed layout of the switchrooms, meter rooms, generator and motor rooms showing where appropriate all existing as well as those items installed under this Sub-Contract. The "As Installed" schematic diagrams of all circuits including control circuits showing switchgear cable, fuse type, size and reference.

- d) Complete cable schedules and distribution board schedules of the type issued by the Engineer. The electrical domestic sub-contractor shall be responsible for informing the Engineer of the quantity required by him to comply with this clause.
- e) Manufacturer drawings showing the arrangement and assembly of component parts of all machines and by piece of equipment which may need servicing.
- f) Diagrams illustrating the principles of operation of automatic controls and of instrumentation, present in combination with any foregoing item, or separately, as agreed with the Engineer.
- g) Manufacturer's internal wiring diagrams for each piece of electrical equipment supplied under the Sub-Contract, together with physical arrangement drawings where necessary to locate and identify the component parts.
- h) The nature and position of all component parts of the earthing system shall be submitted by the Sub-Contractor. The positions of drains, water pipes, structural steelwork, etc., within 4500 mm of the location of each electrode shall be indicated on the plans.
- i) Layouts giving circuit details including circuit reference loading, origin, route, distribution and where buried for each cable, conduit, tray and trunking. The circuit reference shall relate to the appropriate cable schedule and distribution board schedule.
- j) Interface details with existing equipment or equipment installed separately from these works.

4.1.43.3 Two prints of each "As Installed" drawing shall be issued to the Engineer for approval prior to final issue.

4.1.43.4 When these record "As Installed" drawings have been approved by the Engineer, the electrical domestic sub-contractor shall supply:

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- 4.1.43.5** The electrical domestic sub-contractor shall also supply and fix in the main switchroom -
- a) Notices regarding the electrical installation.
 - b) Instructions in the form prescribed by HM Stationery Office as to the treatment of persons suffering from electric shock.
- 1. HMSO Form F954 Electricity
 - 2. Poster 117 First Aid in Emergency
 - 3. Health and Safety Poster
- 4.1.43.6** The electrical domestic sub-contractor shall also provide and fix typewritten circuit lists for every distribution board. These shall be enclosed in folders of sheets of transparent non-flammable material, and fixed inside the distribution boards.
- 4.1.43.7** The electrical domestic sub-contractor shall provide reproduced "A3" size copies of all Record Drawings, perforated and incorporated in rigid loose leaf type bindings with protective coverings, for inclusion in the Operating and Maintenance Manuals.
- 4.1.44.0** **Operation and Maintenance Instructions**
- 4.1.44.1** Within two weeks of the Date of Practical Completion the electrical domestic sub-contractor shall provide three sets of Operating and Maintenance Instructions for all the installations included in this Contract. These sets shall be adequately bound into volumes with board covers to withstand continual usage, each indexed, divided and appropriately cover titled to the Engineer's approval.
- 4.1.44.2** Each set shall incorporate a detailed description of the operating procedures for each installation and item of equipment, together with details of the regular maintenance routines recommended by the Manufacturer of each item of equipment, together with typical fault finding routes and a description of emergency action which should be taken in the event of breakdown of equipment. In addition, for each item of equipment, a list of spare parts shall be given which the manufacturers recommend should be kept in store.
- 4.1.44.3** The manuals and instructions shall contain, though not be limited by the following information -
- (1) Index.
 - (2) Set of reduced A3 size prints from the "As Fitted" record drawings.
 - (3) General description of the systems, equipment used and method of control systems.
 - (4) Schematic diagrams and control diagrams.
 - (5) Schedule of routine maintenance.
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- (6) Schedule of period maintenance for specialised equipment.
 - (7) Schedules of method of adjustments, typical fault finding routine.
 - (8) Wiring diagrams of plant etc.
 - (9) Service manual for all specialised plant giving details as listed above.
 - (10) Separate from the service manual shall be duplicate sets of manufacturer's catalogues relating to specialised plant.
 - (11) Schedule of equipment giving name, address and telephone number of manufacturer, serial number of plant, horsepower electrical supply.
 - (12) Description of emergency action which should be undertaken in the event of breakdown of equipment. Telephone numbers of essential contacts to include.
 - (13) Test and Performance Data.
 - (14) Test Certificates.
 - (15) Equipment and component characteristics such as C.T. curves, etc.
 - (16) Recommended spares part list giving item description, part number and replacement time scale.
 - (17) Health and Safety notes, advice and declaration.

4.1.45.0 Commissioning Dossier

4.1.45.1 Within six weeks of the Contract Works being let to the electrical domestic sub-contractor he shall provide, for the agreement and approval of the Engineer, a comprehensive commissioning dossier giving full details of all tests to be carried out and the proposed method of recording of test information in respect of the plant and installations to be installed in the Contract.

4.1.45.2 Six weeks prior to the anticipated commencement of commissioning works, the electrical domestic sub-contractor shall resubmit the commissioning dossier, augmented and revised to suit any alterations or additions/ deletions to the Scope of the Works, which have been implemented during the Contract period, for final approval of the Engineer.

4.1.46.0 Testing and Commissioning

4.1.46.1 General

All testing and commissioning shall be properly and safely executed in accordance with sound practice, Health and Safety considerations and the Electricity at Work Regulations.

- 4.1.46.2** The electrical domestic sub-contractor shall include for the complete testing and commissioning of the installations, which must be to the complete satisfaction of the Architect/Engineer.
- 4.1.46.3** The electrical domestic sub-contractor shall arrange for the commissioning of the installations to be carried out by a by a firm of suitably qualified Commissioning Engineers as determined elsewhere in this document.
- 4.1.46.4** All testing and commissioning shall be carried out in accordance with British Standards and with the relevant section of this document in the presence of the Engineer or his representative, on site, and where requested at the place of manufacture. Throughout testing and commissioning the electrical domestic sub-contractor shall use properly calibrated and certified instruments and apparatus supplied by the electrical domestic sub-contractor.
- 4.1.46.5** Where test parameters are not given results obtained equal to or better than the minimum standards set out in the British Standard shall be deemed satisfactory.
- 4.1.46.6** The Architect/Engineer or his appointed representative shall have access at all reasonable times to such parts of the electrical domestic sub-contractor 's or his Sub-Contractor's works as may be necessary for the purpose of inspection, examining and testing of materials, workmanship and performance of plant.
- 4.1.46.7** Except where stated in the specification or in the contract documents the electrical domestic sub-contractor shall provide all labour, materials, power, fuel and test equipment for carrying out the tests specified. Tests shall be on the site and/or off site as applicable to the test specified.
- 4.1.46.8** The electrical domestic sub-contractor shall ensure that all test equipment utilised by himself or his representatives for carrying out the tests is adequately maintained and calibrated, and carefully handled and transported.
- 4.1.46.9** The electrical domestic sub-contractor shall give the Engineer a minimum of seven days notice of his intention to carry out tests. All tests will be witnessed by the Engineer or his representative.
- 4.1.46.10** The electrical domestic sub-contractor shall allow for carrying out the testing and commissioning of the installation in sub-sections as may be necessary for technical purpose or to suit the construction programme.
- 4.1.46.11** In the event of the installation failing to pass the commissioning and tests the Client shall be at liberty to deduct from the contract price all reasonable expense incurred by him in repeating the tests.
- 4.1.46.12** In the event of the works being incomplete due solely to delay on the part of the electrical domestic sub-contractor concerned, and causing a postponement of any notified test date, the Main Contractor shall be at liberty to deduct from the contract price all reasonable expense incurred.

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- 4.1.46.13** Additional tests may be carried out as requested by the Engineer during the Defects Liability Period. Tests shall only be requested by the Engineer in the period if equipment is not performing as specified. Should it be found, after re-testing, that the acceptance test criteria has not been maintained, then any additional costs incurred shall be borne by the electrical domestic sub-contractor.
- 4.1.46.14** **Tests at Place of Manufacture**
- 4.1.46.15** (a) General
- 4.1.46.16** All cables, materials and equipment shall be tested in accordance with the appropriate British Standard.
- 4.1.46.17** The following tests shall be carried out in accordance with the details given below:
- (1) Complete switchgear equipment - Routine tests.
 - (2) Earthing devices - Routine tests.
 - (3) Materials - Sample tests.
 - (4) Control Panels - Routine tests.
 - (5) HV Equipment - In accordance with the relevant section of this Specification
- 4.1.46.18** (b) Details of Tests
- 4.1.46.19** (1) Complete Switchgear Equipment:
- 4.1.46.20** In addition to the manufacturers other routine tests, the manufacturer shall, on request by the Engineer, demonstrate to the full satisfaction of the Engineer, that each protective device and contactor is operated ten times in the normal manner.
- 4.1.46.21** Unless specified elsewhere in this document, type tests shall not be required. Type test certificates shall however be supplied by the electrical domestic sub-contractor.
- 4.1.46.22** (2) Earthing Devices:
- 4.1.46.23** Earthing devices shall, where required by the Engineer, be demonstrated to his satisfaction.
- 4.1.46.24** (3) Materials:
- 4.1.46.25** The Engineer reserves the right to witness sample tests on any materials specified.
- 4.1.46.26** (4) Control Panels:
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- 4.1.46.27 In addition to the manufacturer's other routine tests; an insulation test shall be carried out at a voltage of 2 kV to earth for a period of one minute.
- 4.1.46.28 (5) Function:
- 4.1.46.29 The manufacturer shall satisfy the Engineer that the equipment will operate in accordance with function description.
- 4.1.46.30 **Tests on Site**
- 4.1.46.31 **General**
- 4.1.46.32 In addition to all the tests laid down in Part 6 of the I.E.E. Wiring Regulations, the electrical domestic sub-contractor shall carry out the tests listed below.
- 4.1.46.33 **Metal Conduit and Steel Trunking**
- 4.1.46.34 The electrical domestic sub-contractor shall take tests of the continuity of the conduit as erection proceeds. Written records of all tests shall be sent to the Engineer. Where the conduit and trunking is being used as the circuit protective conductor then continuity tests shall be carried out using a high current ohmmeter in accordance with Appendix 15, Clause 3 of the I.E.E. Wiring Regulations.
- 4.1.46.35 **Cables**
- 4.1.46.36 Insulation tests shall be taken on MICC cables 24 hours after the seal have been completed and one month later. Written records of these tests shall be sent to the Engineer.
- 4.1.46.37 The DC resistance of each core of every completed paper insulated cable shall be measured and recorded and shall not in any case exceed the figure stated in BS.6480.
- 4.1.46.38 Where metal sheathed cables are terminated in such a way as to be insulated from earth, the electrical domestic sub-contractor shall demonstrate to the satisfaction of the Engineer by suitable tests that the required conditions for resistance to earth have in fact been fulfilled.
- 4.1.46.39 The test voltage for cables rated up to 500V shall be 500V D.C., for cables up to 1000V, 1000V D.C. Tests shall cover all permutations between conductors, metallic sheath, armour and earth.
- 4.1.46.40 Tests shall be carried out to demonstrate that the phase sequence is correct at all end connections.
- 4.1.46.41 **Distribution Boards, Fuse and Switchgear**
- 4.1.46.42 After erection on site, full functional tests shall be carried out to prove that the equipment is satisfactory.

**Fuses Moulded Case Circuit Breakers
and Miniature Circuit Breakers**

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- 4.1.46.43 Characteristic curves of all protective devices shall be supplied to the Engineer prior to any circuits being made live or electrically tested.
- 4.1.46.44 **Accessories**
- 4.1.46.45 Tests shall be carried out on all completed installations to demonstrate that all switches are connected in the live conductors, that all socket outlets and spur units are correctly connected and that all switches and outlets satisfactorily operate the apparatus to which they are connected.
- 4.1.46.46 **Earthing**
- 4.1.46.47 The electrical domestic sub-contractor shall carry out tests to demonstrate to the Engineer the effectiveness of the earthing system.
- 4.1.46.48 **Lamps and Fluorescent Tubes**
- 4.1.46.49 The electrical domestic sub-contractor shall at the request of the Engineer demonstrate that the lamps and fluorescent tubes are of the correct type and rating and the correct polarity of ES and GES lamp holders.
- 4.1.46.50 **Motors and Motor Starter Contactors**
- 4.1.46.51 The electrical domestic sub-contractor shall demonstrate to the Engineer that all motors run in the correct direction of rotation and that each motor is properly protected by protective devices of correct rating as specified. The Sub-Contractor is to measure and record the normal loading running current of each motor connected under this Sub- Contract whether supplied by him or others. Duplicate copies of readings are to be sent to the Engineer.
- 4.1.46.52 **Instruments and Secondary Wiring**
- 4.1.46.53 All secondary wiring, including panel wiring and control circuits, and all apparatus connected correctly thereto shall withstand a high voltage test of 2 kV to earth for a period of one minute.
- 4.1.46.54 All instruments shall satisfactorily withstand the tests specified in the appropriate BS Specification.
- 4.1.46.55 Care shall be taken to ensure that any equipment which would be damaged by being subjected to a potential of 2 kV to earth is disconnected prior to the commencement of any such HV pressure test.
- 4.1.46.56 **Earth Fault Loop Impedances**
- 4.1.46.57 Where the value of measured earth fault loop impedance for any circuit exceeds the maximum value allowed for that circuit then the Engineer shall be informed.
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- 4.1.46.58 The value of the earth loop impedance and prospective short circuit current at the original of the installation shall be recorded by the electrical domestic sub-contractor and issued with the handover documentation.
- 4.1.47.0 Instructing Employer's Representative in Operation of Plant Equipment and Systems**
- 4.1.47.1 The electrical domestic sub-contractor shall include for any necessary assistance to the Employer's representatives to demonstrate and explain the purpose and function of the installations.
- 4.1.47.2 Such assistance shall be provided prior to or immediately following Practical Completion to suit the requirements of the Employer.
- 4.1.47.3 The electrical domestic sub-contractor shall include for a minimum period of 14 plant operating days to instruct the Employer's representative in the day to day running of the plant and systems.
- 4.1.47.4 The location and function of all items of electrical equipment and the systems, including procedures for starting up, shutting down, isolating sections, etc., shall be comprehensively explained and demonstrated to the Employer's satisfaction.
- 4.1.48.0 Operation and Maintenance Instructions**
- 4.1.48.1 Four weeks prior to the Date of Practical Completion the electrical domestic sub-contractor shall provide for approval, one "Draft" set of Operating and Maintenance Instructions for all of the installations included in this Contract. Upon approval, three complete sets shall be made available at the date of handover to satisfy the requirements of the Health and Safety Regulations. These sets shall be adequately bound into volumes with board covers to withstand continual usage, each indexed, divided and appropriately cover titled to the Engineer's approval. The receipt of these Instructions at the date of hand over shall be a requirement of Practical Completion.
- 4.1.48.2 Within two weeks of the Date of Practical Completion or as defined in the Main Contract Preliminaries, whichever is the lesser time period, the electrical domestic sub-contractor shall provide three sets of the final completed Operating and Maintenance Instructions for all the installations included in this Contract. These sets shall be adequately bound into volumes with board covers to withstand continual usage, each indexed, divided and appropriately cover titled to the Engineer's approval.
- 4.1.48.3 Each set shall incorporate a detailed description of the operating procedures for each installation and item of equipment, together with details of the regular maintenance routines recommended by the Manufacturer of each item of equipment, together with typical fault finding routes and a description of emergency action which should be taken in the event of breakdown of equipment. In addition, for each item of equipment, a list of spare parts shall be given which the manufacturers recommend should be kept in store.
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- 4.1.48.4** Each set shall also contain manufacturer's data and maintenance leaflets specific to all items of plant and equipment used on the project, fully detailed drawings showing the construction of such plant and equipment and full detailed internal and external wiring diagrams for all electrical equipment. These leaflets should be original copies obtained from the manufacturers.
- 4.1.48.5** The manual shall also contain outline design data of all plant, pump and fan curves, test and performance data, test certificates, valve schedules, schedules of Record Drawings and reduced copies of all Record Drawings. Certification shall include, but not necessarily be restricted to:- pressure test certificates on pipework and ductwork systems, commissioning results, asbestos removal and air test results, chlorination certification, fire hose reel tests, automatic controls and temperature flow at taps.
- 4.1.48.6** The manual shall contain the names, addresses, telephone and fax numbers of all material, plant and equipment manufacturers used on the project.

4.2.0 General Specification - Distribution Systems

- 4.2.1 Earthing and Bonding
- 4.2.2 Cable Installation
- 4.2.3 L.V. Switchgear
- 4.2.4 PVC Insulated and PVC Sheathed Cable, Armoured and Non-Armoured
- 4.2.5 XLPE Insulated and LSF Sheathed Cable, Armoured and Non-Armoured
- 4.2.6 Steel Conduit, Trunking and Tray
- 4.2.7 PVC Conduit and Trunking
- 4.2.8 LSF and PVCI Cables and Flexible Cords
- 4.2.9 Not Used
- 4.2.10 Luminaries and Lamps
- 4.2.11 Accessories

4.2.1 Earthing and Bonding Installation

4.2.1.1 General

The electrical domestic sub-contractor is responsible for the earthing of the entire Electrical Installation to satisfy fully the requirements of BS 7671 and this Specification.

The electrical domestic sub-contractor is responsible for equipotential bonding of all mechanical services plant, pipework, ductwork etc. whether or not the electrical/controls installation work associated with these elements is undertaken by others.

4.2.1.2 Standards

The work is to comply with BS 7430:1998, Code of Practice for Earthing.

Compliance with BS 6651:1999, is also required, where earth terminations are associated with a lightning protection system.

4.2.1.3 Main Earth Bars

4.2.1.4 A main earth bar is to be established at the main intake switchroom comprising a pre-drilled HDHC copper busbar wall mounted on stand-off insulators on a section of galvanised steel channel. The cross-section of the bar is to be appropriate to the fault levels prevailing but the minimum acceptable size is 32 x 6mm.

All connections to earth pit/mats, to switchboard earth or neutral bars are to be fitted with test disconnecting links.

Where a site consists of a number of physically separate buildings, an earth bar as above, is to be fitted at the intake switchboard location in each building.

4.2.1.5 Conductors

Generally, conductors are to be green/yellow XL-LSF insulated stranded copper conductors when run within buildings. Externally, PVC insulation may be adopted.

Bare copper tape is to be used where called for in this Specification, the drawings, or the Bill of Quantities. Some such instances are:

- a) Where conductor is part of an earth mat
- b) Where conductors are used to bond individual items of switchgear.
- c) Where conductor forms part of lightning protection network (see lightning protection specification for specific details of PVC oversheath requirements in this instance).

All copper tapes above ground level externally, in exposed locations within the building (other than in switch/plantrooms) or installed in contact with concrete or dissimilar metals are to be PVC sheathed, colour agreed prior to ordering.

4.2.1.6 Termination

Terminations of stranded copper conductor is to be by either:-

- a) Crimped lug conductor bolted to terminal
or
- b) Soldered lug connection bolted to terminal

Copper tape is to be terminated by bolted connection the end being first tinned.

Where joints are necessary in copper tape these are to be riveted to give sound mechanical connection. Such joints are to be tinned prior to connection and subsequently re-cleaned, heated, fluxed and re-tinned to ensure effective electrical continuity.

Where exothermic joints are used, these are to be carried out in accordance with the particular manufacturer's instructions.

Each termination is to be fitted with an identity tag as Messrs Radio Spares "Black-on-Yellow" range

4.2.1.7 Bolted Connection

All bolted connections used on the earthing systems are to be made using carbon steel bolts unless otherwise called for. In all cases bolted connections are to include anti-vibration washers, min 1 x 10 mm or 2 x 8 mm bolts at each joint.

4.2.1.8 Main Equipotential Bonding

Main equipotential bonding of extraneous conductive parts is to be carried out as called for in Regulation 413-02-02 of BS 7671.

Where a site comprises a number of physically separate buildings, main equipotential bonding, as prescribed, to be applied within each.

Main equipotential bonding conductors are to be of copper and of the cross sectional areas prescribed in Regulation 547-02 of BS 7671.

4.2.1.9 Supplementary Equipotential Bonding

Supplementary equipotential bonding is to be provided as required by BS 7671 Regulation 601-04-02 and to meet the requirements prescribed for automatic disconnection of the supply on earth fault. With regard to the latter requirement, supplementary bonding is always to be applied to the undernoted examples of extraneous conductive parts:-

Exposed metal pipework; metal tanks, metal plant, raised floor supports, metal floors, ducting, sinks, taps, metal partitions, metal door frames, metal skirtings, ceiling grids, support structures, fixed metal shelving, etc.

Such supplementary bonding is to be applied between the extraneous conductive parts and between the extraneous conductive parts and exposed conductive parts.

Where supplementary bonding conductors enter walls or ceilings they are to pass through a flex outlet plate.

4.2.1.10 **Earth Mats**

Earth mats are to be formed from either, a buried lattice grid of base copper tape, a series of interconnected driven earth rods, or a combination of both of these, as called for in the Specification or in the drawings/Bill of Quantities. Where earth rods are used, these are to be sectional screw-jointed and of copper coated carbon steel. Each earth rod is to be fitted with a proprietary concrete inspection hood laid flush with the Ground Level. All inspection hoods are to be suitable to withstand vehicular traffic.

Unless otherwise called for, the electrical domestic sub-contractor is to include for the cost of employing a firm of suitably qualified Sub-Contractor to carry out a soil resistivity test, the results of which are to be submitted to the Engineer. Based on these results, a final earth mat design will be determined and, following completion of the installation, resistivity testing by the firm of Sub-Contractor will be required, the results of which are to be recorded in the O & M Manuals. For tender purposes, the electrical domestic sub-contractor is to draw upon his Sub-Contractors record of the local soil conditions and include sufficient earth rods to achieve an earth termination value of 1 ohm or lower for electrical installation earthing. The use of chemical soil additives to reduce soil resistivity is prohibited.

4.2.1.11 Where a cross bond is to be installed between the HV and LV earth terminals of an installation, the LV earth electrode resistance is not to exceed 1 ohm.

4.2.1.12 **Tests**

All earth installations are to be tested in accordance with BS 7671 to prove satisfactory earthing of the complete installation. The results so recorded, are to be included within the O & M Manuals.

4.2.1.13 **Labelling**

Each circuit leaving or entering a main earth bar is to be labelled using sheath ferrules with 3mm high lettering.

4.2.2.0 **Cable Installation**

4.2.2.1 **General**

4.2.2.2 This section details the general requirements for the installation of cables. The particular requirements for HV and LV cables are as detailed in the relevant sections of this specification.

4.2.2.3 **Routes**

4.2.2.4 Cable routes shall generally follow those indicated on the layout drawings. Exact cable routes shall be agreed on site with the Engineer prior to installation proceeding.

4.2.2.5 The electrical domestic sub-contractor is to liaise with other Trades upon the site, to ensure all cable routes are properly co-ordinated with other services and that clashes are avoided.

The electrical domestic sub-contractor is to ensure that cables and cleats do not make any contact with oil, hot or cold water, or any other service.

4.2.2.6 Cables are to be installed within buildings, using alloy claw type cleat supports, unless otherwise called for and routes are to follow the structure of the building and be properly aligned. Cleats are to be provided at the centres necessary to avoid any undue strain on cables, glands or equipment, and in compliance with the manufacturer's recommendations, the drawings and BS 7671.

4.2.2.7 External cables are to follow the features and contours of the site. Cable ducts are to be provided where shown on the drawings. The electrical domestic sub-contractor is to review any duct provisions within 2 weeks of appointment and is to request extra draw-pits, where required by his selected installation method.

4.2.2.8 **Segregation and Spacing**

4.2.2.9 A minimum clearance shall be provided from equipment or other services in accordance with the above and as detailed below.

4.2.2.10 **Minimum Spacings of Cables**

Cable	H.V.	LV	Telephone	Data	Equipment Pipework Ductwork
	mm.	mm.	mm.	mm.	mm.
Buried					
HV	50	300	300	300	300
LV	300	25	150	150	300
Telephone	300	150	150	50	200
Data	300	150	50	50	200
In Air					
HV	50	300	300	300	300
LV	300	-	150	150	150
Telephone	300	150	-	-	100
Data	300	150	-	-	100

4.2.2.11 Deviations from these spacings shall only be allowed with the agreement of the Engineer. L.V. cables are to be installed in accordance with the methods and conditions set out in BS 7671 I.E.E. Wiring Regulations.

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- 4.2.2.12 When installing cables the electrical domestic sub-contractor must take into account the grouping factors specified in BS 7671 I.E.E. Wiring Regulations to ensure that the current carrying capacities of the cables are maintained.
- 4.2.2.13 The electrical domestic sub-contractor shall when installing cables make allowance for future removal or addition of cables.
- 4.2.2.14 The routing of cables shall be taken into account with the minimum bending radii specified by the cable manufacturer for each size and type of cable.
- 4.2.2.15 **Installing Cables on Walls and Flat Surfaces**
- 4.2.2.16 Power cables up to 25 mm diameter overall shall be fixed to walls and flat surfaces using clips, saddles or spacer-bar saddles at 250 mm. intervals, fixed with screws.
- 4.2.2.17 Power cables over 25 mm diameter overall shall be fixed to walls and flat surfaces using cable cleats of alloy construction, unless otherwise called for, in the Bills of Quantities. Fixings are to be at the centres specified by the cable manufacturer and are to be in accordance with BS 7671.
- 4.2.2.18 Additional fixings shall be installed adjacent to terminations and on vertical cables passing through floors, immediately above the floor and immediately on either side of bends.
- 4.2.2.19 **Installing of Cables on Tray and Ladder**
- 4.2.2.20 Before cables are installed, the tray and ladder shall be cleared of all rubbish, inspected, sharp edges smoothed down and protective coatings made good.
- 4.2.2.21 Cables laid on tray or ladder shall be secured as outlined above for cables on walls etc. No more than six cables shall be embraced by one clip or saddle and no more than two layers of cable shall be run on one tray or ladder. Additional fixings shall be installed adjacent to terminations and, on vertical cables passing through floors, immediately above the floor.
- 4.2.2.22 Cable ties may only be used where specifically stated in the schedules, drawings or Bill of Quantities and shall be of stainless steel manufacturer. Where allowed, they are to be fitted at 0.6 m centres and within 100 mm of each bend. Similarly, only where called for in the Bill of Quantities or on the drawings or schedules, nylon cleats may be used in lieu of aluminium. Where allowed, fixing centres are to be as for the aluminium counterparts.
- All secondary steelwork, unistrut brackets and suspensions are to be designed, fabricated, supplied and installed by the electrical domestic sub-contractor. These are to be of sufficient size and frequency to prevent any sagging in cable trays.
- 4.2.2.23 **Installing Cables in Pipe Ducts**
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- 4.2.2.24 Pipe ducts will normally be supplied and laid by the Main Contractor. Where a contract is direct with the electrical domestic sub-contractor however, inclusion is to be made for supply and laying of all pipe ducts and for carrying out all associated work. Unless otherwise stated, each road-crossing duct system must include one spare pipe duct of 100 mm diameter (min).

Pipe ducts are to be of PVC material with self-aligning coupling sleeves, unless otherwise stated and rated to withstand vehicular traffic.

Where called for, they are to be surrounded in concrete; grade 20 as CP.110 with 20 mm aggregate.

- 4.2.2.25 Pipe ducts shall be cleaned out and checked by drawing a mandrel of slightly less than the duct section through the duct immediately before cable drawing commences. Where draw pits are provided the exit and entry pipes must be positioned to give the maximum possible bending radius on each cable, i.e. pipes are to enter close to one corner and leave by the diagonally opposite corner.

- 4.2.2.26 Cables shall be fitted with swivelling pulling-eyes and shall be supported on smooth faced rollers during the drawing operation. Lubricant recommended by the cable manufacturer as having no deleterious effect on the cables, may be used to assist the drawing operation.

- 4.2.2.27 Each duct, including spares, is to be fitted with a nylon rope draw-line, at least 4 metres longer than duct, of minimum breaking strength 550N.

- 4.2.2.28 Immediately after laying and before the backfilling of a trench the ends of cable ducts shall be sealed with hardwood plugs. After the cables have been installed the ends of all ducts shall be sealed. Where the ducts enter buildings the seal shall form a barrier against gas, water, oil, fire and attack by vermin. Spare ducts shall also be sealed using a removable material such as mastic sealant and tape. Ducts and sealing plugs used in Petrol Filling Stations and petroleum environments are to be resistant to attack from hydro-carbons and free of holes.

- 4.2.2.29 Fire barriers in fire resistant walls, floor etc., shall satisfy the requirements of BS.476, and shall be approved by the Engineer.

- 4.2.2.30 Ducts shall be run at least 200 mm. from gas and water pipes, drains, sewers and electrical plant. Clearances between services at crossovers shall be not less than 50 mm.

4.2.2.31 **Installing Cables in Earth Trenches**

- 4.2.2.32 Excavation, cable bedding and back-filling together with laying of tiles and warning tapes will normally be carried out by the Main Contractor.

Where the Contract is direct with the electrical domestic sub-contractor, however, inclusion is to be made for supply of all materials and for all work involved with trenching etc. as laid out in the schedules, drawings and Bill of Quantities.

All such works are to be carried out in accordance with BS 6031:1981 and comply with the Construction (General Provisions) Regulations 1961.

4.2.2.33 Each trench is to be excavated to a minimum of the depth shown at 2.2.53 and be contained below roadways etc. in pipe ducts. These ducts are to be of PVC, unless otherwise stated. Pipe ducts are to extend a distance of 1 metre on either side of the roadway.

4.2.2.34 Each trench is to be filled with a layer of 75 mm of sifted sand, on which the cable is to be laid, followed by an initial covering of a further 75 mm of the same material. Thereafter, the trench is to be back-filled using excavated material from which all rock of aggregate exceeding 30 mm has been removed, by riddling. A PVC marker tape is to be laid below ground surface level as subsequently specified. Laying of backfill material is to be in layers of 0.2 m depth with each layer being well rammed down. Where trenching is through existing grassland, the trench route is to be neatly turfed and the turf laid aside for re-laying once back-filling is complete.

The time interval between turfing and re-laying must ensure that the turfed grass survives and all other steps necessary to ensure survival are to be taken. Whenever possible, reinstatement is to take place within 48 hours. All surplus back-fill material is to be removed from site and disposed of, unless otherwise stated, by those responsible for excavation.

4.2.2.35 Where the trenching works are carried out by others, e.g. Main Contractor, the Contractor is to supervise such work and ensure compliance with this specification. The electrical domestic sub-contractor is to carefully mark out all trench routes on site, irrespective of who subsequently carries out the trenching works.

The electrical domestic sub-contractor is responsible for examining all opened excavations and reporting to the Engineer, on any obstructions or presence of substances which could lead to chemical, electrolytic or mechanical damage to cables. The electrical domestic sub-contractor must forward recommendations for overcoming any such problems.

4.2.2.36 These recommendations shall take into account the effect of ground temperature and ground thermal resistivity on the ratings of the cables.

4.2.2.37 Cables shall generally not be laid if the air temperature has fallen below 0 degrees C. during the previous 24 hours. However, the Sub-Contractor may propose special methods, to overcome this problem, for consideration by the Engineer, who will give specific instructions for each case.

4.2.2.38 Cables shall be fitted with swivelling pulling-eyes and shall be supported clear of the trench bottom on smooth-faced rollers during the laying operation. Single-core cables grouped to carry one three phase supply shall be laid up in trefoil formation, cables touching, apex uppermost and bound together with tie-wraps at 1000 mm. intervals. Rollers shall be removed before backfilling. Precautions shall be taken to ensure that in excavations occupied by more than

one service, the specified minimum clear spacings between the services are maintained throughout the length of the excavation.

- 4.2.2.39 Where cables are ducted under roads or adjacent to railways, ducts shall be haunched in concrete providing a minimum cover of 150 mm. all round. The concrete shall be Grade C20 in accordance with BS 5328 with 20 mm. aggregate. If any joint in a duct is to be encased in concrete in a 25 mm. thick compressible foam filler joint shall be provided in the concrete.
- 4.2.2.40 Cables shall cross other cables only at junctions. Cables shall not be layered unless indicted on the drawings.
- 4.2.2.41 Single core cables shall be laid in trefoil, touching or laid flat. Where they are laid flat, allowance shall be made for cable transposition to ensure equal sharing of the load. Where three-phase and neutral circuits employ multiple single core cables. These are to be laid in trefoil groups with neutral(s) disposed between the groups. Spacing between groups shall be the minimum required to render the groups thermally independent of each other. Cognisance is to be taken by the electrical domestic sub-contractor, of the possible electromagnetic radiation levels emanating from arrangements of single core cables and the trefoil arrangement is to be preserved up to and including the gland-plate, at each termination.
- 4.2.2.42 **Protection**
- 4.2.2.43 Where cables rise vertically from the ground or through floors they shall be protected from below ground or floor level with galvanised steel channel or tubing to a height of 1800 mm. for L.V. cables and 3500 mm. for H.V. cables above floor or ground level. In outdoor locations the top of the channel shall be sealed against the ingress of moisture or vermin and the channel shall extend 300 mm. below finished ground level.
- 4.2.2.44 Cables in timber floors shall be taken through holes drilled in joists, 50 mm. from top of joist. Where this is impossible due to depth of joists, with the agreement of the Engineer cables may be notched into joists and shall be protected where they pass over joists by means of mild steel plate 50 mm. x 3 mm. screwed into joists and finished flush with top of joists.
- 4.2.2.45 **Cable Marking**
- 4.2.2.46 Buried cable routes in grassland and paved areas are to be marked by flush concrete slab markers positioned at 45 m (max.) intervals on straight runs and at all changes in direction (with direction arrow). Unless otherwise called for, slab markers are to be 0.3 x 0.3 x 0.05 mm concrete slabs with lead insert lettering legend to give voltage, direction and depth of laying. Cable joints shall be similarly marked with slabs.
- 4.2.2.47 In unmade ground, shrubberies, etc., markers are to be concrete post type nominally 0.6 m log buried to a depth of 0.3 m. Lead inserts are again to be fitted to give foregoing information.

4.2.2.48 All slab and post markers are to be enumerated, designated, supplied and laid by the electrical domestic sub-contractor.

4.2.2.49 In addition to concrete cable markers and protective tiles, a warning tape shall be placed above each and every cable that is direct buried and above each cable tile. The tape shall be laid at a depth of 300 mm. except where the roadway or paved area base exceeds 300 mm. in which case the tape shall be laid immediately below the surface.

4.2.2.50 The warning tape shall be yellow in colour with black lettering not less than 30 mm. high. It shall be of polythene, minimum 150 mm. wide and 0.1 mm. thick.

4.2.2.51 **Depth of Cover**

4.2.2.52 Unless indicated otherwise, cables and cable ducts shall be laid to provide the minimum depth cover indicted below.

4.2.2.53 **Minimum Depth for Cables and Ducts**

<u>Cable</u>	<u>Pavements, Open Ground</u>	<u>Under Roadways</u>
H.V.	800	1000
L.V.	500	800
Telephone	500	800
Data	500	800

4.2.2.54 Under pavements and roadways the electrical domestic sub-contractor shall consult with and take cognisance of the requirements of the local Highways Authority with regard to depth and spacing of cables and comply accordingly.

4.2.2.55 Permanent reinstatement of tarmacadam areas and other surfaces is to be carried out to the approval of the Engineer and any other interested Authority. The electrical domestic sub-contractor is to fulfil statutory obligations covering reinstatement and maintenance under the Public Utilities Street Works Act 1950, where applicable. Permanent reinstatement is to include keying into existing surfaces.

4.2.2.56 **Re-laying of Slabs**

4.2.2.57 Where re-laying slabs, the electrical domestic sub-contractor is to include for all necessary levelling and for new bedding sand.

4.2.2.58 **Safety**

4.2.2.59 The electrical domestic sub-contractor is to include for all necessary safeguards at each excavation e.g. shoring, barriers, lighting, pumping, etc. and for all plant, consumables, labour, etc. associated with the foregoing.

4.2.2.60 It is to be understood that the foregoing provisions covering reinstatement and safety will generally be carried out by those responsible for excavations as previously noted.

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- 4.2.2.61 Before commencing excavations the electrical domestic sub-contractor is to ensure that, as far as is known by the site owners and their agents, the various public utilities etc., the area is clear of all services such as cables, pipes, drains, etc. or, that those which are known to exist are suitably pegged out.
- 4.2.2.62 Unless otherwise indicated, all excavations within 0.6 m of other services are to be carried out by hand digging.
- 4.2.2.63 In the event that the electrical domestic sub-contractor uncovers an existing service or services, whether or not expected, then the electrical domestic sub-contractor must forthwith support and protect same, as required. Should there be any instance of damage to existing services, then the electrical domestic sub-contractor must immediately report same, via the Main Contractor, where appropriate, to the Engineer and/or Architect.
- 4.2.2.64 **Permits, etc**
- 4.2.2.65 Where a site clearance certificate or permit to work is issued to the electrical domestic sub-contractor, this must not be taken as relieving the electrical domestic sub-contractor of the responsibility to proceed in a safe and careful manner as required by Health and Safety Legislation.
- 4.2.3.0 LV Switchgear**
- 4.2.3.1 Cubicle Switchboards**
- 4.2.3.2 Cubicle type switchboards are to be sheet steel assemblies (unless noted otherwise) complying with BS EN 60439, Part 1, 199 and are to meet the construction form specified in the Schedules and on the drawings. If no construction form is stated, switchboards are to be constructed to Form 4, Type 6.
- Switchboards are to be constructed in accordance with an EIEMA classification where such is specified on the drawings or in the Schedules or Bill of Quantities.
- 4.2.3.3 Cubicles are to be of sheet steel (2 mm thickness unless otherwise stated) adequately braced using steel channel as appropriate for the particular application. Construction to be effected using welding, folding and bolting methods. All construction joints are to be completed prior to commencing any priming or painting, to ensure electrical continuity across joints is maintained.
- 4.2.3.4 Cubicles are to be of front and/or rear access for cabling and maintenance as stipulated in the schedules or on the drawings. Likewise cable entry is to be from above and/or below as stipulated.
- 4.2.3.5 Cubicles are to be finished using epoxy polyester powder coating, electrostatically applied using 5 stage, zinc phosphate pre-treatment to an approved colour (manufacturers standard colour unless otherwise stated).
- 4.2.3.6 Cubicles are to be constructed in sections, as necessary, to facilitate transportation and entry into final accommodation and installation on site.
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- 4.2.3.7 Adequate support channels for shipping are to be included within each cubicle.
- 4.2.3.8 Unless otherwise stated, switchboards are to be ASTA certified to 80 kA/50 kA for 1 second as defined in BS EN 60439-1: 1994.
- 4.2.3.9 Unless otherwise stated the minimum Degree of Protection to BS EN 60529:1992, for cubicles, is to be:-
- | | | |
|----|------------------------------|------|
| a) | Switchgear/distribution gear | IP31 |
| b) | Transformer housings | IP21 |
- 4.2.3.10 **Protective Conductors**
- 4.2.3.11 Each section of the switchboard shall be bonded by a continuous copper strip rated to carry the short circuit currents appropriate to the equipment rating and connected to a main earth terminal on the board.
- 4.2.3.12 All hinged and bolted coverplates are to be bonded to the earth terminal of the associated compartment using a 6.0 mm² (min) bonding conductor.
- 4.2.3.13 The switchboard is to be equipped with all necessary earth, protective and bonding conductor terminal facilities, as required by BS 7671.
- 4.2.3.14 All earth/bonding terminals are to be suitably identified using engraved labels.
- 4.2.3.15 **Main Cables**
- 4.2.3.16 All field cabling is to be as indicated in the schedules, drawings and Bill of Quantities. It is the responsibility of the electrical domestic sub-contractor to convey all such information to the switchboard manufacturer.
- The electrical domestic sub-contractor must ensure that adequate space is allowed for incoming/outgoing cabling within the switchboard.
- 4.2.3.17 **Manufacturer**
- 4.2.3.18 A list of manufacturers as given in the appended schedules
- All switchgear used on the project is to be, unless stated otherwise, by a single manufacturer.
- 4.2.3.19 **Erection of Switchboards**
- 4.2.3.20 The electrical domestic sub-contractor shall be responsible for the correct levelling of switchboards to the satisfaction of the Engineer before the final grouting in, to ensure that the sections of the switchboards will fit properly together and can be bolted together without distortion and without strain on the bonding bolts.
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4.2.3.21 Where wall mounting is scheduled the switchboards shall be secured to the walls by means of at least 6 - 12 mm. bolts of rawlbolt type or bolts through the wall with a 100 mm. x 100 mm. fishplate on the reverse side.

4.2.3.22 **Busbars**

4.2.3.23 LV busbars are, unless otherwise called for, to be short circuit rated to 50 kA for 3 secs/80 kA for 1 sec and are to be formed from HDHC copper mounted on glass filled polyester type mouldings. Insulators must be non-tracking and flame retardant. Bus bars are to comply with BS5486: Part 1..

4.2.3.24 HDHC copper busbars are to be of rectangular section, in multiple laminations and electro-tinned throughout the entire length. Busbars are to be suitably colour coded to denote phasing.

The neutral bar on main and sub-main busbars is to be full section.

Each busbar (main and sub-main) is to be contained within an individual sheet steel enclosure access to which is to be restricted to a coverplate removable only by use of a spanner or such device.

Busbar coverplates are to bear an engraved screw-fixed label bearing the legend:-

“DANGER 415V - ISOLATE BEFORE OPENING”

4.2.3.25 **Switches and Switch Fuses**

4.2.3.26 Switches and switchfuses are to be metalclad units of rating and number of poles specified. Units are to be of 500V rating to BS EN 60947-3:1999 Utilisation Category AC23A and are to be lockable in the “OFF” position.

Use of such units on cubicle switchboards is not permitted and fuse switches are to be used unless noted otherwise on the drawings.

4.2.3.27 **Fuse Switches**

4.2.3.28 Fuse switches are to comply with BS EN 60947-3:1999 for Utilisation for Category AC23B duty at Operational Current (I_e). Where devices are intended for frequent switching Utilisation Category AC23A devices are to be installed.

4.2.3.29 Fuse switches are to be suitable for cubicle mounting with a rotary operating handle interlocked with the compartment door, such that the latter cannot be opened unless the handle is in the ‘off’ position and vice versa. Positive position indicators are to be provided. Fuses are to be to BS 88 Type ‘T’ Class Q1 unless otherwise stated.

4.2.3.30 Interconnections between busbars and fuse switches are to be of solid copper, adequately braced and supported to withstand short circuit rating of main busbars.

Outgoing connections, unless otherwise called for, are to be connected using solid copper interconnections, passing via suitable insulating bushings to outgoing cable box or cabling chamber, as required by form of construction specified.

Neutral links are to be accessible for routine removal/replacement for testing purposes.

4.2.3.31 Distribution Boards

4.2.3.32 Distribution boards are to be metalclad type suitable for cubicle mounting, rated at 500V.

4.2.3.33 Busbars shall be copper and shrouded to enable circuits to be wired while the board is live.

4.2.3.34 The number of ways, current rating and number of phases shall be as indicated on the Schedules.

4.2.3.35 Spare ways are to be provided as indicated on the schedules and/or drawings.

4.2.3.36 Incoming cable terminals shall be shrouded, pressure clamp or socket type.

4.2.3.37 The neutral and earth terminal connector blocks of T.P. & N. distribution boards shall have a separate way for each way of the board, e.g. 4 way T.P. & N. shall have 12 outgoing neutral, and 12 earth terminals. Where distribution boards serve ring circuits with "high integrity earth" in accordance with Appendix 607 of BS7671, dual earth bars are to be fitted.

4.2.3.38 Unless otherwise called for, all distribution boards are to include an integral isolating switch to BS EN 60947-3 utilisation category AC-22A. The isolator is to be capable of carrying, for three seconds, the through fault current of the system. The isolator is to be lockable in the "off" position.

4.2.3.39 Where distribution boards are specified as being of the HRC fuse type, they are to comply with BS 5486, Part 11. The electrical domestic sub-contractor is to supply and fit all necessary cartridge fuses plus any specified spares.

4.2.3.40 Miniature circuit breaker distribution boards are to comply with BS 5486, Part 12.

4.2.3.41 Miniature circuit breakers are to comply with BS EN 60898. MCB's are to have tripping characteristic A, B or C as called for. Each MCB is to be fault-rated to a minimum of 9 kA or higher if stated elsewhere. MCB's inbuilt to switchboards are to be fault rated to match the switchboard, or be cascade protected by upstream devices.

4.2.3.42 Miniature circuit breakers are to be lockable in the "off" position and triple-pole MCB's are to have linked operators.

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- 4.2.3.43 Where called for, combined over-current and r.c.d. circuit breakers are to be provided. These units are to comply with BS EN 61009:1994. Tripping sensitivity is to be 30 mA earth leakage current, unless otherwise called for.
- 4.2.3.44 Miniature circuit breakers are to be calibrated to meet the requirements of BS 60898.
- 4.2.3.45 All distribution boards are to have hinged lockable covers, blank ways as required and front label.
- 4.2.3.46 **Rating of MCB's and Fuses**
- 4.2.3.47 The correct ratings of MCB's or HRC fuses corresponding to the sizes of the sub-circuit conductors shall be fitted.
- 4.2.3.48 All fuses unless otherwise specified shall be HRC cartridge type to BS EN60269-2:1994.88 category gG. (GEC Alsthom or equal), but in all cases shall operate within the parameters shown in Appendix 3 of BS 7671.
- 4.2.3.49 Type 2 Co-ordination to IEC 947-4 shall be achieved between protective devices and contactors and overload relays.
- 4.2.3.50 **Labelling**
- 4.2.3.51 All switchboards and distribution boards shall be fitted with a white ivory main designation label engraved with no more than four rows of 25 mm. black letters, legend to be agreed.
- 4.2.3.52 All metal clad switches and all distribution boards shall be provided with ivory labels giving the following information:
- | | | |
|-----|------------------------|---|
| (a) | Incoming Main Switches | - Incoming 415 volt TP&N on switchboards or supply from (name of switchboard or transformer supplying unit) |
| (b) | Main Switches | - Service (lighting, power, etc.)
Area Served
Phase (red, etc. where applicable) |
| (c) | Distribution Boards | - Service (main or sub-lighting etc.)
Area Served
Phase (red, etc., where applicable) |
| (d) | Isolation Switches | - Name of apparatus controlled
Name of switchboard |
- 4.2.3.53 These labels shall be secured to the covers of the switches and distribution boards by means of small brass round head screws, the covers of the switches and distribution boards being tapped to receive same.
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- 4.2.3.54 The minimum size of lettering used on the labels on switches, isolating switches and distribution boards shall be 10 mm. high and all labels on units of switchboards should be of the same size.
- 4.2.3.55 Each distribution board shall have a typed card inside in a firm plastic envelope fixed to the inside of the cover with M.3.5 screws providing details of the circuit controlled, normal current, the conductor sizes and the size of fuses required. The card shall also state "All Cables rated for CLOSE excess current protection. Fusing factor of fuses not to exceed 1.5". No alternative arrangement will be allowed.
- 4.2.3.56 In addition, each MCB, MCCB, or fused switch shall have an engraved label with 10 mm. high lettering denoting the equipment served.
- 4.2.3.57 **Spare Fuses**
- 4.2.3.58 Spare fuses of each type and rating shall be provided on the following scale. The cost of these shall be included in the cost of the main switchboard. An enclosure similar to a fuse distribution board shall be included on the main switchboard to accommodate all the spare fuses for the installation. This enclosure shall be labelled "SPARE CARTRIDGE FUSES" outside and shall be fitted with a chart inside listing the type, rating, manufacture and quantity of all fuses contained in it.
- 4.2.3.59 The chart shall carry the wording "List of Spare Fuses - Check remaining stock after using cartridges and order further items when stock is reduced to 50% of normal or 2, whichever is the greater."
- 4.2.3.60 The number of spare cartridges shall be as follows -

Fuses Used on Number of Spare

<u>Installation</u>	<u>Cartridges Required</u>
1-3	100%
4-6	50%
7-12	3%
13-36	25%
Over 36	12%

- 4.2.3.61 **LV Air Circuit Breaker**
- 4.2.3.62 Air circuit breakers are to be triple-pole or four-pole as called for. Triple-pole units are to include a bolted neutral link.
- Air circuit breakers are to comply with IEC 947-2, BS EN 60947-2 with Utilisation Category 'B' and breaking capacity is to be 50/80 kA p.m.s. ICs = ICu, unless stated otherwise. Unless otherwise stated, circuit breakers are to be manually-operated, spring assisted, withdrawable pattern. Where called for, spring charging is to be motor wound with electrical release.
- All control buttons are to be provided with hinged covers to give protection from accidental operation.

Shunt trips, where called for, are to be provided. The normal operating voltage for these units is to be 30V d.c. but, where specified, a 240V a.c. version is to be provided.

Charging handles are to be stored with the ACB in an accessible labelled location, not requiring a tool to access.

- 4.2.3.63 Unless otherwise stated, circuit breakers are to incorporate overcurrent, short circuit and unrestricted earth fault protection, in the form of an integral self powered, fully adjustable micro-processor based protective device. The device is to offer an IDMT characteristic to enable co-ordination with down stream devices. The device is to be rated to withstand the effects of surges and interference and is to comply with BS EN 60255-21-3:1995 and BS EN 142-0.

- 4.2.3.64 Generally, the device is to include the undernoted protective features, as a minimum:-

Feature	Typical Adjustable Settings
a) Long time delay over-current Minimum time delay	0.4 - 1.0 x I_n 0.1 - 1.0 sec
b) Short circuit with time delay Definite minimum time delay	2 - 10 x I_n 0.1 - 1.0 sec
c) Short circuit instantaneous	1 - 15 x I_n
d) Earth fault Definite minimum time delay	0.2 - 1.0 x I_n 0.1 - 1.0 sec

Features (b), (c) and (d) to have disabling facility.

- 4.2.3.65 The equipment shall be suitable for incorporating in a cubicle type switchboard. The circuit breaker shall be arranged to receive the incoming supply cables direct on the lower stems of the breaker.

- 4.2.3.66 The operating mechanism shall be of the independent manual trip-free, quick break type, ensuring that the breaker cannot be held closed against the protective trips incorporated. The OFF and ON positions shall be clearly indicated and provision for locking in the OFF position shall be provided.

- 4.2.3.67 A set of mechanical interlocks shall be fitted to ensure that it cannot be withdrawn whilst in the ON position, nor plugged in whilst in the ON position and automatic shutter gear shall be fitted to shield the line contacts when the breaker is withdrawn.

- 4.2.3.68 The circuit breaker should also incorporate a lockable closing facility in such a way that the manual trip is always effective.

- 4.2.3.69 With the breaker in the isolated/test position no access shall be available to live parts.

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- 4.2.3.70 Five normally open and three normally closed volt free, positively driven electrically separate auxiliary switches shall be provided.
- 4.2.3.71 Where called for in the Technical Schedule, a restricted earth fault relay is to be included complete with separate matching current transformers and inter-trip relay (to/from HV) with send/receive facilities.
- 4.2.3.72 Four matching ring type Class 5P20 current transformers manufactured to BS 7626, of suitable ratio shall be mounted in the circuit breaker and shall be suitably rated for operation with the installed protection and instrumentation.
- 4.2.3.73 The secondary wiring shall be totally enclosed and run in such a way as to prevent mechanical damage and risk of fire in normal operation.
- 4.2.3.74 Suitable engraved labels with approved wording describing the function of the circuit breaker including all fuses, etc., contained with the breaker and the earth leakage protection shall be provided and fixed to the circuit breaker.
- 4.2.3.75 Where specified, additional features shall include -
- (i) Shunt Trip
 - (ii) Under voltage release with time delay
 - (iii) H.V. circuit breaker inter-tripping
 - (iv) Restricted earth fault relay
 - (v) Surge protection device
- 4.2.3.76 The following spare gear shall be provided with the circuit breaker:
- (i) One set of main contacts
 - (ii) One set of arcing contacts
 - (iii) Schematic wiring diagrams, physical arrangement
- 4.2.3.77 All switchboards, large distribution boards and control panels shall be provided with a proprietary heavy duty rubber mat in front of the unit and extending its full length. The rubber mat shall be suitable for the purpose and provide an insulating environment for anyone operating the switchboard, distribution board or control panel.
- 4.2.3.78 The electrical domestic sub-contractor is to employ a firm of suitably qualified Switchgear manufacturer to prepare a full discrimination study for the installation and submit settings and curves, for comment. This is required to ensure that the electrical domestic sub-contractors selected device manufacturer can comply with the design intent and this information is to be included in the O&M Manual.
- 4.2.3.79 Moulded Case Circuit Breakers**
- 4.2.3.80 Moulded Case circuit breaker are to comply with IEC 947-2, BS EN 60947-1 and 2 with Utilisation Category 'A', and breaking capacity is to be 50kA (min). ICs = ICu, unless stated otherwise. Unless otherwise stated, circuit breakers are to be
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manually-operated, spring assisted, fixed pattern. Where called for, spring changing is to be motor wound with electrical release.

All control buttons are to be provided with hinged covers to give protection from accidental operation.

Shunt trips, where called for, are to be provided. The normal operating voltage for these units is to be 30V d.c. but, where specified, a 240V a.c. version is to be provided.

- 4.2.3.81 Unless otherwise stated, circuit breakers are to incorporate adjustable overcurrent and short circuit protection.

For ratings up to and including 100A, MCCB's are to have adjustable thermal (80%-100%) and fixed magnetic trip unit, unless otherwise detailed. For ratings above 100A MCCB's are to include an electronic tripping device giving:

- Adjustable base current setting
- Adjustable over-current setting (40%-100%)
- Adjustable short-circuit setting (2x-10x)

Where called for electronic tripping devices will include adjustable trip time settings, instantaneous tripping and unrestricted earth fault protection.

- 4.2.3.82 The equipment shall be suitable for incorporating in a cubicle type switchboard, with connection to suit the particular form of construction to BS 5846.

- 4.2.3.83 The operating mechanism shall be of the independent manual trip-free, quick break type, ensuring that the breaker cannot be held closed against the protective trips incorporated. The OFF and ON positions shall be clearly indicated and provision for locking in the OFF position shall be provided.

- 4.2.3.84 The circuit breaker should also incorporate a lockable closing facility in such a way that the manual trip is always effective.

- 4.2.3.85 Five normally open and three normally closed volt free, positively driven electrically separate auxiliary switches shall be provided.

- 4.2.3.86 Where matching ring type Class 5P20 current transformers manufactured to BS 7626, of suitable ratio shall be mounted in the circuit breaker and shall be suitably rated for operation with the earth leakage protection system, the over current protection and instrumentation.

- 4.2.3.87 The secondary wiring shall be totally enclosed and run in such a way as to prevent mechanical damage and risk of fire in normal operation.

- 4.2.3.88 Suitable engraved labels with approved wording describing the function of the circuit breaker including all fuses, etc., contained with the breaker and the earth leakage protection shall be provided and fixed to the circuit breaker.

4.2.3.89 Where specified, additional features shall include:-

- (i) Shunt Trip
- (ii) Under voltage release with time delay

4.2.3.90 The electrical domestic sub-contractor is to employ a firm of suitably qualified Switchgear manufacturers to prepare a full discrimination study for the installation and submit settings and curves, for comment. This is required to ensure that the electrical domestic sub-contractors selected device manufacturer can comply with the design intent and this information is to be included in the O & M Manual.

4.2.4.0 PVC Insulated and PVC Sheathed Cable, Armoured and Non-Armoured

4.2.4.1 Cables

4.2.4.2 The cables shall be 600/1000 volt grade and shall comprise single, two, three and four core, laid up, wormed circular with non-hygroscopic wormings sheathed with PVC Armouring shall consist of a single layer of galvanised steel wires for multi-core cables and aluminium, strip wire or tape armour for single core cables, and sheathed with black PVC

4.2.4.3 Cables with copper conductors shall comply with BS.6346:1997.

4.2.4.4 Cables with aluminium conductors shall have solid sectoral shaped conductors, insulated with PVC compound, made up and covered with four layers of PVC tape, armoured with a concentric layer of hard drawn strip or single wire as specified and sheathed overall with PVC compound. Cables with aluminium conductors shall comply with BS.6346

4.2.4.5 The sizes and number of cores shall be as specified in the various sections, or drawings. Where 3 core cables are used on single phase circuits, the cores are to be correctly colour coded.

4.2.4.6 Glands

4.2.4.7 Copper cables shall be terminated in waterproof brass compression type glands with armour clamp and seals for outer and inner PVC sheaths, back nut and earth tag. For all situations a PVC shroud shall be fitted to the gland In external situations, cables are to enter equipment from below.

4.2.4.8 Aluminium cables shall be terminated in aluminium type glands but shall otherwise be as described above.

4.2.4.9 Cable glands are to meet the requirements of BS6121L1993 and BS EN 50262.

4.2.4.10 Non-ferrous cable gland plates are to be provided for single core cable terminations to eliminate eddy current heating.

4.2.4.11 Terminations

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- 4.2.4.12 Copper conductors are to be terminated with limited compression crimped-on terminals or hot tinned brass or copper soldering sockets to BS 91: 1998.
- 4.2.4.13 Aluminium conductors are to be terminated with limited compression soft aluminium crimped-on terminals or hot tinned copper or brass soldering sockets to BS 91 abrasion soldered to the cores. With tunnel type terminals the sectoral conductor shall be swaged to a circular section before insertion in their terminals. With terminals rated over 30 amps, split brass sleeves shall be fitted over the rounded conductors. The compressor and dies to this "Swage Term" system shall be supplied by the cable manufacturer. Aluminium cables shall be terminated in accordance with the Manufacturer's instructions.
- 4.2.4.14 At each end of each cable adjacent to the terminal shroud, a proprietary identification tag is to be fitted over the sheath. Where cables enter equipment from below, the tag is to be fitted in a visible location, as close as possible to the termination.
- 4.2.4.15 Identity tags (6-characters) are to be as Radio Spares "Black-on-Yellow" type or approved equal.
- 4.2.4.16 **Spreader Boxes**
- 4.2.4.17 It is the responsibility of the Sub-Contractor to ensure that all switchgear and distribution boards are provided with any spreader boxes required for the termination of cables. Spreader boxes shall be of sheet steel construction finished to match the service served.
- 4.2.4.18 Spreader boxes shall also be provided at plant and equipment where the manufacturer's cable termination arrangements are inadequate for the cables detailed, or where vertical gland plates are provided in exposed or external locations. Cable terminations in all such cases shall be arranged with cables entering from below.
- 4.2.4.19 **Cable Installation**
- 4.2.4.20 The Sub-Contractor shall be responsible for the correct measurement of all cable lengths prior to ordering the cables.
- 4.2.4.21 The Sub-Contractor is to ensure that the method of installation is such that the required current carrying capacity of each individual cable is maintained at the design level.
- 4.2.4.22 Where single core cables are employed in three-phase and neutral circuits the phase cables are to be run in trefoil groups with the neutral alongside.

Were more than one trefoil group is involved, then the groups are to be spaced at the minimum distance to render the groups thermally-independent, with the neutrals disposed between the groups. Cognisance is to be taken by the electrical domestic sub-contractor from arrangements possible electromagnetic radiation levels emanating from arrangements of single core cables and the trefoil

arrangement is to be presented up to an including the gland plate at each termination.

4.2.4.23 External runs shall be in accordance with the structure of the building and the routes available. Generally cables are to follow the line of roadways and paths and run parallel to building lines.

4.2.4.24 External runs shall be in earthenware or PVC ducts where these are provided or laid in the ground as specified in the following paragraph. All routes shall be agreed with the Engineer prior to installation of cables.

4.2.4.25 **Installation**

4.2.4.26 Cable installations shall conform to the requirements of Section 2.2.0 of this Specification.

4.2.5.0 XLPE Insulated and LSF Sheathed Cable, Armoured and Non-Armoured

4.2.5.1 **Cables**

4.2.5.2 The cables shall be 600/1,000 Volt grade and shall comprise single, two, three and four core, laid up, circular, XLPE insulated, extruded thermoplastic LSF taped bedded, galvanised steel wire armour (aluminium wire for single core cables) and black LSF compound sheath. They shall have plain stranded copper conductors. Where 3 core cables are used on single phase circuits they are to be correctly colour coded.

4.2.5.3 The oversheath shall be free of halogens.

4.2.5.4 **Standards**

4.2.5.5 The cables shall be constructed in accordance with the requirements of BS.6724:1997 and shall meet the performance characteristics of same.

4.2.5.6 **Glands, Terminations and Joints**

4.2.5.7 The cables shall be terminated in outdoor brass compression type glands with armour clamp, sheath seals, back and earth tag and shroud. In external situations cables are to enter equipment from below.

4.2.5.8 Cable glands are to meet the requirements of BS6121:1993 and BS EN 5062

4.2.5.9 The conductors shall be terminated using compression crimped- on terminals or hot tinned brass or copper soldering sockets to BS.91:1998.

4.2.5.10 At each end of each cable adjacent to the terminal shroud, a proprietary identification tag is to be fitted over the sheath. Where cables enter equipment from below, the tag is to be fitted in a visible location as close as possible to the termination Identity tags are to be as specified for PVC/SWA/PVC cables.

4.2.5.11 **Smoke and Gas Emission**

4.2.5.12 When tested in accordance, with IEC 754-1 the acidic gas emission during the test shall be less than 0.5 per cent.

4.2.5.13 The oxygen index of the bedding and sheath shall be not less than 30 in accordance with BS.2782, Test Method 141 D.

4.2.5.14 During smoke emission tests, the Health and Safety Executive Guidance Note on Threshold Limit Values shall be followed. They shall also meet the requirements of Category C of IEC 332-3 for reduced flame propagation.

4.2.5.15 **Installation**

4.2.5.16 The cable installation shall generally be in accordance with the requirements of Section 2.2.0 of this Specification And the requirements laid down herein for installation of PVC/SWA/PVC cables.

4.2.5.17 LSF cables may be installed at temperatures down to -10 degrees C. The cable bending radius shall be not less than eight times the cable diameter. It should be noted that LSF sheaths are less robust than PVC sheaths and are more prone to scuffing and abrasion damage.

4.2.5.18 LSF sheathed cables are not to be installed where they will be in prolonged contact with oil. This would result in softening and swelling of the sheath. In addition, the electrical domestic sub-contractor should seek advice from the Cable manufacturer with regard to the installation of LSF cables in waterlogged ground or within ducts susceptible to flooding as some LSF cables are hygroscopic.

4.2.5.19 **Spreader Boxes**

Where armoured cables are used it is the electrical domestic sub-contractor's responsibility to ensure that all switchgear and distribution boards are provided with any spreader boxes required for the termination of those cables, particularly for aluminium conductors. Spreader boxes shall be of sheet steel construction finished to match the service served.

4.2..20 Spreader boxes shall also be provided at plant and equipment where the manufacturer's cable termination arrangements are inadequate or where vertical gland plates are provided in exposed or external locations. Cable terminations in such cases shall be arranged with the cable entering from below.

4.2.6.0 **Steel Conduit, Trunking and Tray**

4.2.6.1 **Steel Conduits**

4.2.6.2 All steel conduit is to be manufactured by a BESA approved company. Steel conduit, unless otherwise stated is to be Class 2 black enamel (inside and outside) welded conduit to BS 4568, Parts 1 and 2 and BS EN 50086-1 for screwed conduit installation.

Galvanised steel conduit is to be to Class 4 hot-dipped galvanised (inside and outside) during manufacture to the same or equivalent standards as above.

Minimum diameter of any steel conduit used in the works for general wiring, is to be 20 mm.

4.2.6.3 All threads are to be cut to the appropriate length specified in BS 4568. Following screwing, the surfaces of the conduit are to be reamed at both ends to remove all burrs, lubricants and swarf, before erecting.

4.2.6.4 **Conduit Fittings**

4.2.6.5 All conduit fittings and accessories including couplers, ordinary clips, saddles, pipe hooks, threaded reducers, stopping plugs, lock nuts and male and female bushes shall be as manufactured to BSS 4568 and BS EN 50086-1 where applicable.

4.2.6.6 All threaded couplers, threaded reducers, stopping plugs and lock nuts shall be made of malleable iron. Bright steel circular milled lock nuts only shall be used. All male and female bushes shall be made of brass.

4.2.6.7 Where it is stated in the Bills that galvanised conduit shall be used the conduit fittings, boxes, adaptable boxes, ceiling boxes, etc., shall be galvanised.

4.2.6.8 **Conduit Cutting**

4.2.6.9 Conduit shall be cut clean and square with the axis using a saw, or tube-cutting tool or machine.

4.2.6.10 Dies are to be run over conduit threads cut during original manufacture, to ensure these are clean and free-wiring.

4.2.6.11 Where conduits are held in vices, care shall be taken to ensure that the outer surfaces remain undamaged. Tool marks must be filed away and the tube left smooth. Protective coatings on steel conduit shall be made good.

4.2.6.12 **Screwed Joints**

4.2.6.13 Conduits to be screwed and butted solidly into all joints, boxes, fittings, etc. to ensure electrical continuity is preserved and optimised.

4.2.6.14 Before any conduit system is plastered or screeded in, and prior to wiring, a test is to be carried out to ensure satisfactory electrical continuity of all conduit branches. The results of all such tests are to be recorded.

4.2.6.15 The number of running couplings used in any conduit system is to be the minimum practicable. Such couplings are to have a lock-ring fitted at each end.

4.2.6.16 **Bends and Connections**

- 4.2.6.17 Conduit bends and sets are to be site formed using a bending machine and with the minimum practicable deformation of the conduit bore. Only in exceptional circumstances will the use of manufactured or inspection elbows be permitted.
- 4.2.6.18 Conduits are to be connected to accessories, trunking, switchboards, etc., where screwed connection is not available, using a coupling with lock-ring externally to brass male bush and steel serrated crush washer, internally.
- 4.2.6.19 **Cleanliness**
- 4.2.6.20 Open ends of conduit, where upward, are to be effectively sealed against ingress of foreign matter, using plugs, caps or other covers. Wood, rag or paper plugs are not be used.
- 4.2.6.21 Where called for, a suitable draw-wire is to be left in conduit systems for use by others.
- 4.2.6.22 **Conduit Fixing and Installation**
- 4.2.6.23 Conduit in chases in solid building fabric subsequently concealed may be fixed with crampets. Where the concealment is by wet- applied finishes, particular care shall be taken to make good protective coatings as soon as the metal is laid bare by the driving process.
- 4.2.6.24 Conduit saddles, conduit boxes and adaptable boxes shall generally be fixed to the building fabric with substantial sherardized steel screws in accordance with Section 1.31.0 herein.
- 4.2.6.25 After erection, damaged sherardizing or galvanising shall be made good with cold-galvanising paint.
- 4.2.6.26 Surface run conduit exposed to view is to be fixed using spacer bar saddles. Where run in attics, ceiling voids or other agreed spaces, conduits are to be fixed using pressed steel on spacer saddles or other approved proprietary fixing.

Irrespective of fixing type, fixing centres are not to exceed:-

<u>Conduit Dia.</u>	<u>Spacing</u>
20 mm - 25 mm	1.4 m
32 mm - 40 mm	1.5 m
50 mm	1.8 m

- 4.2.6.27 Conduit systems shall be arranged to present a neat appearance and shall generally follow the lines of the building fabric. Where practicable, conduit shall be grouped in parallel lines. All vertical routes shall be plumb.
- 4.2.6.28 Conduit shall be neatly offset around piers, columns and other obstructions, even when these features are not shown on the Contract Drawings.

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- 4.2.6.29 Conduit systems shall be designed so that condensation inside the system does not become a problem, incorporating drains where necessary.
- 4.2.6.30 Each conduit installation is to be laid out with due regard paid to the facilities required for the drawing in of cables. In particular, the number of normal bends between consecutive draw boxes is to be limited to two only and no conduit run is to exceed 10 m overall straight length or 7.5 m on a length incorporating a bend or bends.
- 4.2.6.31 Where groups of cables emanate from separate distribution boards, a draw-in box per group is to be provided.
- 4.2.6.32 A conduit box shall be fitted at every outlet point except where the conduit connects directly with the box of an accessory. Boxes shall be provided for the attachment of all luminaires.
- A conduit box, with earth terminal, shall be used as the junction box between solid conduit and flexible or pliable conduit.
- 4.2.6.33 At every conduit termination where screwed entry connection is not available, the means of connection is to be locking ring, coupling, serrated washer (externally), locking ring and male brass bush internally.
- 4.2.6.34 Tees, crosses and those bends in locations where formed bends are inappropriate because of spatial limitations, appearance or function shall be made with standard conduit boxes. A back-outlet box shall be used where a surface conduit turns and passes through a wall.
- 4.2.6.35 Covers and lids to boxes mounted flush with the building fabric finish shall have a 10 mm. overlap all round.
- 4.2.6.36 Conduit boxes used for luminaires shall be independently fixed to the building fabric. Where the background is structural steelwork, one conduit fixing shall be used on each conduit branch within 50 mm. of the conduit box.
- 4.2.6.37 **Conduit Spacing and Clearance**
- 4.2.6.38 Conduit installations shall be laid out in such a manner as to give the following minimum clear spaces -
- | | | |
|----|--|------|
| 1. | between surface conduits and wall finish | 7 mm |
| 2. | between surface conduits and structural steelwork or support systems | 4 mm |
| 3. | between two conduit runs | 4 mm |
| 4. | between concealed conduits in voids behind demountable ceilings and background | 4 mm |
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	4. between concealed conduits in voids behind fixed ceiling and background	NIL
	6. between conduit and other services	150 mm
	7. above central heating radiators	1000 mm
4.2.6.39	Adaptable Boxes	
4.2.6.40	Adaptable boxes are to be manufactured from sheet steel, unless otherwise called for. They are to be used in lieu of a BS 4586 box where two or more parallel conduit lengths are to be coupled. All boxes are to be fixed in accessible positions.	
4.2.6.41	Boxes are to include earthed steel barriers where segregation of services is necessary.	
4.2.6.42	Boxes are to have steel lids, secured by 4 x M5 brass RH screws. Flush box lids are to overlap by 6 mm all round and be of 16 s.w.g. mild steel.	
4.2.6.43	Boxes are not to be buried in floors unless specifically agreed by the Engineer.	
	Boxes mounted externally are to be galvanised malleable cast iron type with heavy duty water-tight lid to IP64.	
4.2.6.44	Circular Conduit Boxes	
4.2.6.45	Conduit boxes are to be of malleable cast iron to BS 4568 finished BE or galvanised as appropriate and fitted with mild steel lids, 1.6 mm thick of appropriate finish secured by RH brass screws.	
4.2.6.46	All boxes are to finish flush with finished surface. Boxes are to have screwed spout entries. The exception to the foregoing is where boxes are used in a back entry looping arrangement.	
4.2.6.47	Boxes are to be of the end, 90°, 90° tangent, tee, Y or 4 way type as required.	
4.2.6.48	Masking Rings/Extension Rings	
4.2.6.49	The use of each of these is to be acceptable only in exceptional circumstances.	
	Where the tile or plaster finish around a box is incomplete or otherwise ragged a circular PVC masking ring is to be fitted.	
4.2.6.50	Flushing of boxes to plaster, tile, or other fabric surfaces is generally to be achieved by off-setting conduit. However, this may also be achieved by fitting of extension rings provided the ring depth does not exceed 25 mm. Accessory boxes to be mounted in tiled walls, are to be connected to the fixed conduit by a 200 mm section of flexible steel conduit to allow accurate final repositioning.	
4.2.6.51	Damp Situations	

- 4.2.6.52 All exposed steel conduit and fittings in outside areas or other specified situations shall be galvanised and equivalent to the types specified above.
- 4.2.6.53 **Stopping Plugs**
- 4.2.6.54 All spare ways in junction boxes, etc., left for possible future extensions shall be fitted with malleable iron stopping plugs.
- 4.2.6.55 **Bushes**
- 4.2.6.56 Female brass bushes shall be fitted to all free ends of conduit.
- 4.2.6.57 **Painting of Steel Conduits**
- 4.2.6.58 All parts of the conduit where the enamelling has been damaged and all exposed screw threads shall be painted with black anti- sulphuric paint before erection and again after erection. On galvanised conduit galvafrond or other zinc rich paint must be used.
- 4.2.6.59 **Continuity**
- 4.2.6.60 To preserve the earth continuity of the conduit system, bright steel circular milled lock nuts shall be fitted on each side of all conduits, couplings and at each entry to every type of conduit fitting or metal clad accessory.
- 4.2.6.61 All conduit boxes are to include an earth terminal of the pillar type.
- 4.2.6.62 **Flexible Conduit**
- 4.2.6.63 Flexible conduit shall be watertight flexible PVC sheathed metallic conduit complying with BS.731. The flexible conduit shall terminate in clamp type connectors and a 2.5 sq. mm. copper earth continuity conductor shall be run from an earth terminal in the conduit box to the earth terminal on the equipment.
- 4.2.6.64 PVC sheathed flexible conduit shall be connected to rigid conduit via boxes securely fixed to the walls, etc.
- 4.2.6.65 **Steel Trunking**
- 4.2.6.66 Sheet steel cable trunking and accessories are to be manufactured from heavy gauge galvanised sheet steel. The trunking is to comply with BS 4678.
- 4.2.6.67 The minimum body thickness shall be as follows:

<u>Size</u>	<u>Thickness</u>
Up to 50 x 50 mm.	1.2 mm
75 x 75 mm. to 100 x 100 mm	1.6 mm
150 x 150 mm. and greater	1.8 mm

- 4.2.6.68 Where a rectangular trunking exceeds overall dimensions equal to or greater than 150 x 50, a central partition is to be included.
- 4.2.6.69 Where cable trunking passes through fire division walls, suitable fire barriers shall be provided.
- 4.2.6.70 All trunking and accessory joints are to be bridged using 12.5 x 2.5 mm copper tape, bolted to the trunking using M5 RH brass screws, nuts and shake-proof washers. A continuity test is to be carried out on each section, prior to cabling or covering commencing.
- 4.2.6.71 Where the ends of conduit trunking and accessories of galvanised equipment has been damaged it shall be painted with galvafroid or other zinc rich paint.
- 4.2.6.72 Steel lighting trunking systems shall be constructed from galvanised mild steel trunking and fittings complying generally with BS.4678, Part 1, modified as below. Finish shall be Class 3.
- 4.2.6.73 Materials used for lighting trunking bodies shall be at least 1.2 mm. thick. Thickness of material and profile shall be selected to suit the specified weight-loads and the specified suspension intervals.
- 4.2.6.74 Lighting trunking lids shall be manufactured from high quality colour fast extruded plastics, of a profile to enable it to clip-in to the trunking body and to give the appearance shown on the drawings.
- 4.2.6.75 Trunking is to be installed clear of the structure using purpose made bridges or hangers. Trunking is to be supported within 300 mm of each bend, tee or set.
- Where trunking passes through a floor or wall, the lid is to be cut 75 mm on each side to allow future lid removal.
- 4.2.6.76 **Cable Tray**
- 4.2.6.77 Cable tray is to be manufactured from sheet steel and comply with BS 1449: Part 1 hot-dip galvanised after manufacture to BS 729 (1971). Trays are to be perforated with flanges as undernoted:-

Duty	Width (mm)	Gauge (mm)	Flange Height (mm)	Return Flange Height (mm)
Light (non return flange)	≤ 225	1.0	12	n/a
	>225 ≤ 300	1.2	12	n/a
	> 300	1.5	12	n/a
Heavy (non return flange)	≤ 225	1.0	35	n/a
	>225 ≤ 600	1.2	35	n/a

	> 600	1.5	35	n/a
Medium (return flange)	≤ 225	1.0	25	5
	>225 ≤ 300	1.2	25	5
	> 300	1.5	25	5
Heavy (return flange)	≤ 225	1.0	50	18
	>225 ≤ 600	1.2	50	18
	> 600	1.5	50	18
Extra Heavy (return flange)	≤ 225	1.0	75	18
	>225 ≤ 600	1.2	75	18
	> 600	1.5	75	18

In general, the use of light duty tray is to be restricted to minor runs of communications wiring and fire alarm wiring.

4.2.6.78 Cable tray fittings shall, wherever possible, be standard components and made by the manufacturer of the straight tray.

4.2.6.79 Connections between pieces of cable tray shall be made in such a way that -

1. the internal dimensions of the tray shall be maintained across the connection;
2. the rigidity and load carrying ability of the tray shall be maintained across the connection;
3. fixing components shall be capable of removal and replacement with simple hand tools, and, if ferrous by nature, shall be suitably coated to prevent corrosion.

4.2.6.80 Clear space between the rear of any tray and the supporting structure is to be:-

<u>Width</u>	<u>Space</u>
≤ 100 mm	75 mm
> 100 mm	100 mm

4.2.6.81 Fixings shall be at regularly spaced intervals of not more than 1200 mm. and at 225 mm. from bends and intersections.

4.2.6.82 Fixing brackets shall be fabricated from galvanised steel bar. Cut ends shall be treated with zinc rich paint. Where cable trays are run below raised floors the brackets shall be extended in height to clear underfloor trunking and cables.

- 4.2.6.83 Mushroom-head steel roofing bolts and nuts shall be used for coupling sections together.
- 4.2.6.84 Cable tray shall be cut along a line of plain metal, i.e. not through the perforations. All cut ends of galvanised cable tray shall be prepared and treated with zinc rich paint.
- 4.2.6.85 Holes cut in tray for passage of cables shall be grommeted, bushed or lined.
- 4.2.6.86 Site fabrication of accessories shall be allowed only by the Engineer's consent.
- 4.2.6.87 Any welding shall be treated with zinc rich paint.
- 4.2.6.88 Traywork and supports must be capable of supporting without deflection in excess of 10 mm, the total weight of cables to be installed and allow for at least 20% additional future weight.
- 4.2.6.89 Traywork passing through fire barriers is to be fitted with a lid of inverted equal width tray for at least 250 mm either side of the barrier.
- 4.2.6.90 Earth continuity bonding of copper braid to BS 4109 with connecting lugs, of minimum c.s.a. 4 mm² are to be fitted across each joint tray sections and accessories, secured by M6 roofing bolt, nut and shake-proof washer. A main equipotential bonding connection is to be made to all trays in the main switchroom.

4.2.6.91 **Cable Ladder**

- 4.2.6.92 All cable ladder used in the works is to be of mild steel to BS 1449 hot-dip galvanised after manufacture to BS 729.

Ladder carrying capacity is to be maximised by locating rings off-centre to give greater depth. Rungs are to be of slotted channel to allow cleating/strapping of cable.

Ladder construction is to be:-

<u>Duty</u>	<u>Width</u> (mm)	<u>Gauge</u> (mm)	<u>Rung Centres</u> (mm)	<u>Flange Height</u> (mm)
Medium	As Specified	1.5	300	100
Heavy	As Specified	2.0	300	125
Extra Heavy	As Specified	2.0	300	150

- 4.2.6.93 All ladder accessories, bends, tee, etc. to be factory made by ladder manufacturer.

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- 4.2.6.94 Cable ladder must be capable of supporting, without significant or undue deflection, the weight of cables to be installed and allow for at least 20% additional future weight.
- 4.2.6.95 Earth continuity bonding of copper braid of minimum c.s.a. 6 mm² to BS 4109, with connecting lugs to be fitted across all ladder and accessory joints, secured by M6 roofing bolt, nut and shake-proof washer.
- 4.2.6.96 Where cables egress the ladder rack suitable drop-out plates are to be fitted.
- 4.2.6.97 Ladder rack is to be spaced off the supporting structure as specified for cable tray (2.6.80).
- 4.2.6.98 **Supports for Trunking, Tray, and Ladder Rack, etc.**
- 4.2.6.99 Channel brackets are to be used for support of individual or multiple runs of trunk, tray, ladder, etc. these being of the trapeze type, with screwed rod supporting single or multiple tier(s) of channel or, for heavier duties, constructed wholly from channel.
- 4.2.6.100 Channel material is to be to BS 6946 manufactured from mild steel to BS 1449, hot-dip galvanised after manufacture, to BS 729. Material thickness and channel dimensions to be appropriate to the total weight carried with overall allowance for future weight addition of 20%.
- 4.2.6.101 Supports are to be provided at the centres necessary, with regard to weight involved and bracket/suspension design used. This is to be decided by the electrical domestic sub-contractor to keep deflection less than 10 mm.
- 4.2.6.102 Such bracket/suspension assemblies are to be fixed to the structure using appropriate expansion type masonry plugs or bolts. For fixings to structural steelwork, the fixing detail requires to be agreed with the structural engineer and steelwork contractor.
- 4.2.6.103 The cost of brackets, suspensions, etc., is to be included in the per metre rates quoted for trunk, tray, cables, ladder, etc., in the Bill of Quantities or Schedule of Rates, as applicable.
- 4.2.6.104 Attention is specifically drawn to the requirements of sub-section 1.21.0 "Co-operation and integration with other Trades". The electrical domestic sub-contractor must ensure that the bracket design adopted, in each case, is fully co-ordinated with the space and support requirements of other Trades.
- 4.2.7.0 PVC Conduit and Trunking**
- 4.2.7.1 Conduits**
- 4.2.7.2 Conduits shall be approved heavy gauge high impact PVC complying with BS.4607, Type B, made in full conformity with and any subsequent modifications
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thereto, and of a size not less than 20 mm. Each length of conduit shall bear a stamp guaranteeing it to be to this Preamble.

4.2.7.3 Jointing may be carried out by screwed connector or waterproof adhesive.

4.2.7.4 PVC conduits should not be used in temperatures of less than -10 degrees C, or greater than 60 degrees C.

4.2.7.5 Expansion couplings shall be installed on straight runs more than 3.8 m. long using non-setting adhesive.

4.2.7.6 Flexible PVC conduit shall be black reinforced type with compression type adapters.

4.2.7.7 **Conduit Fittings**

4.2.7.8 All conduit fittings and accessories shall be manufactured in conformity with BS. 4607, Type B, where applicable.

4.2.7.9 Solid or inspection elbows, bends or tees shall not be used. Circular conduit boxes shall be provided at all junctions but no boxes should be installed in floors in inaccessible positions.

4.2.7.10 Terminations of accessory boxes shall be by threaded coupling and male bush.

4.2.7.11 Stopping plugs shall be fitted in all spare ways in junction boxes. Plugs shall be screwed type.

4.2.7.12 **Fixing of Conduits**

4.2.7.13 Concealed conduit shall be fixed by means of PVC conduit clips not more than one metre apart. Conduits fixed on the surface of walls or ceilings shall be fixed by spacer bar saddles, fixed not more than 0.6 metres apart and secured by means of 38 mm. enamelled countersunk screws.

4.2.7.14 In damp situations exposed to the atmosphere saddles shall have nylon retaining screws and galvanised fixing screws.

4.2.7.15 Conduit shall not be fixed to suspended ceilings. In all cases where there are suspended ceilings, conduit and trunking shall be fixed to the structural ceilings.

4.2.7.16 Conduit shall be fixed 250 mm. on both sides of all boxes and the box shall itself be fixed.

4.2.7.17 Rawlplugs shall be used for fixings to brickwork, self-tapping screws for fixing to aluminium sections, rawlnuts, rawl anchors, spring toggles, gravity toggles, or rawl-bolts shall be used for fixing to other materials, as directed by the Engineer.

4.2.7.18 All conduits and fittings shall be erected and dried out to the satisfaction of the Engineer by drawing through a cloth swab.

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- 4.2.7.19 All conduit runs shall be lined up using string lines for horizontal runs and plumb-bob for vertical runs, diagonal runs will not be permitted.
- 4.2.7.20 Conduits shall be arranged in a neat and orderly manner to the satisfaction of the Engineer. Conduits shall follow the contours of the various buttresses, beams and other projections closely but shall be kept clear of steam, hot water or gas pipes.
- 4.2.7.21 Where considered necessary conduits may be run on MS supports manufactured from 40 mm x 6 mm flat bar fixed by means of rawlbolts to ceilings and walls. The bars shall be shaped to suit the conditions and the electrical domestic sub-contractor shall be considered to have included such bars in his rate.
- 4.2.7.22 **Circular Conduit Boxes**
- 4.2.7.23 Small standard circular PVC conduit boxes conforming to BS.4607 with PVC lids and brass fixing screws shall be provided and fixed at all junctions. Where twin fluorescent luminaires are suspended from conduit boxes, two external lug fixings all be provided at each box. Heat resistant boxes shall be used for direct suspension of luminaires.
- 4.2.7.24 All boxes at accessories or lighting points shall have earthing terminal.
- 4.2.7.25 The minimum number of junction boxes shall be used, but the maximum length of run between the boxes shall not exceed nine metres with bends or twelve metres without bends.
- 4.2.7.26 **Bending of PVC Conduit**
- 4.2.7.27 PVC conduit up to 25 mm diameter shall have cold bends made using the correct size of bending spring or bending machine. Sizes greater than 25 mm shall have hot bends made using rubber cores or as directed by the manufacturer.
- 4.2.7.28 No distortion of the conduit shall be permitted and such malformed bends shall be deemed unacceptable.
- 4.2.7.29 **PVC Trunking**
- 4.2.7.30 PVC cable trunking shall be heavy gauge PVC with clip on lid and only the accessories supplied by the trunking manufacturers shall be used. Each individual group of cables forming a circuit within the trunking shall be separately bound together at 500 mm. intervals for the full length of the run. In vertical runs of trunking suitable racks for the support of cables shall be inserted every two metres.
- 4.2.7.31 Trunking shall be levelled using a spirit level.
- 4.2.7.32 Couplings for trunking shall be internal plain type.
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- 4.2.7.33 Where cable trunking passes through fire division walls, suitable fire barriers shall be provided.
- 4.2.7.34 PVC cable trunking used for direct suspension of fluorescent luminaires shall have heat resistant boxes between trunking and luminaire.
- 4.2.7.35 PVC skirting trunking shall be heavy gauge with clip-on lid. Fixings shall be at 450 mm. centres using rawlplugs and brass round head screws. Where PVC twin and earth cables leave trunking to supply flush outlets, the trunking shall be slotted before fixing to surfaces. The manufacturer's guidance shall be sought to ascertain correct installation methods. No claim for re-doing abortive work will be accepted if any trunking is installed contrary to the manufacturer's instructions or advice. Trunking lid shall not be installed until all power wiring and telephone, etc. wiring is completed. The lid shall be installed only after the Engineer's authority has been given in writing.
- 4.2.7.36 Allowance shall be made in the measured items for trunking lid for the erection of lid in short lengths and for returning labour and materials to erect lid as directed and not necessarily to completion in any one floor or area.
- 4.2.7.37 **Erection of Trunking**
- 4.2.7.38 Cable trunking shall be securely fixed at suitable intervals to avoid any visible sag or twisting of the trunking. Fixings to walls, etc., shall be by approved rawlplug and brass screw fixing. Fixing to steelwork shall be by proprietary spring steel clips or other approved method. Trunking shall be suspended where required using manufacturer's suspension brackets.
- 4.2.7.39 When conduit connections are made to the trunking female adapters with male screwed PVC bush shall be used.
- 4.2.7.40 **Earthing**
- 4.2.7.41 A continuous green and yellow earth wire shall be run to each outlet box, accessory, lighting or switch point and connected to the earthing terminal.
- 4.2.8.0 LSF and PVC Cables and Flexible Cords**
- 4.2.8.1 **General**
- 4.2.8.2 All cables and flexible cords shall be manufactured by a reputable British Manufacturer in accordance with BS 6007, for rubber cables and BS.6004, for PVCI. and LSF cables, unless otherwise specified elsewhere in this Specification.
- 4.2.8.3 Every coil of cable or flexible cord shall bear the Maker's label firmly attached, containing the following information: Name of Maker, Description of Cable, Classification, Length, Size, and Grade.
- 4.2.8.4 No coil of cable or flexible cord manufactured more than one year prior to delivery on the site shall be used in the installation.
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4.2.8.5 **Identification of Cables**

4.2.8.6 Every core of cable shall be identifiable at its termination and throughout its length.

4.2.8.7 Cables shall be identified by colour and/or lettering/numbering in accordance with BS 7671 : 2001, Table 51.

4.2.8.8 Where existing installations are being altered resulting in a mixture of new and old cables, each cable core shall be identified separately in accordance with BS 7671 Appendix 7.

4.2.8.9 All switchgear having mixed cabling must be labelled with warning notices to indicate the interface in a clear unambiguous manner.

4.2.8.10 **Joints**

4.2.8.11 The wiring shall be carried out in the looping-in principle. All joints shall be made at main switches, distribution boards, ceiling boxes, switch boxes, socket outlet boxes and fixed apparatus only. No joints shall be made in joint boxes unless the special permission of the Engineer is first obtained.

4.2.8.12 **Installing Cables in Conduit and Trunking**

4.2.8.13 Before cables are installed, cable trunking covers shall be removed and the interior of the trunking cleaned out, inspected, sharp edges smoothed down and protective coatings made good. Conduits shall be swabbed through. Cabling shall commence only with the written permission of the Engineer.

4.2.8.14 Cables shall not be drawn into conduit more than once. This precludes the re-use of cables withdrawn from conduit for any reason.

4.2.8.15 Cables installed in trunking shall be grouped into circuits, each group being bound at 1200 mm. intervals with Spiroband tape bands. Phase colour identification bands shall be provided at 1200 mm. intervals.

4.2.8.16 300 mm. of cable shall be left at each terminal outlet and 600 mm. at equipment and control gear.

4.2.8.17 **Conductor Size**

4.2.8.18 Unless otherwise scheduled the minimum size of conductor shall be 1.5 sq. mm. Wiring shall be identified at each end and at all access points or at frequent intervals along the route of the circuit, by letter and figure markings corresponding with the distribution board, phase and circuit fuse from which it is fed.

4.2.8.19 **Flexible Cords**

4.2.8.20 Flexible cords shall be circular type with the live neutral and where necessary, the earth conductor enclosed in a common sheath. Unless otherwise scheduled the

minimum size of conductor shall be 24/0.20 mm. Voltage grade is to be 300/300V.

4.2.8.21 Colour identification of cores for flexible cables and cords shall be in accordance with BS 7671, Table 51B.

4.2.8.22 Flexible cords shall comply with BS.6500. Cords for use in ambient temperatures up to 60 degrees C. shall be rubber insulated and sheathed or PVC insulated and sheathed. Cords for temperatures up to 85 degrees C. shall be butyl rubber insulated with H.O.F.R. or heat resisting PVC sheath. Cords for temperatures up to 150 degrees C. shall be silicone rubber insulated with textile braiding. Cords for temperatures up to 180 degrees C. shall be varnished glass fibre insulated and braided.

4.2.8.23 **Installation of Flexible Cords**

4.2.8.24 Suitable bushes and means of cord anchorage shall be provided at all terminations. Sleeves of approved design shall be fitted to the ends of braided cables.

4.2.8.25 Terminations shall incorporate an approved type of anti-spread device. Flexible cords on exposed surfaces are to be neatly clipped to follow the surface and be of the minimum length to achieve this.

4.2.8.26 **Earth**

4.2.8.27 Earth terminals shall be fitted to all conduit boxes in accordance with BS 7671 IEE Wiring Regulations. The cover fixing screws or the box fixing screws shall not be used as earth terminals.

4.2.8.28 **Conductor Identification**

4.2.8.29 At distribution boards and other equipment where live CPC and/or neutral conductors are present, all cable conductors shall be fitted with circular interlocking ferrules identifying the associated phase and neutral circuit number. Neutral conductors shall have the letter "N" added, e.g. L1-12N for a red phase single phase neutral and be identified, e.g. L123-4N for a three phase neutral.

4.2.8.30 **LSF Cables**

4.2.8.31 Where LSF cables are specified these shall have a cross linked halogen free insulation. The cable dimensions shall conform to the requirements of BS.6004.

4.2.8.32 As LSF insulation is less robust than PVC, care should be taken when drawing cables into conduit.

4.2.9.0 **Not Used**

4.2.10.0 **Luminaires and Lamps**

4.2.10.1 **Luminaires**

4.2.10.2 Components used in the construction of luminaires and the luminaires themselves shall conform to the following British Standards.

BS 2782 Methods of testing plastics

BS 2818 Ballasts for the operation of tubular fluorescent lamps on AC 50 Hz. and 60 Hz. supplies

BS 4533 Electric luminaires (lighting fittings)

BS 4800 Paint colours for building purposes

BS 5225 Photometric measurement

Luminaires for high frequency applications are to comply with IEC Em 6589 with regard to leakage currents and electromagnetic induction criteria.

4.2.10.3 The electrical domestic sub-contractor shall allow for providing and fixing to all ceiling points the luminaires specified by type letter in the Schedule and Drawings.

4.2.10.4 Ceiling luminaires shall be fixed direct on to the ceiling boxes or trunking, other than where plug-in ceiling roses are specified.

4.2.10.5 Where ceiling mounted luminaires occur with surface conduit work an approved type of mounting block shall be provided and fixed.

4.2.10.6 Where recessed luminaires occur, the boxes shall be securely fixed at the appropriate height above the finished ceiling level as detailed in the manufacturer's catalogue.

4.2.10.7 Recessed or semi-recessed luminaires shall be wired by means of flexible cord, and 2 amp 3 pin plug and socket ceiling rose fixed to a box mounted in the ceiling space.

4.2.10.8 In the case of pendant type luminaires and unventilated ceiling luminaires the fixed wiring cables shall terminate in the ceiling box and the wiring shall be carried to the lampholder in single or multicore heat resisting flexible cable, 300/300 volt grade of the same size as the fixed wiring cables. They shall be of silicone rubber insulated and glass fibre braided.

4.2.10.9 The connection between the fixed wiring cables and the braided cables shall be made using 15A porcelain connectors taped insulating tape.

4.2.10.10 All ceiling mounted fluorescent luminaires shall be fixed to two outlet boxes linked by conduit and arranged at the fixing centres to suit the fitting length unless otherwise stated. The luminaire shall be securely fixed against the ceiling to prevent the amplification of control gear noise. Where luminaire cut outs are small

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- than a complete ceiling tile, a plywood backboard is to be fitted behind the tile with hole cut to accept the luminaire.
- 4.2.10.11 All ball and socket joints shall be bridged by means of a flexible lead and securely earthed.
- 4.2.10.12 The internal wiring of luminaires and connections thereto, shall where necessary, be of a suitable heat resisting type. Where wiring passes through any metal part of fittings the entry hole or slot shall be adequately bushed.
- 4.2.10.13 Prismatic diffusers are to be of acrylic material. Polystyrene must not be used.
- 4.2.10.14 **Suspended Ceilings**
- 4.2.10.15 Luminaires shall not be fixed to suspended ceilings. Independent threaded steel rod or conduit drops shall be provided and fixed to the structure. Where the ceiling is not readily demountable for access, the conduit system shall be used and it shall be possible to wire circuits after the ceiling is erected.
- 4.2.10.16 **Flexible Pendants**
- 4.2.10.17 In all positions where luminaires are not specified, flexible pendants, consisting of Bakelite break rings, ceiling roses, flexible cords and lamp holders specified below shall be provided and fixed.
- 4.2.10.18 All ceiling roses shall be of porcelain or plastic in accordance with BS 67 or BS 5733 and shall be fixed by means of RH brass screws.
- 4.2.10.19 Flexible cords shall be silicone rubber insulated, twin, circular, class 300/300 volt grade, capable of operating at 150 degrees C.
- 4.2.10.20 Lampholders shall be in accordance with BS 5042 and be of white plastic for BC lamps, with suitable cord grip.
- 4.2.10.21 Lampholders for all ordinary drop pendants shall be fixed at a height of 2700 mm. or as detailed on site.
- 4.2.10.22 **Lamps**
- 4.2.10.23 Tungsten lamps of approved British Manufacture shall be supplied in accordance with BS.161. Lamps shall have caps to suit the specified luminaire in each case.
- 4.2.10.24 Mains frequency fluorescent lamps shall be supplied in accordance with BS.1853 and shall be of approved manufacture. The lamps shall be T8, 26 mm. diameter colour temperature 3500K unless otherwise stated.
- Where called for, lamps are to be suitable for operation with high frequency luminaires and comply with IEC 81.
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Miniature fluorescent lamps as produced by various manufacturers are to be provided to suit the specified luminaires as detailed in the Schedule of Luminaires. These lamps are to operate at 50 Hz or at high frequency, as called for.

4.2.10.25 High pressure mercury lamps shall be in accordance with BS.3677 and IEC 188.

4.2.10.26 Low pressure sodium discharge lamps shall be in accordance with BS.3737 and IEC 192. High pressure sodium discharge lamps are to be in accordance with IEC 662.

4.2.10.27 The lamps shall be suitable for the luminaires specified and for the starting gear provided.

4.2.10.28 All lamps shall be suitable for the voltage and wattage shown on the schedules and plan.

4.2.10.29 **Lamp Control Gear**

4.2.10.30 Ballast for tubular fluorescent lamps shall be to BS.2818 (high frequency electronic type unless otherwise stated) and for Mercury and Sodium lamps to BS EN 60922 and BS EN 60923.

Electromagnetic regulation is to comply with BS 800.

4.2.10.31 Capacitors for discharge lamps shall be to BS.4017.

4.2.11.0 Accessories

4.2.11.1 **Lighting Switches**

4.2.11.2 Switches are to be slow make-and-break (for a.c.), suitable for the control of fluorescent lighting or other reactive loads, and silent in operation. The minimum rating of switches shall be 15 amperes 240 volt A.C. They shall comply with BS.3676.

4.2.11.3 Unless otherwise specified, switches shall be single pole, breaking the phase conductor only and the Sub-Contractor shall ensure that, in every case, the switch is so connected. They shall be rocker operated grid switch type complete with adjustable grid suspension.

4.2.11.4 Where two or more switches are located together they shall be ganged under a common plate. If two or more phases are brought together in one switch box, phase barriers shall be fitted, and insulating shield engraved "DANGER 415 VOLTS" shall be fitted between the switches and the cover plate. The shield shall be fixed by at least two screws.

4.2.11.5 A flush mounting switch unit shall be mounted in an outlet box with a cover plate of approved finish. The plate shall overlap the metal box by at least 5 mm. and shall be fixed with suitable non-ferrous screws.

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- 4.2.11.6 A surface mounting switch unit shall be mounted in an outlet box and have a neatly fitting cover plate fixed to the box with suitable non-ferrous screws.
- 4.2.11.7 Where flush mounting switches are specified for surface installation the appropriate box shall be provided so that the cover plate fits neatly.
- 4.2.11.8 A metalclad surface weatherproof switch unit shall be totally enclosed in a galvanised weatherproof cast iron box. Where specified, such switches are to be of polycarbonate construction.
- 4.2.11.9 Outlet boxes for switches shall be pressed steel for flush and surface mounting and where specified, cast iron or polycarbonate for surface mounting, as supplied by the manufacturer of the switches.
- 4.2.11.10 Grids shall be provided with an earth terminal which shall be connected to the earth terminal of the outlet box by means of a 1.0 sq. mm green single core PVC insulated cable. Where there are metal plate switches, the plates shall be provided with an earth terminal and this shall be connected to the earth terminal of the boxes described above.
- 4.2.11.11 **13 Amp 3 Pin Switch Sockets**
- 4.2.11.12 Sockets shall comply with BS.1363 and shall be supplied with boxes complying with BS.4662. The boxes shall be pressed steel or cast iron for flush or surface mounting. The boxes of all socket outlets shall have an earth terminal which shall be connected to the earth terminal of the socket with 1.5 sq. mm PVC sheathed (Green/Yellow) conductor. Deep steel boxes shall be used for flush installations.
- 4.2.11.13 **13 Amp 3 Pin Plug Tops**
- 4.2.11.14 The plug tops shall be 13 amp rating with semi-sleeved rectangular pins and shall be unbreakable moulded type. They shall be manufactured to BS 1363 and the latest supplement thereto and be fitted with cartridge fuses to BS 1362 rated at 2, 5 10 or 13 amps, the rating being decided by the item of equipment to which the plug top is connected. The plug tops shall be finished white and for every switch socket and socket installed, one plug top shall be provided.
- 4.2.11.15 Fuses of rating 2, 5, 10 and 13 amps shall be supplied in the quantities Billed and handed to the Clerk of Works at the end of the Contract. Plugs fitted to apparatus shall have the appropriate size of fuse to suit the cord on the appliance.
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|-----------------------|-------------|
| 0.5 sq. mm conductor | 3 amp fuse |
| 0.75 sq. mm conductor | 5 amp fuse |
| 1.5 sq. mm conductor | 13 amp fuse |
- 4.2.11.16 **13 Amp Fused Spur Units**
- 4.2.11.17 13 amp fused spur units shall each consist of a sheet steel box with single pole fuse unit. The fuse unit shall be suitable for accommodating fuses to BS 1362 in
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a retractable fuse carrier. The overlapping cover plate shall have corners and edges neatly rounded and bevelled complete with a fuse carrier finished white.

4.2.11.18 Where called for, these units shall incorporate a suitably bushed hole in the cover plate for a flex outlet, complete with internal cord grip.

4.2.11.19 Where the above units are required with indicator lights, the indicator shall be of the neon type - coloured RED.

4.2.11.20 **Control Switches**

4.2.11.21 Control switches for local isolation purposes shall be 20, 30 or 60 amp rating, double pole, one way flush mounting pattern with pilot lamp. All switches shall be complete with earthing facilities.

4.2.11.22 The switches shall be fitted with special steel boxes supplied by the manufacturer and the front plates shall be moulded insulated pattern, or as specified.

4.2.11.23 **Telephone Outlets**

4.2.11.24 Where telephone outlets terminate on walls, etc., they shall consist of telephone cord, LJU outlet plates, with shuttered jack connector, together with cable tie mounted on standard steel boxes. The outlet shall be BT approved.

4.2.11.25 **Water Heaters**

4.2.11.26 Final connections to water heaters shall be from a switched spur unit using three core heat resistant flexible cord, rated in accordance with the heater.

4.2.11.27 **5 Amp Sockets**

4.2.11.28 Sockets shall comply with BS 1363 and shall be supplied with boxes complying with BS.4662.

4.2.11.29 **5 Amp Plug Tops**

4.2.11.30 The plug tops shall be 5 amp rating round pin, unfused, and shall be unbreakable type.

4.2.11.31 The plug tops shall be finished black and for every socket installed a 5 amp plug shall be provided.

4.2.11.32 **Engraving**

4.2.11.33 Engraving of all switches, etc., shall be neat and symmetrical with standard spacing between letters. All marking shall be engraved in full, no abbreviations will be allowed. All infilling shall be in red except where stated otherwise. The electrical domestic sub-contractor shall include the cost of engraving in the price entered for the switch, etc.

4.3.0 Not Used

4.4.0 General Specification - Particular Systems

- 4.4.1 Fire Alarm Installation - Addressable Systems
- 4.4.2 Emergency Lighting - Self-Contained
- 4.4.3 Mechanical Services Electrical Installation
- 4.4.4 CCTV
- 4.4.5 Lightning Protection Installation
- 4.4.6 Intruder Alarm Systems
- 4.4.7 Structured Cabling Installation

4.4.1.0 Fire Alarm Installation - Addressable System

4.4.1.1 Standards

4.4.1.2 In general the fire alarm installation shall comply with BS.5839, Part I. Equipment shall comply with BS EN 54 and BS.5839. All amendments to the above standards shall be deemed to be included within the prices submitted by the electrical domestic sub-contractor.

4.4.1.3 General

4.4.1.4 The fire alarm system shall be a micro-processor based analogue addressable detection system with each activation point being uniquely identifiable at the system console and at the remote repeater panel. The fire decision process shall take place within the control panel on the basis of the information received from the remote detectors. The system shall incorporate facilities for the shut down of mechanical services plant and lifts. All devices shall be labelled with address. The electrical domestic sub-contractor shall provide a complete and working system including any extra items required (e.g. power supplies, outstations, I/O units etc..)

4.4.1.5 Control Panel

4.4.1.6 The control panel for the system shall be micro-processor based monitoring all detectors on the system using multiplexing techniques. The panel shall incorporate the following facilities:

- (a) 1 No. loop detection circuit addressing up to a maximum of 120 points. The panel shall incorporate a ring (loop) controller for each circuit which shall under normal conditions monitor the loop from one end only. In the event of a short circuit on the loop remote short circuit isolators (described elsewhere in this section) shall isolate the damaged section and the loop controller shall then address the remainder of the loop from both ends. Under this condition the panel shall indicate a "fault" condition identifying the detectors affected.
- (b) 2 No. common sounder outputs each delivering a maximum of 1 amp at 30 volt D.C.
- (c) Software defined zoning with the facility to isolate/test individual detector units or complete zones as required.
- (d) Internal memory logging up to a minimum of 500 events including alarm activation, system test, etc., the memory shall store details of time of the "event", location of the detector operated and indication of alarm or fault as appropriate.
- (e) Integral back lit alphanumeric LCD display having space for not less than 80 characters description of "events", 20 characters being available for user defined.

- (f) Integral 24 hour clock.
- (g) Key pad control unit for operation of the system including testing and isolating of detectors/zones and over-riding of pre-programmed outputs. Access to the system shall be by means of an integral key switch unit only.
- (h) LED indication of line fault, alarm, system fault, battery/ charge failure and mains supply failure. The panel shall incorporate facilities for testing all LED's simultaneously.
- (i) Push-button switches for silence alarms, evacuate, reset system, accept event and recall event.
- (j) Volt-free changeover contacts rated 1 amp at 30 volt D.C. (plant shutdown facilities) as required.
- (k) Additional sets of terminals providing a continuous output of 24 volt D.C. in both normal and alarm conditions.
- (l) Full line monitoring facilities for all detectors and sounder circuits.
- (m) The panel shall incorporate the facility for delaying the "alarm" signal, in event of any automatic detector operating, for an adjustable period of up to four minutes.
- (n) The panel shall monitor the condition of the remote detectors and automatically adjust the fire decision process to take account of changes in the detector condition. The panel shall provide a fault alarm when any detector condition is outwith the tolerance specified by the manufacturer and this should be logged as an event.

4.4.1.7 The control panel and the repeat panel shall be located as shown on the contract drawings.

4.4.1.8 Battery and Charger Unit

4.4.1.9 The battery/charger unit shall be mounted in a separate wall mounted, ventilated steel enclosure. Batteries shall be sealed lead acid type connected to provide 24 volt D.C. nominal.

5.4.1.10 The unit shall have a full fault monitored battery charger unit either integral to the control panel or in an external ventilated sheet steel cubicle, as appropriate.

4.4.1.11 The battery charger shall be rated to carry the full fire alarm load with the battery on float in accordance with BS.5839.

4.4.1.12 The standby battery should have sufficient capacity to maintain the system under normal operation for a period of not less than 72 hours, after which

sufficient capacity should remain to operate the alarm (including ancillary devices) for not less than 30 minutes.

4.4.1.13 Automatic Detectors

4.4.1.14 Automatic detectors shall be uniquely addressable and of the plug-in type either smoke operated (optical) or heat detector (rate of rise or fixed temperature) as indicated on the layout plans. Each detector shall incorporate an integral LED indication lamp which shall illuminate on operation of the detector.

4.4.1.15 Manual Call Points

4.4.1.16 Call points shall be uniquely addressable and shall be of the breakglass type, coloured red, with replaceable glass cover with weak area to allow breaking without a striker. They shall be flush mounted in all areas except plant rooms and basement and sub-basement car parking areas.

4.4.1.17 Call points shall incorporate a test facility. The call point shall incorporate a unique "address" unit as described above.

4.4.1.18 Short Circuit Isolators

4.4.1.19 Short circuit isolator units shall be connected into each detector loop and positioned to divide the loop into a minimum of four sections not more than 20 detectors in each. In the event of a short circuit on any section, that section shall be isolated, signalling a "fault" condition at the control panel.

4.4.1.20 Short circuit isolators shall be mounted within the ceiling void at an accessible location and shall be complete with address unit in order that the location of the fault may be quickly identified. The isolator unit shall be included in the total number of address locations on each loop.

4.4.1.21 Repeater Panel

4.4.1.22 The panel shall have the following facilities:

- (a) 40 character alphanumeric display as per main control panel.
- (b) 20 character printer as per main control panel.
- (c) Key pad controls to allow the following functions:
 - (i) Silence Alarms
 - (ii) Excavate Alarms
 - (iii) Accept event and recall event

4.4.1.23 Access to key pad controls shall be possible only by means of an integral key switch unit.

4.4.1.24 The panel shall be suitable for flush mounting.

4.4.1.25 Auto Dialler

4.4.1.26 A B.T. approved auto communicator shall be provided and fixed adjacent to the main control panel. In the event of an alarm the unit shall automatically signal via BT RedCARE line to a 24 hour manned central station approved by the Local Fire and Police Authorities and relay the alarm message.

4.4.1.27 The communicator shall also be used to relay intruder alarm signals to the central station via the same telephone link. In the event of simultaneous alarms on both systems the "fire alarm" signal shall take priority.

4.4.1.28 The unit shall automatically re-dial if no acknowledgement is received from the central station.

4.4.1.29 Wiring

4.4.1.30 All wiring associated with the fire alarm system shall, unless indicated otherwise, be carried out by means of FP200 cables or equivalent as described elsewhere. The cable sheath shall be coloured red.

4.4.1.31 The detector circuits shall be wired in ring circuits as indicated on the schematic wiring diagram. The zoning indicated on the layout drawings is designed to facilitate the programming of the system and to simplify testing and maintenance. The detector circuits need not necessarily loop into all detectors on a zone in sequence, it being permissible to loop from one "zone" to another to follow the most economical route for cabling.

4.4.1.32 Sounder circuits and relay units as detailed elsewhere shall however be wired in a conventional radial circuit with no tees or spurs being permitted.

4.4.1.33 Testing and Commissioning

4.4.1.34 The system wiring shall be fully tested in conjunction with and to the satisfaction of the Fire Alarm installer's any field devices are connected or any addressing takes place and before final connections are made to the control panel.

4.4.1.35 The electrical domestic sub-contractor shall be responsible for liaison between the Consulting Engineer and the Fire Alarm installers to define the address descriptions, and output programming requirements prior to installation of the main control panel. electrical domestic sub-contractor to schedule address descriptions from Architects drawings and submit for comment 2 weeks before commissioning.

4.4.1.36 The final commissioning shall be carried out by the Fire Alarm installers commissioning Engineer.

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- 4.4.1.37 The electrical domestic sub-contractor shall allow for four maintenance and service visits for twelve months in accordance with BS.5839, Part 1.
- 4.4.1.38 The electrical domestic sub-contractor shall allow for all necessary attendance on the equipment manufacturer's Engineer during testing and commissioning.
- 4.4.1.39 The electrical domestic sub-contractor shall make arrangements with British Telecom and pay all charges in connection with the cable link between the digital communicator and the remote manned centre. The BT RedCARE telephone line shall be of blocked incoming call type.
- 4.4.1.40 The electrical domestic sub-contractor shall make arrangements with the Central Station and shall pay all connection charges and rental of the facility for a twelve month period.
- 4.4.2.0 Emergency Lighting - Self-Contained**
- 4.4.2.1 General**
- 4.4.2.2 The emergency lighting installation shall comply with BS 5266-1:1999 and BS EN 1838:1999.
- 4.4.2.3 System**
- 4.4.2.4 The system shall comprise fluorescent self-contained luminaires, plus mains fittings especially adapted with battery inverter packs.
- 4.4.2.5 The supplies to the luminaires both switched and unswitched, shall be taken from local lighting circuits.
- 4.4.2.6 Circuit Wiring**
- 4.4.2.7 The system shall be wired using the same wiring system as used for the associated general lighting circuit (unless otherwise specified). The cables shall be terminated at the luminaire position and connected to the terminals within the luminaire via BESA circular conduit boxes.
- 4.4.2.8 Luminaires**
- 4.4.2.9 The emergency luminaires shall be as listed on the lighting schedule and complete with lampholder and suitable lamps.
- 4.4.2.10 The luminaire shall conform to BS EN 60598-2-22:1999. The design of luminaire shall have been tested and approved in accordance with the ICEL Scheme.
- 4.4.2.11 The luminaire shall provide a minimum output of 180 lumens over a discharge period of three hours.
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4.4.2.12 Where the luminaire is provided with wiring tails, these shall be terminated by means of porcelain connectors within standard BESA circular conduit boxes mounted adjacent to the luminaire.

4.4.2.13 Testing and Commissioning

4.4.2.14 The installation shall be tested and commissioned in accordance with the requirements of BS. 5266-1:1999.

4.4.3.0 Mechanical Services Electrical Installation

4.4.3.1 Control Panels

4.4.3.2 All control panels shall be supplied and erected by the Mechanical Services Contractor. The electrical domestic sub-contractor shall provide power supplies to each control panel and equipment as shown on the drawings. All field wiring to all items of control equipment shall also be carried out by the electrical domestic sub-contractor. All other works associated with the mechanical services shall be carried out by the Mechanical Services domestic sub-contractor.

4.4.3.3 Liaison

4.4.3.4 The electrical domestic sub-contractor shall include for liaison with the Mechanical Services domestic sub-contractor when carrying out testing, commissioning and setting to work of the Mechanical Services Installation.

4.4.3.5 Wiring and Containment

4.4.3.6 All outgoing power and control wiring from the Mechanical Control Panel shall be carried out by the Electrical Services domestic sub-contractor, in dedicated containment supplied and installed by the Electrical Services domestic sub-contractor, unless otherwise indicated.

4.4.3.7 Energising The Supply

The electrical domestic sub-contractor shall not energise the electrical supply to any Mechanical Services Control Panel until all testing has been carried out, all results produced and all control functions, timeclocks etc. have been adjusted or set.

4.4.4.0 Closed Circuit Television

4.4.4.1 General

4.4.4.2 The premises will be protected by the closed circuit television system comprising fixed and moving cameras as indicated on the layout drawings and described in this specification. The system shall be supplied and installed by a NACOSS approved company, and confirm to NACOSS code of practice for CCTV ref. NACP20.

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- 4.4.4.3 The system shall comprise a number of high resolution colour cameras mounted on or within rotational domes, external housings and internal brackets. Where required cameras shall be controlled by means of telemetry control which shall be transmitted via co-axial cables.
- 4.4.4.4 The cameras shall be controlled and monitored via a matrix controller which shall co-ordinate the various video inputs through multiplexers and recoding equipment and on to monitors.
- 4.4.4.5 The telemetry control keypad shall be located on the control desk along with the monitors and playback / recording equipment. The playback / recording equipment shall be located remote from the control desk in the equipment room.
- 4.4.4.6 A clear sharp and stable image with a minimum resolution of 750 TV lines on each of the monitors. Each camera will be given a personal address, the address being displayed on the bottom left hand corner of the applicable monitor when viewed.
- 4.4.4.7 The equipment shall be registered under the requirement of the Data Protection Act with appropriate signage displayed and CCTV log book provided.
- 4.4.4.8 Control and Monitoring**
- One (1 No.) Digital recorders shall be provided within the For digital multiplexing and recording. The units shall be sized as detailed below to monitor and record all new cameras. The unit is expandable up to sixteen cameras. Digital recorder 16 way 320 GB Unit.
- 4.4.4.9 Digital Recorder 16way 320 GB Unit**
- The control and monitoring equipment will be located as detailed above and shall have the facility for Remote Monitoring. This shall allow the client to view all new cameras via the free issue remote Network viewing software.
- 4.4.4.10 The unit will have in built CD Writer.
- 4.4.4.11 Digital Recording System**
- 4.4.4.12 The digital video management system design shall be a microprocessor-based video processor, multiplexer, and recorder running on the Windows 2000 operating system.
- 4.4.4.13 The device shall be available in a rack mount chassis version and a desktop chassis version, in the characteristic black colour. The rack-mount chassis version shall be installed out of the box into a standard 19-inch rack with no additional hardware needs. This chassis shall be equipped with sliding rack rails for quick and easy installation and servicing. Rack-mounting and desktop versions shall provide the same features and functions. The rack-mount chassis shall protect the front accessible items, such as the CDRW drive, floppy
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drive, power switch, fan and LEDs, behind a locking front panel. An additional fan is included on the front of the system to improve the reliability of less ventilated applications. A thumb tab accessible from the front locking panel allows for this fan to be easily serviced. LEDs show through the front locking panel for easy determination if power is on, if the unit is recording, if a drive is being accessed or if alarms have occurred.

- 4.4.4.14 Designed to operate with black-and-white and colour composite video signals, the device shall compress and multiplex video images from up to 16 cameras and store them in the unit's image database. It shall provide a variety of multiple-and single camera display and playback options, and several alarm/event-triggered response options. The system shall also provide operator-selectable camera recording rates, optional image enhancement tools, and optional operator-selected activity target settings for motion alarm filtering and/or perimeter alarms.
- 4.4.4.15 The unit shall provide operator-definable live filters to record and trigger alarm events when the light level changes, motion is detected, a perimeter is crossed, or an object of a specific size and speed moving in a specified direction is detected. The unit shall provide operator-definable filters to search the image database for light changes, motion and perimeter violations, objects of a specific size and speed moving in a specified direction, as well as camera, date/time and filter settings then display a list of matching video segments.
- 4.4.4.16 The unit shall provide for simultaneous recoding, playback, transmitting, database searching and archiving. One channel of audio and up to eight text inputs shall be supported with required hardware properly installed and set up according to manufacturer's instructions. Live audio shall be available for listening while viewing live video. Cameras shall be configurable as visible or covert by the authorized user.
- 4.4.4.17 The unit shall be capable of displaying up to 16 cameras during playback mode with or without text. Recorded audio shall be available for listening while viewing recorded video from any camera recoded during the same time frame. Text shall be available during playback without obstruction of the video image.
- 4.4.4.18 All display features shall be available from an on-screen interface. Some features shall also be available from an optional manufacturer-specific camera control device. All programming features shall be available from an on-screen programming interface. All user activity on a unit shall be capable of being logged for specified time periods.
- 4.4.4.19 Monitoring Equipment**
- 4.4.4.20 Monitoring shall be by means of colour monitors of diagonal size 17 inches for multi screen and spot viewing.
- i) TFT Flat Screen (17")**

TFT flat panel monitors providing high-resolution display of analogue computer signals. Monitors to provide bright, active matrix displays offering up to 1280 x 1024 resolution. Each monitors will provide high quality viewing that automatically adapts to the appropriate input resolution.

Each monitor shall be have desktop stands that are easily adaptable to be wall or pole mounted.

Monitor to Incorporate:

VGA (D-sub) connector
Detachable desk base stand included
Supports up to 1280 x 1024 (SXGA) resolution
Up to 700:1 Contrast ratio
Brightness: 250cd/m2
Response time 25 ms
Low power consumption (45 watts)

ii) Standard Monitors (17")

Each monitor shall be have desktop stands that are easily adaptable to be wall or pole mounted.

Monitor to Incorporate:

Metal Enclosure
17" diagonal screen
750 tvl resolution
Vertical/Horizontal control
Brightness/Contrast control

4.4.4.21 Cameras/Lens/Housing Equipment

i) External Functional Dome Cameras

External Dome Cameras shall be External Weatherproof high resolution colour/mono fully functional dome camera as detailed on drawings.

Camera to Incorporate:

Vandal Resistant IP66 weatherproof housing
Pendant/Surface Mount/In ceiling mounted options
4.9" Acrylic smoked bubble
Black or
23 x optical zoom lens
470 TVL resolution
EXView HAD CCD
360 degrees/sec pan preset speed
200 degrees/sec tilt speed
80 presets

7 alarm inputs
Auto focus
Built in line surge and limited lightning protection
Minimum Illuminance (0.01 lux in Mono)

ii) Fixed External Camera

Fixed External Camera shall be type External Weatherproof high resolution colour mono camera located as detailed on drawings.

Camera to Incorporate:

IP66 die cast Vandal Resistant Housing
Cable management system
Auto iris varifocal lens
570 TVL resolution
240V/12V DC/24V AC
1/2 " Colour/Mono camera
Minimum Illuminance (0.4 lux in Mono)

iii) Internal Fixed Dome Camera

Fixed Dome Camera shall be type Internal high resolution colour fixed dome camera located as detailed on drawings.

Camera to Incorporate:

Vandal Resistant Dome Housing
Suitable for wall or ceiling mount
3-6mm varifocal lens
480 TVL resolution
12V DC/24V AC
1/4 " Colour camera (ccd interlace)
Minimum Illuminance (1.5lux)

4.4.4.22 Camera Locations (Examples):-

4.4.4.23 Camera No.1 shall be via suitable wall bracket on the corner of building as detailed on drawing No. 4144/E/006 and set up to view approach to main entrance (external)

4.4.4.24 Camera No. 2 shall be located on new 6.0 metre column as detailed on drawing No. 4144/E/006 and set up to view main entrance doorway (internal).

4.4.4.25 Camera Power Supplies

4.4.4.26 All equipment to be installed shall be suitable for continuous operation on a 230 volt 50Hz electrical supply.

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- 4.4.4.27 A 12v dc /24 V ac 1 Amp fused weatherproof power supply unit shall be provided adjacent to each camera from a local distribution board with final connection from a 13amp connection unit in PVC/PVC flexible cable.
- 4.4.4.28 The supplies to the connection units will be on the same phase.
- 4.4.4.29 Camera Mounts/Fixings**
- 4.4.4.30 Pole Cameras (if applicable)**
- 4.4.4.31 Cameras shall be mounted via an adaptor bracket onto a 6 metre tilt down camera column.
- 4.4.4.32 Pole Specification
6 metre square or tubular galvanised
Anti-climb bracket
Lighting bracket (if required)
Lockable access hatch
Auto winch facility
Concealed cable facility
Built in entry/exit points
- 4.4.4.33 Wall/Corner/Ceiling Mount**
- 4.4.4.34 Cameras shall be mounted directly to wall via suitable swan neck bracket, corner mount adaptor, pendant mount or recessing kit
- 4.4.4.35 Cable Installation**
- 4.4.4.36 The system shall be installed using CC125 duct grade co-axial cable for all external video signals.
- 4.4.4.37 The system shall be installed using RG59 co-axial cable for all internal video signals.
- 4.4.4.38 All telemetry signals shall be via Belden 8723 duct grade or normal
- 4.4.4.39 All electrical works required for the above are detailed elsewhere
- 4.4.4.40 All civil works required for the above are detailed elsewhere
- 4.4.4.41 All system cabling shall be security clipped to galvanised cable tray and building structure.
- 4.4.4.42 Commissioning**
- 4.4.4.43 Following completion of the installation, a firm of suitably qualified commissioning engineers shall test and commission the System. The commissioning of any part of the System shall constitute the practical completion of that part. Handover to the relevant parties shall be made upon
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practical completion, by means of a Handover Certificate. Partial System Handover shall be allowed.

4.4.4.44 Training in the operation of the System shall be carried out during a separate visit prior to time of handover.

4.4.4.45 Maintenance

4.4.4.46 The equipment shall be covered by warranty for a period of 12 months from date of commissioning.

4.4.4.47 All maintenance works shall be carried out in line with NACOSS requirements.

4.4.4.48 Allowance shall be made for four maintenance and servicing visits by the equipment manufacturer in the 12 month period after handover.

4.4.4.49 Data Protection Act

4.4.4.50 Appropriate signage will be displayed throughout to meet the requirement of the Data Protection Act.

4.4.4.51 Commissioning will include the set up of privacy zones to ensure compliance with Data Protection Act.

4.4.4.52 A system log book is to be provided at handover.

4.4.5.0 Lightning Protection Installation

4.4.5.1 Air Termination

4.4.5.2 At the points marked on the plan the electrical domestic sub-contractor shall erect air terminations which shall comply with BS.6651.

4.4.5.3 Down Conductors

4.4.5.4 Down conductors shall be installed as shown on the plans. Where tapes are used they shall be fixed to the structure by proprietary saddles, and be complete with brass flat head screws and phosphor bronze rawlplugs. The down conductors shall follow the most direct path behind the facade cladding possible between the air terminals and earth terminations.

4.4.5.5 No upturns in any down conductor shall be permitted and bends shall be made with as large a radius as possible with a minimum of 600 mm. radius.

4.4.5.6 Copper tape shall be welded to each down conductor approximately 50 mm. above the test clamp. Copper tape shall continue into the ground to the earth electrode.

4.4.5.7 All down conductors and saddles shall be PVC covered. Colour to be selected by Engineer from standard colours available.

4.4.5.8 Copper Tape and Solid Circular Conductors

4.4.5.9 These shall be manufactured from high conductivity copper with high purity, electrical and mechanical properties as specified within BS.2874 and BSEN 13601. These conductors shall be installed above or below ground, as indicated upon the drawings.

4.4.5.10 Fittings and Fixings for Conductors, Cables, Air Terminations and Test Clamps

4.4.5.11 The selection of individual fittings shall suit the type of conductor and surface/material to be fixed to and ensure that components shall have adequate mechanical performance and shall not be adversely affected by corrosion when installed. Each type shall generally be as indicated upon the drawings.

4.4.5.12 Metallic Connections Bonding

4.4.5.13 All straight runs of metallic conduit, pipework or metallic cable sheathing, whether internal or external to the building structure, in excess of 15 m. shall be bonded at both ends to the lightning protection system.

4.4.5.14 The incoming supply cable to each facility shall be bonded to the lightning protection system at the point of entry to the mains switch.

4.4.5.15 Each cable/conduit emanating from the main LV switchboard shall be bonded to the lightning protection system.

4.4.5.16 Installation Requirements

4.4.5.17 General

4.4.5.18 Each down conductor shall have a test joint, suitably labelled, located 300 mm. below roof level. There shall be no connection, other than direct to an earth electrode, made below the test joint.

4.4.5.19 Joints

4.4.5.20 All external joints and conductor transitions shall be made using an exothermic welding process, approved by the manufacturer of the lightning protection system components.

4.4.5.21 All internal joints between copper tapes shall be made using "Silfoss" soldering techniques between two tapes clamped at high pressure for jointing, and riveted, all to the approval of the lightning protection system component manufacturer and the Engineer.

4.4.5.22 Waterproofing protection shall be applied to each joint made between dissimilar metals, the protection extending a minimum of 75 mm. to either side of the joints.

4.4.5.23 Conductors

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- 4.4.5.24 Conductors shall be installed in straight lengths, in a neat and orderly fashion.
- 4.4.5.25 Earth Rods**
- 4.4.5.26 Copper Bond Type**
- 4.4.5.27 Copper bond type earth rods shall be used for driving into "difficult" soils, where severe corrosion resistance and exceptionally long life are not indicated. Each rod shall consist of a high tensile steel core over which a copper sheath of 0.25 mm. minimum thickness shall be molecularly bonded to the steel. Coupling threads shall be formed at each end of a rod, so as to ensure that the corrosion resistant integrity of the copper covered rod is not compromised. A driving stud shall be fitted during driving into soil.
- 4.4.5.28 Coupling pieces shall be manufactured from aluminium bronze alloy, and be of sufficient length counterbored to completely shield the threads on the rods. The coupling arrangement shall be at least as strong as the rod.
- 4.4.5.29 Driving studs shall comprise high tensile, cap headed Allen screws.
- 4.4.5.30 Earth Rod Clamps**
- 4.4.5.31 The clamps shall be heavy duty suitable for connecting the lightning protection conductors to the earth rods, as detailed upon the drawings.
- 4.4.5.32 The bodies of the clamps shall be manufactured from cast aluminium bronze alloy and fitted with phosphor bronze screws.
- 4.4.5.33 The design of clamp shall provide high mechanical strength, rigidity and corrosion resistance, thereby ensuring long term electrical stability, reliability, creep and relaxation of the connection.
- 4.4.5.34 Earth rod clamps shall be manufactured in accordance with the following.
- 4.4.5.35 The clamp body shall be manufactured from cast aluminium bronze alloy to BS.1400, Grade AB1.
- 4.4.5.36 Clamp screws shall be manufactured from phosphor bronze to BS.2874, Grade PB102.
- 4.4.5.37 Inspection Pits**
- 4.4.5.38 Inspection pits and lids shall be of concrete construction, or plastic moulding with a galvanised steel lid where light duty is indicated upon the drawings.
- 4.4.5.39 Plastic moulding inspection pits shall be bedded in concrete.
- 4.4.5.40 A drilled, galvanised steel earth bar shall be incorporated within each inspection pit spanning the diagonal for earthing/bonding connections.
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4.4.5.41 Roof Cladding Seam, Holdfast Clamps

4.4.5.42 Hold fast clamps shall be used to fix conductors to structural cladding materials within the fixing screw penetrating the surface.

4.4.5.43 Provision shall be made for attaching proprietary conductor clamps.

4.4.5.44 The stainless steel shall be manufactured to BS.970, and the fixing screw shall have a locknut and stainless steel serrated washers.

4.4.5.45 Electrical Requirements

4.4.5.46 General Bonding

4.4.5.47 All major items of metal on or forming part of a building or structure shall be bonded to the lightning protection system, including the reinforcing bars.

4.4.5.48 Down conductors shall follow the most direct route to the appropriate earth rod.

4.4.5.49 Bends in conductors shall have the largest permissible bending radius, although no upturns shall be permitted in down conductors.

4.4.5.50 Conductors between test clamps and earth pits shall be buried not less than 500 mm. below ground level. Where the tape enters the ground, physical protection shall be provided to a minimum of 300 mm. above ground level.

4.4.5.51 All bonding connections embedded in concrete shall be wrapped in "Denso" tape or equivalent.

4.4.5.52 Earth Rods

4.4.5.53 Where groups of earth rods are to be driven, then the spacing between rods shall be at least equal to the driven depth.

4.4.5.54 Where compacting materials are indicated for rod bedding, then coke, breeze and fly ash shall not be used due to their corrosive effect on copper.

4.4.5.55 Inspection, Testing and Certification

4.4.5.56 General

4.4.5.57 The electrical domestic sub-contractor shall be responsible for appointing a firm of suitably qualified commissioning engineers to carry out all tests as detailed below, in accordance with the requirements of BS.6651, and recording the results for certification of the system.

4.4.5.58 Earth resistance of each earth electrode.

4.4.5.59 The continuity of all conductors, bonds and joints comprising the entire system.

4.4.5.60 Only those conductors forming part of the lightning protection system shall be included within the tests above. All other connections shall be disconnected and electrically isolated.

4.4.5.61 The firm appointed by the electrical domestic sub-contractor shall supply all equipment and test instrumentation necessary for the complete testing of the installation at each building or facility. The accuracy of all tests, calibration of test instructions, etc., shall be demonstrated to the satisfaction of the Engineer.

4.4.5.62 The Engineer shall be given 14 days advance warning of tests on each facility in order that they might be witnessed.

4.4.5.63 Measurements and Test Valves

4.4.5.64 With all peripheral connections removed, the resistance to earth of each earth termination network shall not exceed 10 ohms multiplied by the number of earth electrodes comprising the system.

4.4.5.65 With all earth electrodes connected to the system and all extraneous bonding removed, the resistance to earth of each system when measured at each point equidistant between earth electrodes, shall not exceed 10 ohms.

4.4.5.66 Note:

4.4.5.67 The removal of all extraneous bonding shall only be performed for acceptance testing, and the system shall not be left in this condition for longer than the minimum time for appropriate testing.

4.4.5.68 Additional Measures

4.4.5.69 The tests indicated above shall be performed within the building programme to enable additional earth rods and radial tapes, or other earthing measures to be installed with minimum disruption to the Civil Engineering hardstanding associated with each facility.

4.4.5.70 The need for additional earthing measures shall be agreed with the Engineer subject to the result of the testing procedures indicated above. The Engineer shall advise what additional measures are to be taken, if any.

4.4.6.0 Intruder Alarm Systems

4.4.6.1 General Requirements

4.4.6.2 The following specification is for an Intruder Alarm System to be installed to confirm with the requirements of British Standard 4737 and NACOSS. The system should be installed in compliance with the Association of Chief Police Officers of Scotland (ACPOS) policy on False alarm management. This system should employ confirmation as detailed below.

4.4.6.3 Setting requirements (DD243)

4.4.6.4 Setting the System

4.4.6.5 The completion of the full setting procedure will be achieved by a Door Contact fitted to the final exit door.

4.4.6.6 Unsetting the System (DD243 Section 6.4.5)

4.4.6.7 Means of unsetting are designed to minimise the likelihood of false alarms either during or as a result of the unsetting process. Unsetting the system will be achieved by Portable Ancillary Control Equipment (Portable ACE). Opening the initial entry door, prior to unsetting the system, disables all means of confirmation throughout the protected premises until after the expiry of the entry timer.

4.4.6.8 Sequential Alarm Confirmation

4.4.6.9 The Intruder Alarm System shall incorporate Sequential Alarm Confirmation Technology and comply with the requirements of DD243:2002.

4.4.6.10 All areas with protection have effective sequential confirmation facilities.

4.4.6.11 An alarm condition is sequentially confirmed when at least two separate alarm conditions from independent detectors are reported within a time period of 60 min. Two detectors of different technologies having overlapping areas of coverage OR two detectors of the same single technology not having overlapping areas of coverage, can generate a confirmed activation. NOTE : Two independent dual technology movement detectors incorporating the same technologies can be regarded as detectors of different technologies, and may have overlapping areas of coverage.

4.4.6.12 Where a number of detectors or sensors are connected to one circuit e.g. Breakglass, Vibration, Magnetic Reed Door Contact, activation of more than one detector in any one circuit will not give rise to a confirmed alarm message.

4.4.6.13 Reinstating (re arming)

4.4.6.14 After the System has been set, if one detector (not on the entry route) activates, an unconfirmed alarm occurs and the confirmation time starts. If a second independent detector does not activate before the confirmation time expires the system will be reinstated. However if the original detector activated remains triggered at the time of reinstatement, that detector will be isolated, the ARC signalled, and where possible the customer or their representative advised accordingly. If subsequently one detector activates, an unconfirmed alarm occurs and the confirmation time starts again.

4.4.6.15 Resetting

After an alarm condition has occurred the System should be reset:

- i) By the user if the alarm signal has not been designated as confirmed (i.e. "customer reset")

OR

- ii) By means not normally available to the user if the alarm signal has been designated as confirmed (i.e. "engineer reset") except for the following configurations:
 - a) Unlocking the initial entry door unsets the System
 - b) Unlocking the initial entry door disables all means of confirmation
 - c) Unsetting in conjunction with the ARC
 - d) Restoring a System installed to BSEN50131

4.4.6.16 Control Equipment

4.4.6.17 The Alarm System to be controlled by a Multi-Circuit microprocessor based Control Unit. The Unit is operated from a mains derived low voltage 3 ampere 'Smart' Power Supply Unit with a Rechargeable Standby Battery and incorporates a 1000 event log and integral Digital Communicator and Modem. (For access to Remote Engineering and Support Services)

4.4.6.18 The Control Unit to be located at

4.4.6.19 The control panel will be fitted with a combination of Remote Input Modules (RIO's) and keypads fitted on an RS485 data communication line. All of the systems should be capable of measuring voltage and resistance on each of the zones, as well as carrying out communication level diagnostics on keypads and RIO's.

4.4.6.20 Panel to Incorporate:

Self diagnostics
Intrusion trace
Programmable function keys
User names
Fast forward/reverse search
Mechanical lid tamper switch
Event log date search
7 access levels
Remote servicing
System configuration display
Programmable user menu
High/low resistance monitoring
Automatic summer time
On-line printing
Reversible output polarity
One-touch operation
Digicom keypad programmable
Programmable output module

4.4.6.21 Control Panel Ancillaries

4.4.6.22 The system is to be operated using the portable Ancillary Control Equipment (ACE) method utilising proximity tokens and a combined Keypad/Proximity Reader which is to be located at the main school entrance.

5.4.6.23 A supplementary Extension Speaker is to be located at the secondary entrance.

4.4.6.24 The multi Zone R.I.O (Remote Input/Output Module) connected to the Control Unit, to be fitted within the area.

4.4.6.25 An additional combined Keypad/Proximity Reader is to be located within the secondary school entrance and entrance to the basement level.

4.4.6.26 Signalling and Audible Alarms

4.4.6.27 External Sounder

4.4.6.28 A Self Actuating Electronic Sounder, Strobe Light assembly housed within a protective cover to be fitted on the front elevation.

4.4.6.29 Alarm Monitoring

4.4.6.30 Indication of unauthorised entry into the premises is Audible and via British Telecom RedCARE.

4.4.6.31 This Specification should include for the provision of a RedCARE Signalling Unit which is to be located adjacent to the Control Unit.

4.4.6.32 The RedCARE Subscriber Terminal Unit (STU) transmits alarm signals or changes of state to an approved Alarm Receiving Centre (ARC) via the BT Telephone Network. Line fault monitoring is incorporated which will indicate faults or line cuts at the control unit and at the ARC.

4.4.6.33 For RedCARE Signalling the REN value of all the equipment on the exchange telephone line should not exceed 4.0. Telephones provided by BT and RedCARE STU's should be regarded as having an REN of 1.0. Some modems, facsimile machines and electronic point of sale equipment are not compatible with RedCARE Signalling. Each such device should be connected to the telephone line via a Modem Compatible Device (MCD) which has an REN of 0.5

4.4.6.34 A float charged Power Supply Unit complete with an 8 zone RIO (remote Input/Output module) and with a sealed lead acid battery to be located at secondary entrance.

4.4.6.35 A Dummy Hexagonal Cover with Strobe Housing is to be located as indicated on drawings.

4.4.6.36 Monitored System and Police

4.4.6.37 Costs include a £30 fee made payable to local Police force. This is the one off administration fee for the application of a Unique Reference Number used by the police in the administration and monitoring of alarm systems.

4.4.6.38 Detection Equipment

A) Magnetic Contacts

Surface Magnetic contacts are to be provided as per specification below and located as detailed on drawings/technical schedule etc..

Operating Gap : 15mm
Contact Type : NC (Normally closed)
Colour : White or Brown
Dimension : 50(L) X 9(W) X 9(H) mm

Flush Magnetic contacts are to be provided as per specification below and located as detailed on drawings/technical schedule etc..

Operating Gap : 12mm
Contact Type : NC (Normally closed)
Colour : White or Brown
Dimension : 9mm(W) 19mm(L)

Roller Shutter/Heavy duty contacts are to be provided as per specification below and located as detailed on drawings/technical schedule etc..

Operating Gap : 75mm (Max.)
Contact Type : NC (Normally closed)
Dimension : 89(L) X 39(W) X 39(H) mm
Housing : Aluminium (Anticorrosion finish)

B) Movement Sensors

Dual technology sensors are to be provided as per specification below and located as detailed on drawings/technical schedule etc.

Detector is to be selected to suit coverage area required

Typical Coverage areas would be

11m x 8m
15m x 11m
18mx15m
37m x 4m
360 degree (typically 12m)

Detectors are to incorporate:

- Combined Microwave/PIR Technology
- Microprocessor signal analysis
- Alarm memory with exit/entry delay
- Trouble output
- Phase sensitive PIR Processing
- Animal activity sensor
- Automatic sensitivity select mode for false alarm tolerance
- Self testing of PIR/Microwave signals
- Adjustable microwave control
- Selectable walk test LED
- Horizontal & vertical adjust
- LED disable
- Autosensing panel status output
- Fluorescent light interference filter
- Absolute white light immunity
- low profile ABS white enclosure

C) Acoustic/Break glass sensors

Dual technology sensors are to be provided for the protection of glass as per specification below and located as detailed on drawings/technical schedule etc.

Detector is to be selected to suit coverage area required

Typical Coverage areas would be

2m – 9m radius

Detectors are to incorporate:

- Dual technology for sensing glass flexing prior to breaking
- Digital signal analysis/processing
- Adjustable detection circuits
- Frequency selectivity
- Fail safe self checking
- False alarm tolerance

D) Panic Attack Alarm Devices

Double action panic attack buttons are to be provided as per specification below and located as detailed on drawings/technical schedule etc.

Panic buttons are to incorporate:

- Double action switch (two red slider bars)
- Key reset facility

Stainless steel, brass or white finish
Tamper leaf
Silent action (latching alarm)
Flag indication
Operating temperature (-40oC to +50oC)
Size 81mm x 63.5mm x 29mm

4.4.6.39 System Power Supplies

4.4.6.40 All equipment to be installed shall be suitable for continuous operation on a 230volt 50Hz electrical supply.

4.4.6.41 A 230volt 13Amp switched fused connection unit with neon indicator shall be provided adjacent to all equipment from and local distribution board with final connection in PVC/PVC flexible cable.

4.4.6.42 The supplies to the connect units will be on the same phase.

4.4.6.43 Cable Installation

4.4.6.44 The system shall be installed using Beldin 8723 2 pair standard cable for communications signals.

4.4.6.45 The system shall be installed using 8 core 7 strand 0.25 cable for detection circuits.

4.4.6.46 All electrical works required for the above are detailed elsewhere.

4.4.6.47 All civil works required for the above are detailed elsewhere.

4.4.6.48 All system cabling shall be security clipped to galvanised cable tray and building structure and routed in conduit within walls.

4.4.6.49 Commissioning

4.4.6.50 Following completion of the installation, a firm of suitably qualified commissioning engineers shall test and commission the System. The commissioning of any part of the System shall constitute the practical completion of that part. Handover to the relevant parties shall be made upon practical completion, by means of a Handover Certificate. Partial System Handover shall be allowed.

4.4.6.51 Training in the operation of the System shall be carried out during a separate visit prior to time of handover.

4.4.6.52 Maintenance

4.4.6.53 The equipment shall be covered by warranty for a period of 12 months from date of commissioning.

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- 4.4.6.54 All maintenance works shall be carried out in line with NACOSS requirements.
- 4.4.6.55 Allowance shall be made for four maintenance and servicing visits by the equipment manufacturer in the 12 month period after handover.
- 4.4.6.56 Field Device (Descriptions) – Examples**
- 4.4.6.57 Ground Floor**
- 4.4.6.58 Circuit No.1 – Corridor**
- 4.4.6.59 One Corridor Dual Technology Movement Detector having a range of 15 metres, and an angle of coverage of 5 degrees, is to be installed on right hand wall at a height of 2.6 metres and directed forming a curtain of protection across the Inner Area not on the Entry/Exit Route.
- 4.4.6.60 Circuit No.2 –**
- 4.4.6.61 Circuit No.3 –**
- 4.4.7.0 Structured Cabling Installation**
- 4.4.7.1 Standards
- The International Standard for Generic Cabling Systems is ISO11801: 2002. All references to this standard, in this document, refer to this version.
- Where possible, International Organization for Standardization (ISO standards) are used in this document. Where two sets of standards exist with similar characteristics, it is expected that the ISO standard shall be applied.
- Standards noted are current at time of writing; the prevailing versions of these standards shall be used at time of design and installation.
- 4.4.7.2 Structured Cabling Systems
- The primary network shall be designed as Category 5 enhanced / Class D to ISO 11801. The network shall be Fast Ethernet standard IEEE802.3u with auto-sensing switches.
- The infrastructure to be provided under the infrastructure-cabling contract shall include the structured cabling, RJ45 sockets, RJ45 patch panels and cabinets, these shall all be compatible and from the same manufacturer to ensure optimum performance.
- The Client shall supply as part of the School equipment the router, servers and associated UPS, switches and patch leads in accordance with the Department's ICT Equipment Guidelines.
- 4.4.7.3 Data Communications Centre (DCC)
- A dedicated Data Communication Centre (DCC) shall be provided, size 2 m x 2 m x full ceiling height (min 2.7 m) and shall have no windows. This room shall house the Main Distribution Facility (MDF).
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The DCC shall be naturally ventilated with air inlets at low level and air outlets at high-level opening to the corridor or to the store. Ventilation to the outside is generally not required.

4.4.7.4 Main Distribution Facility (MDF)

The MDF shall be located in the DCC in lockable floor mounted equipment cabinets as detailed in section 4.3.4. It shall be supplied with patch panels.

The Client shall supply as part of the school's equipment, the router, servers and associated UPS, switches and patch leads in accordance with the Department's ICT Equipment Guidelines.

4.4.7.5 Data Communications Centre (DCC)

A local electrical sub distribution board shall be provided in the DCC. The design capacity will need to be established on site but as a minimum a 35 A single-phase electrical supply shall be provided.

A dedicated earth from the main earth bar at the main LV switchboard shall be provided to the DCC to serve each of the data cabinets. The design capacity will need to be established on site.

A dedicated line (ExchL) from the telecommunications provider for Internet (WAN) connection shall be located in the room.

4.4.7.6 Main Distribution Facility (MDF)

Power supply to each cabinet shall via a separate industrial type plug and socket to IS/EN 60309 from an MCB so as to eliminate the risk of nuisance tripping. This shall be terminated in a switched spur, with a trailer lead directly connected and mounted in the cabinet.

4.4.7.8 Cabinets

Five types of cabinets are appropriate for general usage.

Type 1 shall be min. 39U, w. 600, d. 600. This is the smallest usable cabinet for general equipment.

Type 2 shall be min. 39U, w. 800, d. 600. This cabinet is for structured cabling where vertical cable management is required in the additional available 200 mm.

Type 3 shall be min. 39U, w. 600, d. 910. This extra depth is required for rack-mounted servers.

Type 4 shall be min. 39U, w. 800, d. 910. This cabinet is for all requirements in small schools (structured cabling, equipment, servers).

Type 5 shall be min 6U, w. 600, d. 400. This cabinet is a wall-mounted unit to house switches. These items shall be selected to suit cabinet size.

U = height unit = 44.5 mm

All cabinets shall be 19" rack mounting type of a solid and durable type. Frame shall be of min. 2 mm steel, doors and panels of min. 1.5 mm steel. Frame shall be seam-welded.

All floor-mounted cabinets shall be supplied with a plinth. Plinth shall have side openings in each direction.

Specified cabinets shall be suitable for computer room environments and shall conform to IP21 EN 60.529/IEC 529. Note that IP21 conformance is required on the installed cabinet after completion of installation. It is the installer's responsibility to ensure that sufficient care is taken during installation to achieve this.

Cabinets shall be supplied with lockable front doors with safety glazing. They may either be floor or wall mounted. Side and rear panels shall be of a steel construction and shall be removable. During installation, all adjacent cabinets shall be bolted together by the installer and only 2 side panels shall be required in total.

Cabinets shall be installed such that all equipment including patch panels may be serviced and installed from the front.

Cabinets shall be supplied with brush plates or other such entry mechanism to ensure that cable entries are tidy and sealed to IP21.

Suppliers shall declare conformance or otherwise with regard to the EU EMC directive relating to electromagnetic interference, on the completed installation, EU 89 / 363 with all amendments.

Cabinets shall be installed with full safety earthing.

All passive metallic components in the cabinet, when fully assembled with patch panels etc., shall be bonded to provide an adequate signal ground.

4.4.7.9 Patch Panels

Patch panels are required in all cases and shall be mounted in Type 2 cabinets.

Patch panels shall be 1U per row, with 24 x RJ45 type terminations per row.

Every second patch panel shall have a 2U horizontal cable management bracket mounted underneath. U = height unit = 44.5 mm.

Patch panels shall be fully accessible from the front.

4.4.7.10 Sockets

Sockets shall be of a single piece rugged construction. Modular socket assemblies will not be accepted. The supplier shall provide samples of sockets for approval.

For data sockets termination shall be on IDC style punch down connections to TSB-568-B.

4.4.7.11 Warranty

A fifteen-year warranty is required on the fibre optic cable installation and all other associated fibre optic components.

A link performance certificate for horizontal cabling is required, specifying that all such cables meet or exceed the requirements of ISO11801 Annex A.

A proprietary testing device shall be used to test the installation as recommended by the cabling manufacturers and approved by the Building Services Consulting Engineer.

4.4.7.12 Horizontal Cables

All cabling, connections and accessories in the structured cabling system shall conform fully to standard ISO/IEC 11801, EN50173, class D. tested to TSB67.

Cable shall be of a low smoke type and shall conform to building standards for plenum cables. Conformance or otherwise with standards IEC 332-1, 695-1, 754 and 1034 shall be requested.

Only three cable impedances are recognised by the standards; 100Ω, 120Ω and 150Ω; only 100Ω cables shall be used. Only UTP cable shall be used.

4.4.7.13 General Requirements

All cableways (cable trays, trunking, conduit, wall boxes and Dado trunking where appropriate) shall be completely installed by the electrical domestic sub-contractor prior to the beginning of the structured cabling installation.

In general, cable trays shall be specified as wide and flat, rather than deep. In no case shall cables be laid more than six deep into a cableway.

No cableway shall be filled more than 60% after the initial installation.

Maximum loading for a cableway after upgrades and additions is 75%.

Gutter bolts shall be secured with the head inside and the nut outside.

For fibre optic cable, basket and tray are acceptable; it is not normally possible to guarantee the bend radius required for fibre in trunking. Conduit shall not be used for fibre optic cable, except for completely straight runs.

Carrier systems shall be bonded using flat-earth straps in accordance with current standards.

Where cable trays are used or vertical runs are required, cables shall be clipped to trays using loosely attached cable ties. Where cable ties are used to secure structured cables they shall be tied in bundles. Bundles shall be no greater than ten cables per bundle. Under no circumstances shall cables be tied tightly.

The shortest possible routes shall be used; drops and rises shall be minimised.

Power may not be run in the same compartment as structured cabling, under any circumstances.

Lift shafts shall not be used as routes for wiring.

Where crossovers exist, some cross-sectional area of cableways may be lost; this shall be accounted for when calculating the cable tray.

Where trunking or conduits pass through fire compartment walls, floors and ceilings, holes must be sealed with sealing compound giving appropriate rating of fire stability, to BS476 Part F.

4.4.7.14 Testing, Commissioning and Record Drawings

All components must be guaranteed to Category 5e UTP Unscreened.

The performance of each link shall conform to ISO/IEC 11801: 2002 Class D and test set up and test equipment specification as per TSB 67 October 1994.

Test results shall be supplied to the Consultant and Client prior to acceptance of the installation. Results shall be supplied as a word file, in printed and electronic format.

Optical attenuation on all fibre optic links shall comply with ISO11801 section 7.3.1, table 10.

As a minimum the following results shall be provided per fibre optic cabling link, Connection Map, Length, Attenuation.

Horizontal cabling links shall be tested to TIA/EIA 568A Basic Link.

As a minimum the following results shall be provided in a link performance certificate per horizontal cabling link:

- ☐ Connection Map
- ☐ Length (or propagation delay)
- ☐ DC loop resistance/Pair
- ☐ Capacitance per pair
- ☐ Attenuation per pair (0-100MHZ)
- ☐ Near End Cross Talk NEXT per each pair combination (0-100MHZ)
- ☐ ACR per pair.

On completion, the supplier shall provide full test results in a bound paper form, and in an electronic format on disk and also provide 'as installed' drawings with floor plans, wire charts, cable paths, upgrade routes in AutoCAD 14 or latest edition as detailed above.

4.4.7.15 Training and Demonstration

After the Building Services Consulting Engineer is satisfied and has witnessed that all equipment and systems are operating satisfactory, training and demonstration shall take place.

Adequate notice shall be given to the Client and, at an agreed time and in the presence of the Building Services Consulting Engineer, a training and demonstration event shall be provided.

4.4.7.16

Appendix A Completion Record Sheet

School Name: Address		
Project:		
		Signatures & Date
Information and Communication Technology Infrastructure, installed, tested and operating satisfactorily.		
Operating & Maintenance Manuals handed over School and explained.		
Training and demonstration meeting held in the presence of the Building Services Consulting Engineer and School Caretaker and Principal.		Date:
Wall Chart provided, explaining common operating / maintenance procedures.		
As installed Drawings handed over to school in hard copy and on disc.		
School Principal Name:	Signed:	Date:
Building Services Consulting Engineers Name:	Signed:	Date: