



Manchester Metropolitan University
Estates Projects
Righton – Ground Floor Study Space

Electrical Services Specification

27th May 2022

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REV	DESCRIPTION	PREPARED BY	DATE
-	Tender	J. Staley	27.05.22

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1 CONTRACT PARTICULARS

Site:	Righton – Ground Floor Study Space Finance Service Centre Cavendish Street Manchester M15 6BG
Client:	Manchester Metropolitan University Bridgewater House 7 th Floor 58-60 Whitworth Street Manchester M1 6LT
Architect:	AHR Architects 5 th Floor 55 Princess Street Manchester M2 4EW
Building Services Consultant:	Hulley & Kirkwood Consulting Engineers Ltd 2 Commercial Street Manchester M15 4RQ

2 GENERAL REQUIREMENTS

2.1 Extent of Works

The works undertaken in this Contract covers the manufacture, works testing, supply and delivery to site, erection, connecting up, site testing, adjusting and setting to work of the complete electrical services installation, as described in this specification and shown on the drawings.

The works shall comprise the complete electrical services installations required with the redevelopment of Manchester Metropolitan University's Righton Building study space refurbishment.

The works shall comprise the whole of the labour, plant and, unless otherwise indicated, all of the materials necessary to form a "complete installation" including their manufacture, works testing, and such commissioning and testing as are prescribed in subsequent sections of this document and as may otherwise be required to give an effective working installation.

The Electrical Services Contractor shall visit site as part of the tendering process to familiarise themselves with the details of the site and in particular the ceiling voids, roof eaves, key plantroom and riser areas. It is assumed that the Electrical Services Contractor will be visiting site prior to submission of tender, and no variation to the works will be accepted as a result of information that may come to light which may not explicitly be identified within this specification, but which could reasonably have been obtained by such a visit to site.

2.2 Provision of Contractors Design Information

The Electrical Services Contractor shall undertake the electrical installation and full compliance with the following,

Design Performance Criteria

The Electrical Services Contractor must ensure that the electrical services installation complies fully with the requirements stipulated within the CIBSE guides, relevant British Standards and Building Regulations.

The Electrical Services Contractor shall also ensure the installation complies with the development brief current at the time of tender.

Electrical Services Design Contractor Design Calculations

The Electrical Services Contractor must ensure that any design calculations used in the delivery of the Electrical Installations are submitted to Hulley & Kirkwood for comment 8 weeks prior to the construction issue date.

Electrical Services Design Contractor Design Drawings

Production of installation drawings associated with section 2.36.

Electrical Services Design Contractor Design Risk Assessments

N/A

2.3 Related Documents

This specification shall be read in conjunction with any schedules, supplementary specifications, drawings and other documents issued with it and enumerated in the invitation to tender. In the event of a contradiction between this specification and a specified requirement on any drawing becoming apparent either before or after tendering then Hulley & Kirkwood shall be immediately informed.

The requirements of this specification are in addition to those of the other documents listed above.

2.4 Documents

The Electrical Services Contractor (whether their tender is accepted or not) and any other recipients of the specification and documents (whether they submit a tender or not) shall treat the details of the specification and drawings, etc. as private and confidential and shall not reproduce same without the Contract Administrators permission.

2.5 Contract Documents

The drawings for this Contract are as per Section 4.2.

The Electrical Services Contractor shall ensure that the actual arrangement of the layouts and the routes are such that the installations are laid out and installed in the neatest possible manner.

The Electrical Services Contractor shall allow for any offsets, bends, supports, brackets and other like items which, although not specifically indicated on the drawings, are required in order to ensure the installations are laid out and installed in the neatest possible manner.

If alterations and/or modifications are required to suit unforeseen conditions which have been encountered on the site the Electrical Services Contractor shall provide Hulley & Kirkwood with details of the required alterations and/or modifications for approval. Where appropriate, Hulley & Kirkwood shall arrange for instructions to be issued to cater for any alterations and/or modifications which are required.

The layout of the installations shall be to the entire and complete satisfaction of Hulley & Kirkwood.

2.6 Discrepancies

In the event of there being a discrepancy in the drawings, specifications or schedules or omissions there from or anything necessary for the proper completion of the works, the Electrical Services Contractor is to obtain a decision on the matter from the Contract Administrator no extra will be allowed in respect thereof.

2.7 Qualifications of Tender

The Electrical Services Contractor's attention is directed to the fact that under no circumstances must any alteration or amendment be made to the text, wording or figures, or to any of the tender documents, which shall be accepted without any qualifications whatsoever. Should the Electrical Services Contractor be unable to submit an unqualified tender, the whole of the tender documents shall be returned as directed and no tender submitted. The Electrical Services Contractor may, if he so wishes, submit a bid based on

alternatives providing always that these are scheduled and priced individually and set out in a separate document.

2.8 Alternatives

The Electrical Services Contractor may propose alternative methods and selections, for consideration by the Client and Hulley & Kirkwood, provided a complete tender is submitted for the work as given in this specification. Alternative proposals should include full technical details to enable a full assessment to be made on the proposed variations.

If materials or items of plant manufactured and/or supplied by a manufacturer named as or equal and approved are to be used instead of the manufacturer specified, the Electrical Services Contractor shall be responsible for ensuring that the substituted materials or item of plant is equivalent in performance and operating characteristics to the specified materials or item of plant. Any additional costs for larger starters, additional space, larger power cables and changes to adjacent work or builderswork will be borne by the Electrical Services Contractor. In addition, in mechanical and electrical plant rooms where items of plant named as equal and approved is used instead of the specified item of plant and the dimensions of such equivalent items of plant differs from the specified items of plant, the Electrical Services Contractor shall prepare and submit for approval, accurately dimensioned layouts of rooms affected.

In addition to the manufacturers specified or named as equal and approved, the Electrical Services Contractor may propose alternative manufacturers of equipment and/or apparatus to Hulley & Kirkwood for acceptance, listing in each case a corresponding credit for each alternative proposed. The tender price must be based on the items of plant or materials specified or named as equivalent. The Electrical Services Contractor must also certify in writing to Hulley & Kirkwood that the alternative meets all space, power, design and all other requirements of the specified or equivalent materials or apparatus.

Prepare and submit with the tender, the names of the manufacturers of the items of plant to be supplied. The Electrical Services Contractor must list manufacturers in their categories, "AS SPECIFIED" or "EQUIVALENT". Tenders submitted without the manufacturers'/suppliers' list filled out may be disqualified.

No substitution of materials or equipment will be permitted except by written request and consent of Hulley & Kirkwood.

Unless alternatives are fully detailed all things offered in the tender shall be deemed to comply with the specification(s) and/or drawing(s).

The Electrical Services Contractor's attention is drawn to the Appendices to be completed in respect both of the materials included in the tender which must comply, in all respects with the specification and the schedules of alternative materials which are offered as an alternative in place of those specified.

2.9 Provisional Sums

All such sums defined in the specification and/or schedules or form of tender are to be included in the tender price.

All such sums are the gross amount and will be adjusted or deducted from the final price. Expenditure against these sums will be at the direction of the Contract Administrator.

2.10 Variations

No variations or addition to the contract are to be undertaken without the prior written approval of the Contract Administrator.

Where possible, estimates are to be agreed prior to the work being commenced or alternatively are to be priced on the schedule of rates which form part of the contract. The schedule of rates is to be completed by the Electrical Services Contractor and approved by the Contract Administrator before final acceptance of the Electrical Services Contractor's tender.

The schedule of rates should cover all items being used on the Contract by the Electrical Services Contractor and generally as shown on the schedule of rates attached to the tender document. Where work cannot properly be measured and valued, the Contractor shall allow day work rates as inserted in the tender documents. Where such work is authorised, record sheets detailing all labour and materials employed are to be recorded daily and signed weekly by the Clerk of Works and triplicate copies forwarded to the Contract Administrator offices, immediately after signing. No payment will be permitted unless the above conditions are strictly complied with.

2.11 Schedule of Rates

The Electrical Services Contractor shall, within 14 days of notification of an order, complete and forward to the Contract Administrator, for their approval, a full and comprehensive schedule of rates which shall itemise the unit installed cost and extended total costs against each item and section of the works.

2.12 Method Statements

At the time of the tender submission the Electrical Services Contractor shall submit to the Principal Contractor, method statements for all activities which may have an associated element of risk, and for any other elements of work as requested.

Approval of these method statements must be obtained from the Principal Contractor prior to commencement of the works.

The nature of the electrical services installations will require the production of method statements and associated risk assessments throughout the contract and all such allowances shall therefore be included.

2.13 Definitions

For the purpose of this specification the following definitions apply:

1. Commissioning:

The advancement of the building services installations from the state of static completion to working order to the specifications relevant to achieving compliance with same, without prejudice to the need to comply with health and safety requirements. For each system it includes setting to work, regulation (that is testing and adjusting repetitively) to achieve the specified performance, the calibration, setting up and testing of the associated automatic control systems, and the recording of the system settings and the performance test results that have been accepted as satisfactory.

2. Inspection:

Establishment at completion of installation that the specified and approved provisions for efficient operation have been put in place.

3. Performed Testing:

The evaluation of the performance of a commissioned installation.

4. Approved:

And words derived therefrom, means approval in writing by the Electrical Services Contractor unless otherwise stated. All systems or equipment designs shall have operated successfully for not less than two years under conditions generally similar to those required by this Contract. Facilities shall be given at the tender stage, if required by the Electrical Services Contractor to enable him to evaluate the features and performance of equipment offered in the tender. The approval of a design or piece of equipment shall be without prejudice to the site tests required after installation.

5. Size:

When related to cables, conduit, cable tray and cable trunking means nominal size in accordance with the recognised methods of sizing these components.

6. Complete Installation:

The words "complete installation" shall mean not only the major items of plant and equipment conveyed by this specification, but all the incidental sundry components necessary for the complete execution of the works and for the proper operation of the installation, with their labour charges, whether or not these sundry components are mentioned in detail in the tender documents issued in connection with the contract.

2.14 Statutory Regulations

The materials components and completed installations shall conform to the appropriate British Standard or European Standard, including all amendments current at the time of tendering. Construction products should comply with European Standards and Technical Specifications (ESTS). Wherever reference is made to a British Standard, a corresponding ESTS (generally ISO Series) shall be equally acceptable.

Where available, all materials, equipment etc. forming part, or whole, of the services specified in the Contract, should be obtained from BS EN ISO 9000-1 (1994) "Quality Management & Quality Assurance Standards" certified manufacturers and preferably "kite marked" or EEC equivalent.

The dates of Standard references are given in good faith. The Contractor is obliged to ensure compliance with latest issue.

The Electrical Services Contractor shall comply fully with the following Standards: -

Institution of Electrical Engineers:

BS 7671, the IET Wiring Regulations for Electrical Installations (current edition, including amendments and Guidance Notes).

Health and Safety at Work etc., Act 1974:

and including:

Health and Safety Executive Guidance Note PM5

Health and Safety Executive Guidance Note HS (G) 70

COSHH Regulations 2002

Construction Design and Management Regulations 2015

Code of Practice Reducing the Exposure of Employed Persons to Noise HMSO 1982

The Building Regulations, including all amendments therein.

Regulations under the Electricity Acts

Any special requirements of the Local Electricity, Gas or Water Undertakings

2.15 Compliance with British Standards

The equipment and/or installations shall conform to the relevant British Standards and Codes of Practice current three months prior to the date for return of tenders, except where a specific date of issue is stated. A certificate of compliance with the relevant British Standard shall be provided to the Electrical Services Contractor at their request. In the event of a contradiction between this specification and any BS or CP the Contractor shall immediately be informed.

Where practicable, each item of equipment shall be clearly and indelibly marked to indicate the standard with which it complies.

Equipment not manufactured in the UK shall be of a standard which ensures its compliance with all appropriate British Standards.

2.16 Approvals and Compliance

Where applicable, the Electrical Services Contractor shall obtain and ensure approvals and compliance with the following: -

- Insurance Company - Test Certificates
- Water Authority
- Gas Authority
- Planning Officer
- Building Control Officer
- Environmental Health Officer
- Fire Officer and LPC
- Water Regulations
- British Standards and Codes of Practice
- Building Regulations

- Manchester Metropolitan University Facilities Managements Building Guide & Requirements Documents
- Manchester Metropolitan University Facilities Managements Standards

2.17 Condition and Quality of Materials

All plant materials and equipment shall be new and the Electrical Services Contractor shall ensure no plant, materials or equipment is installed showing any sign of corrosion, or faults or damage in any way.

The Electrical Services Contractor shall take delivery, off-load, handle and provide adequate weatherproof and safe storage and protection for all materials, plant, equipment and tools.

Systems and equipment selected by the Electrical Services Contractor shall have a successfully proven performance for not less than two years under equivalent conditions to those required by the tender documents. Systems and equipment that do not comply with the foregoing proven performance period may be considered provided full technical details and evidence of suitability are given at time of tender.

The Electrical Services Contractor shall ensure that all equipment can be installed in the allotted spaces, and shall maintain adequate access for maintenance and repair.

All equipment shall be installed in accordance with the manufacturers' written instructions.

All materials and equipment shall be sorted under proper cover to the satisfaction of the Principal Contractor, and in such a manner that deterioration or damage does not occur.

Pipes shall be adequately supported and stored on properly made racks to prevent bending and distortion and the ends shall be closed and protected by means of caps.

The storage of pipes by laying them on earth will not be permitted.

Where materials cannot be stored in suitable buildings, they shall be raised clear of the ground and protected by means of waterproof covers.

Machined and bright surfaces shall be protected by paint, tallow or grease. On completion, surfaces so protected shall be cleaned and where appropriate, polished.

All plant and equipment is to be left in a condition ready for painting, where painting is specified either as part of the Contract or by others. Parts liable to corrode are to be painted immediately after removal of the temporary protection.

Fittings and other components shall be stored in bins or on shelves in such a way that the Employer's Agent may conveniently check such items for adherence to the specification, and for any interim valuation.

All bright and polished parts of all material and equipment shall, if liable to corrode or tarnish, be protected by a suitable film or adhesive tape which shall be removed immediately prior to practical completion of the works.

Material subject to damage or deterioration due to excess exposure to ultra violet light shall be suitably protected.

2.18 Metricated Products

All products supplied and fitted shall be metric.

2.19 Rationalisation of Supplies

Items, fittings and accessories to be used in quantity shall, where practicable, be the product of one manufacturer, and shall be used only for the purpose recommended by the manufacturer.

2.20 Design Life

All components used in this specification shall be designed for a 25-year life cycle under operating conditions detailed. Where this cannot be achieved, the Contractor shall guarantee a replacement life span of 25 years for all components and spare parts.

2.21 Samples

Samples shall be manufactured to allow for approval aesthetically of all items of equipment forming part of this Contract. Samples may also be required, as back up, in order to establish final approval for any engineering/installation proposals, which may be made during development of the project. Allowance for these shall be built into the tender price.

Upon approval, samples shall be logged and delivered to a 'samples store', location to be advised for retention as control samples, in case of requirements for later quality comparison.

2.22 Mock Ups

Mock ups may be required, in order to establish modes of working, integration, co-ordination, etc. The Electrical Services Contractor will be expected to be instrumental in the establishment/ planning/ installation of such mock ups and to have made due allowance for this within the tender price.

2.23 Quality of Workmanship

The following technical specification outlines the minimum requirements in terms of equipment to be provided and level of installation quality expected by the Electrical Services Contractor. It shall not relieve the Electrical Services Contractor for their responsibility to ensure that the quality of workmanship provided is in accordance with all relevant standards, including BS.7671, together with the requirements of good working practice. This shall include elements such as the method of laying cables into trunking and onto cable trays, etc.

2.24 Contractor's Superintendence

The Electrical Services Contractor shall give all necessary superintendence during the execution of the works and shall constantly employ at least one competent foreman, careful and skilled in the trades and callings required by the specifications to manage and direct the work. The Electrical Services Contractor shall be represented at all site meetings as and when requested by a competent and responsible person who can make decisions with regard to the running of the project.

The Electrical Services Contractor shall liaise the whole of the work to ensure a minimum working period within the occupied areas.

Such foreman shall have charge of all drawings, specifications and any other documents delivered for the use and guidance of the Electrical Services Contractor and shall be authorised to accept any written or verbal instructions given by the Contract Administrator. The foreman shall not be changed during the progress of the works without the written permission of the employer's authorised representative.

2.25 Dismissal of Incompetent Persons

Any person employed by the Electrical Services Contractor on the works who shall appear to the Contract Administrator to be incompetent or to act in an improper manner shall be discharged from site at the request of the Contract Administrator and shall not be re-employed on the works without the Contract Administrators permission.

2.26 Painting

With the exception only of specially and self-finished surfaces, the whole of the equipment shall be painted minimum one coat in the factory after full and proper preparation including priming. Parts not accessible after erection shall have an additional coat applied in the factory. One final coat shall be applied to all accessible parts after erection. Painting shall be suitable for the equipment operating conditions identified.

2.27 Scaffolding

The Electrical Services Contractor shall provide all scaffolding required to undertake this Work Package.

2.28 Location of Points

The term point in this clause implies any electrical outlet termination point or control points. All lighting points, accessories, equipment and controls shall be fixed in the positions described precisely as the scale will permit on the drawings and/or detailed within the specification. Hulley & Kirkwood reserves the right to make such local alterations and adjustments as may be expedient during the progress of the work without incurring extra costs, providing the Electrical Services Contractor is not permitted by such instructions to the dismantling of work already executed to the specification/drawing and the use of additional raw materials than otherwise would have been required.

2.29 Emergency Telephone

The successful Electrical Services Contractor will be required to provide a list of emergency telephone numbers at which responsible members of their organisation may be contacted at all times in the event of any emergency.

2.30 Provision of Electrical Diagrams

Wiring diagrams shall be provided in respect of all electrical equipment and/or systems which form part of the works.

Such diagrams shall be fully comprehensive and shall co-ordinate the manufacturer's data in respect of individual items of equipment so as to present, as a whole, the complete information for any inter-connected group or groups of such items. They shall include: -

- a. Co-ordinated wiring/connection details between equipment and cables showing coding, cable core size and identification.

- b. Schematic layouts presented in “ladder” or similar format such that it is possible to comprehend the operation of a particular system, the inter-connections between the various systems and to identify the components and wiring connections shown on the co-ordinated wiring/connection diagrams.

Wiring diagrams shall be prepared by Technicians having the necessary knowledge to do so competently. The Electrical Services Contractor shall be responsible for the accuracy of such diagrams and shall be liable for all costs arising from any errors in them.

Deviations from the requirements of the specification may be considered, but only if they are fully detailed in a letter accompanying the tender and the difference in price between the specified requirement and that offered is stated in the accompanying letter. Unless deviations are fully detailed, the price given in the tender document shall be deemed to include for all items required by the tender documents.

2.31 Electricity Supply

Unless otherwise indicated, all apparatus and wiring shall be suitable for use with a 3 phase, 4 wire, 400 volt or 230-volt, single phase, 50Hz TN-S supply.

Electrical supplies to the control panels, plant and equipment shall be as detailed in this Specification.

Bonding of all extraneous conductive parts of the installation shall be carried out in accordance with the current edition of the IET Wiring Regulations.

2.32 Electrically Operated Motors and Control Gear

Unless otherwise specified, all electrically operated motors shall comply with BS 2048 and/or BS 5000. Each motor shall be of a size and type to adequately drive the item of equipment to which it is fitted without overloading under the normal working conditions of the Installation served by the item of equipment.

Motors with a rating of less than 0.37kW shall be suitable for operating with a single phase, 230 Volt, 50 Hertz electrical supply. Motors with a rating of 0.37kW and above shall be suitable for operating with a three phase, 400 Volt, 50 Hertz electrical supply.

All motors fitted in fans, pumps, stokers and burners shall be continuously rated.

Electrical insulation shall comply with BS EN 60085:2008. The use of insulation conforming to Classes Y and A of BS 2757 shall not be permitted.

Motors with a rating of less than 1kW shall be totally enclosed.

Motors with a rating of 1kW and above shall be drip proof and screen protected.

Motors with a rating of 2.2kW and above shall be provided with integral power factor correction capacitors, to ensure a power factor of not less than 0.92 lagging at full load.

Each motor which is set for automatic restart shall be fitted with a warning label.

Each label shall be permanently fixed in a prominent position to the motor or item of equipment and shall take the form of a 150 x 100 x 3 thick white plastic plate engraved in not less than 10mm high red infilled letters with the following logo: -

DANGER**THIS MOTOR IS AUTOMATICALLY CONTROLLED AND MAY START WITHOUT WARNING. ISOLATE BEFORE INSPECTION.**

The electricity supply to contactor operating coils shall not exceed 230 Volts. Protective fuses shall be fitted where contactor operating coils are remotely controlled.

The control gear for each motor with a rating in excess of 0.37kW shall include the following:

1. Under voltage protection.
2. For each phase of a three-phase motor a hand reset combined thermal overload device and single-phase protection device with adjustable time lag.

Motors under automatic control, shall be controlled from starters which shall be arranged to automatically restart the motors after the restoration of electrical supplies following a power failure. To suit their particular application starters shall be either intermittent duty rated or frequent duty rated and shall comply with BS EN 60947:2012.

Unless otherwise specified, the type of starters to be provided for motors shall be in accordance with the following: -

Motor Rating	Type of Starter
Not exceeding 5.5kW	Direct on line
Over 5.5kW	Assisted start (Star/delta)

Starters and contactors which are automatically controlled shall also be capable of being manually operated.

2.33 Electrical Welding Interference

The Electrical Services Contractor shall ensure that when welding on site, the welding earth connection shall be connected direct to the metal of the specific weld and that the connection and return cable shall be of suitable size to sustain the welding current.

Prior to any weld proceeding, the Electrical Services Contractor shall prove to the Employer's Agent that the earth connection meets with this requirement. The Electrical Services Contractor shall also ensure that the welding equipment arrangement complies fully with BS EN 1011 and the Health and Safety Document No.8.

2.34 Interference Suppression

All equipment used by the Electrical Services Contractor shall be suppressed to comply with BS EN55014 so as to cause no interference with radio, television or electronic apparatus in use at the works.

2.35 Dimensions

Dimensions indicated on drawings shall in all cases be taken in preference to dimensions given by the scale of the drawing, and the wording of the specification shall be taken in preference to dimensions written on the drawings.

The Electrical Services Contractor shall take responsibility for double checking and taking their own dimensions from the site for the setting out of all plant and equipment, and shall be responsible for the accuracy of those dimensions.

2.36 Installation Drawings, Diagrams and Schedules

The Electrical Services Contractor shall provide all plant manufacturing, installation, working, arrangement and final wiring drawings for approval prior to manufacture or installation.

The Electrical Services Contractor shall prepare, or shall cause their Specialist Suppliers and Contractors to prepare, all necessary drawings, diagrams and schedules for the following purposes: -

- a. To illustrate in detail the arrangement of the various sections of the works and to identify or describe the various components.
- b. To illustrate that the detailed designs of the various services and sections of the works have been properly integrated by the Electrical Services Contractor with the detail of the buildings and with the work of other Trade Packages and other services installations.
- c. To furnish to other trades such information as is the responsibility of the Electrical Services Contractor to provide.
- d. To locate and identify all necessary test points, access positions or other provisions for the commissioning routines.

Such drawings and documents shall be made available as requested and in good time to comply with the requirements and the Main Contractor's construction programme and to enable other interested parties to make full use of the information and discharge their own responsibilities.

Wiring diagrams shall be fully comprehensive and shall co-ordinate the Electrical Services Contractor's data in respect of individual items of equipment, so far as to present as a whole, the complete information for any interconnected groups of such items.

The Electrical Services Contractor shall be responsible for the accuracy of such diagrams.

All drawings, diagrams and schedules called for in this clause shall be submitted to the Contract Administrator for approval prior to issue for construction and installation purposes.

Whilst it shall remain the responsibility of the Electrical Services Contractor to identify and provide full detailed installation drawings, the following is a guide to the categories which will be required, the scale quoted being in each case the minimum.

- a. General layout drawings at a scale of one fiftieth full size, or as appropriate and agreed based on the arrangements provided as part of this package.
- b. Typical detailed connection or assembly diagrams.
- c. Detailed sections through ceiling voids, vertical shafts and horizontal ducts and trenches to a scale of one twentieth full size.
- d. General arrangement drawings of all mechanical plant and equipment showing the positions of the equipment, and of associated motors, starters, motorised dampers and the like.

The Electrical Services Contractor shall be responsible for the accuracy of the information he provides and shall be liable for all costs arising from any errors or delays in such information.

The Electrical Services Contractor shall allow for liaising fully with other Contractors selected to prepare detailed co-ordination drawings for the works, and shall allow for attending co-ordination meetings as required to allow this action to happen.

2.37 Builder's Work Drawing

All builder's work drawings shall be supplied by the Electrical Services Contractor under this works package. The builderswork drawings shall be based on the required provisions to accommodate the final installation drawings the Electrical Services Contractor shall provide all necessary technical information to other work package Contractors as required.

The suitability of the proposed equipment shall be checked by the Electrical Services Contractor to ensure that all equipment offered is designed to be accommodated within the spatial area constraints identified on the tender drawings allowing for maintainability access. Under no circumstances shall equipment be ordered by the Electrical Services Contractor that does not fit into the space available.

The builders work and painting requirements of this Contract shall be as follows.

Drilling of all holes for all fixings and supports and other items where fixing is by means of screws, plugs and expanding type fixings.

Foundation bolts, stays, brackets and other fixings shall be supplied by the Electrical Services Contractor. The Electrical Services Contractor shall provide for the Main Contractor proper and sufficient drawings or templates of all items requiring foundation bolts or other fixtures and all plant required to be built into or otherwise affecting the building structure.

The Electrical Services Contractor shall ensure that adjustments to foundation levels to accept plant, bedding and grouting of plant on foundation and bases, and grouting in all other fixings is adequately and properly preformed and that the levels and adjustments previously made to the plant by the Main Contractor are not thereby disturbed.

2.38 Inspection and Tests at Manufacturers Works

Electrical switchgear and equipment assembled specifically to meet the individual design requirements of the project shall be reviewed by Hulley & Kirkwood in drawing proposal format initially. Upon acceptance of the drawn proposals, the Electrical Services Contractor may commence with manufacture in line with their contract programme. At an appropriate time during the fabrication of such equipment, the Electrical Services Contractor shall invite the Hulley & Kirkwood to the Manufacturer's premises to inspect the equipment and undertake witness testing in line with the Consulting Engineer's schedule of tests (copies available upon request). The Contractor shall make full allowance for transportation and accommodation costs for the Consulting Engineer within their offer, should this be required.

2.39 Provision of Record Documents

The Electrical Services Contractor shall supply, as a prerequisite to Practical Completion of works and compliance with the Health and Safety at Work Act, 1974, comprehensive record documents in uniform indexed bound sets. The indexing system shall be in accordance with requirements (to be advised in due course).

The Electrical Services Contractor is advised that great importance will be placed upon the quality, accuracy, clarity and completeness of the record documents and upon their being made available promptly. The Electrical Services Contractor's attention is drawn to the fact that the provision of the record drawings is an intricate part of the handover procedure as defined in the CDM Regulations and that handover will not be achievable until the record drawings are made available.

The Electrical Services Contractor shall demonstrate from time to time, as required by the Main Contractor throughout the execution of the works, that adequate and accurate records are being kept such as will ensure the completeness and accuracy of the record documents and that the record documents are themselves being progressively compiled as the work on site proceeds. Records shall be compiled by site-based personnel.

2.40 Record Documents

Record documents shall comprise the following: -

- a. Record documents/drawings and schedules
- b. Operating and Maintenance Instructions

Record drawings shall be issued in the following sequence: -

- 1. Preliminary
- 2. Final

The record documents shall be adequate for the following purposes: -

- a. To record clearly the arrangements of the various sections of the works as actually installed, and to identify and locate all components parts thereof.
- b. To make it possible to comprehend the extent and purpose of the works and the method of operation thereof.
- c. To set out clearly the extent to which maintenance and servicing is required and how, in detail, it should be executed.
- d. To provide sufficient and readily accessible information properly to facilitate the ordering of spares and replacements.

The record documents shall be correlated so that the terminology and the numerical and/or references used therein are consistent with and similar to those used in the physical identification of component part of the works.

2.41 Concealed Works

In all cases where work is to be covered or concealed, a minimum of 7 days' notice shall be given to Hulley & Kirkwood before such work is covered. Failure to comply may result in the works being uncovered at the Electrical Services Contractor's cost.

2.42 Protection of the Works

All equipment, materials and components shall be in perfect condition when handed over. The Electrical Services Contractor shall frequently check that adequate protection is provided against rough treatment, dust, grit, frost and other like hazards.

The Electrical Services Contractor shall be responsible for leaving uncompleted sections of the contract works in a safe condition and shall include for any temporary works necessary to give reasonable protection from unauthorised interference.

2.43 Standstill Maintenance

The Electrical Services Contractor shall be responsible for any standstill maintenance required to the plant and components between installation and completion of the works.

2.44 Installer Maintenance

The Electrical Services Contractor shall provide installer maintenance. Installer maintenance shall mean undertaking all comprehensive planned maintenance and operation procedures and activities for a period of 12 months. The period of installer maintenance shall follow acceptance of the installation by the Client and their authorised agents.

2.45 Testing and Commissioning

The testing and commissioning of the system shall be carried out fully in accordance with the details as contained in this specification and full cost allowances shall be included in this respect.

2.46 Running of New Plant for Commissioning

The Electrical Services Contractor shall allow within this tender, for the running of new plant and equipment in conjunction with other work package Contractors to allow the complete commissioning to take place to a satisfactory completion.

The Electrical Services Contractor shall include within their costs for the replacement of all filters after the commissioning process has been completed and handed over to the client.

2.47 Operating and Maintenance Instructions

Operating and Maintenance Instructions shall be provided by the Electrical Services Contractor in electronic format. The manuals shall be written to be read in conjunction with the record drawings and shall comply with the under-noted requirements.

The Operating and Maintenance Manuals shall be assembled throughout the contract period and a record copy of the Manuals shall be maintained on site for the reference of all parties.

The standard of presentation shall be at least equal to that provided by Specialist Technical Writers.

Provisional copies of the Operating and Maintenance Manuals (electronic) shall be submitted for comment and information prior to commencement of dynamic commissioning.

After revision to incorporate any comments and to include "Commissioning Results", electronic copies of the "Final Draft" of the Operating and Maintenance Manuals shall be provided prior to Handover.

The Contractor shall allow for final modifications to the “Final Draft” copies of the Operating and Maintenance Manuals to incorporate user feedback during the initial 6 months post practical completion period.

These Operating and Maintenance Manuals shall be produced on a word processing/database system (such as MS Word). System selected to be confirmed as compatible with the system currently used by the Client at time of production of Operating and Maintenance Instructions. Where manufacturer's information is to be incorporated, this shall be done wherever possible by image scanning directly into the document. The software basis to be adopted shall be agreed in advance with the Principal Contractor.

The format of the Operating and Maintenance Manuals shall include:

- a. A general description of the scope, purpose and manner of working of each system or apparatus forming part of the works.
- b. A detailed description of the scope, purpose and manner of working of each system of automatic controls and/or monitoring instruments.
- c. Data or general design parameters (and associated normal operating temperatures, pressures, etc. based on the commissioning activity).
- d. Clear and comprehensive instructions for the starting up, running and shut down of each system or apparatus.
- e. Clear and comprehensive instructions for dealing with emergency conditions for each system or apparatus.
- f. Instructions in respect of any precautionary measures from time to time necessary (e.g. against corrosion or freezing).
- g. Instructions in respect of the care of apparatus normally subject to seasonal disuse.
- h. Instructions as to the nature, extent and frequency of servicing necessary properly to maintain the works in good condition and as to the materials to be used for the purpose. This information may be supported in detail, but not replaced by, maintenance instructions provided by the suppliers of particular component apparatus.
- i. The names and addresses of suppliers of all major components of the works as may potentially be required to obtain spare parts or replacements.
- j. List of all recommended spares, complete with manufacturer's references, addresses, telephone numbers and fax numbers. The list shall cover all spares required for the normal life of the plant and equipment supplied as part of this package.
- k. Directory listing manufacturer's references, names, addresses, fax and telephone numbers for all items of plant and equipment supplied under this package.
- l. Clear and precise information so as to allow safe decommissioning of systems and disposal of materials, including, but not limited to, items of controlled waste.
- m. Clear and practical Health and Safety Advice, including guidance on the Electricity at Work Regulations 1989.
- n. Pro-Forma Sheets for use in future system modifications.

- o. A full recommended five-year programme of planned preventative maintenance.
- p. Information on the safe disposal of equipment as identified in the WEEE Regulations.
- q. Fault finding procedures for each system and item of equipment.
- r. Copies of all signed testing and commissioning certification.

Copies of manufacturer's drawings and related information shall be supplied with respect to the nature, type and method of operation of individual pieces of equipment, together with their detailed maintenance instructions. Such data, in the form of individual electronic folders and the like, shall be indexed and cross-referenced to the Operating and Maintenance Instructions. This information shall only be provided in electronic format.

The Electrical Services Contractor's attention is drawn to the fact that the Operating and Maintenance Instructions form an integral part of the handover procedure as defined by the CDM Regulations and that until such time as these documents are made available handover will not be possible.

Commissioning Requirements:

The Electrical Services Contractor may, at their own expense, employ a Specialist Contractor to inspect, set to work and commission any equipment which may be of a special nature. In such cases, the Electrical Services Contractor shall be responsible for the nomination, supervision and expense of the Specialist Contractor, and also for all works carried out by the Specialist Contractor.

The Client shall not be held liable for any additional costs incurred by the Specialist Contractor being delayed in testing and commissioning plant, equipment or controls, etc. The Engineer shall witness all commissioning after the plant is presented in full working order.

Test Results and Certificates:

All visual inspection and electrical test results shall be recorded and included in this section. All plant and equipment tested and certified at the manufacturer's works shall also be included.

The following is a list typical of the certificates that shall be included in this section: -

1. Fire alarm test and commissioning certificate
2. Emergency lighting test and commissioning certificate
3. All electrical test records
4. Inspection certificate as prescribed by the IET Wiring Regulations
5. Completion certificate as prescribed by the IET Wiring Regulations
6. NICEIC test certificates
7. Compliance certificates as required by Local Authority
8. Any Insurance or Local Authority reports

9. All handover certificates

Notwithstanding the requirements for the Operating & Maintenance Manuals listed previously, further electronic copies of test certificates shall be handed over to the Contract Administrator for building control certification purposes.

Other Documentation:

The following supplementary information shall also be provided:

1. Emergency lighting maintenance/test log book.
2. Fire alarm maintenance/test log book.
3. Intruder detection system maintenance/test log book.
4. Framed fire alarm zone chart and updated fire alarm schematic shall be installed adjacent to the fire alarm control panels.
5. Schematic wiring diagram in permanent form shall be provided adjacent to the main switchboard. The schematic shall show the sub-mains distribution cabling, switchgear and controls, and main equipotential bonding arrangements.
6. Electric shock treatment card in permanent form shall be provided adjacent to the main switchboards.

In addition to the production of the above documentation, the Electrical Services Contractor shall instruct the person-in-charge of the premises, or an appointed representative in the use of the electrical installation. This should include the following:

- a. Use of switchgear and replacement of fuses, MCBs and MCCBs.
- b. Operation of local switches.
- c. Operation of emergency lighting.
- d. Operation of controls/power supplies to mechanical plant.
- e. Operation of fire alarm including refuge alarms.
- f. Operation of disabled alarm systems.
- g. Operation of security systems.
- h. Operation of standby power systems.

In the event of the Electrical Services Contractor failing to comply with the above requirements, the Client shall reserve the right to make alternative arrangements and costs arising therefrom will be deducted from the Final Account.

2.48 Identification

Each item of equipment (i.e. switchpanels, distribution boards, consumer units, rotary isolators etc.) shall be provided with an identification label. Each label shall take the form of a minimum 100mm x 100mm x 3mm thick white plastic plate. Each plate shall be engraved in not less than 10mm high red or black infilled letters and numerals with the item's

identification reference number, the manufacturer's name, the manufacturer's reference number, the installation or area served and the item's duty or output. The labels shall be drilled and fixed to the items of equipment with self-tapping screws, bolts, clips or other approved fixing devices. The identification reference numbers for items of equipment shall be the same as those which are allocated to the items of equipment on the record drawings for the works.

All final wiring accessories shall also be complete with an identification label. With the exception of circuit references, labelling of wiring accessories shall take the form of proprietary engraving. Circuit references can be provided via adhesive labels having text no less than 8mm stating the circuit reference.

2.49 “As-Installed” Drawings

The “As-Installed” drawings shall be produced and provided by the Electrical Services Contractor and shall comprise the documents listed in the following paragraphs, as applicable. The “As-Installed” drawings should be based on the installation / working drawings, which the Electrical Services Contractor shall keep updated throughout the duration of the works. This will ensure that the final “As-Installed” drawings are as accurate as possible, and that they reflect the installed services provisions.

Electronic copies of the final approved “As-Installed” drawings and Operating & Maintenance Manuals shall be handed over to the buildings Client no later than two weeks prior to the Contract completion date. A receipt shall be obtained for all final drawings and Operating & Maintenance Manuals handed over to the Client, a copy of which shall be passed to the Hulley & Kirkwood for information purposes

Failure to produce the final approved drawings and documentation prior to handover may result in the installation not being accepted by the buildings Client. In this situation, the Electrical Services Contractor shall operate all electrical systems, to the requirement of the Client, until such times as the final approved drawings and documentation are received. The responsibility for the production and timeous handover of the “As-Installed” drawings and Operating & Maintenance Manuals rests with the Electrical Services Contractor.

Sub-standard or inaccurate “As-Installed” drawings submitted to Hulley & Kirkwood for review will not be accepted.

The “As-Installed” drawings shall be produced in the latest version of AutoCAD available, the release version to be at the Employers Agent's option to suit existing working methods. The AutoCAD masters shall be produced in a competent professional manner using best practice in the use of colours, layering and file creation methods. Unsatisfactory AutoCAD masters will be rejected.

Generally, the “As-Installed” drawings submitted shall comprise the following: -

- All such documents shall clearly be endorsed “As-Installed” near to the title block.
- All text on drawings shall be in past tense.
- All drawings shall be produced electronically using AutoCAD software as described above.
- Distribution drawings, plans and schematic for each service showing origin, route, terminations, size and type.

- Plans showing the locations of all plant and equipment.
- Wiring diagrams for all plant and equipment supplied.
- Schedules of equipment utilised including wiring accessories and luminaires etc,

Drawings or sets of drawings to a scale consistent with that used for the “Construction” drawings which shall show the “As-Installed” location of the following: -

- a. The location, including level, if buried, of service connections incorporated in the works, whether carried out by the Electrical Services Contractor or by the appropriate Authority, illustrating points of origin and termination, size and material of pipes, line pressure and/or other relevant information.
- b. The layout, location and extent of all containment services showing sizes of all.
- c. Location, identity, size and details of all apparatus served by or associated with each of the services. The information with respect to size and detail may be presented in schedule form subject to prior arrangement of the Construction Manager.

Manufacturer's drawings or sets of drawings which shall show: -

- a. The general arrangement and assembly of component parts of all machines and equipment which may require servicing.
- b. The internal wiring of each piece of electrical equipment incorporated in the works, together with physical arrangement drawings, where necessary, to locate and identify the component parts.

Comprehensive diagrams or sets of diagrams which shall show: -

- a. The principles of the arrangement and operation of each of the various services as related to the central plant, other principal components and zoning of distribution etc.
- b. All power and control wiring and including size, type of conductor or pipes used and identifying the terminal points of each.

Comprehensive schedules illustrating procedures for fault finding and for action in the event of equipment or system failure.

Comprehensive schedules of spare parts, lubricants, etc., including itemised specifications, identification numbers and sources of supply.

2.50 Instruction and Training of Client Personnel

The Electrical Services Contractor shall, in collaboration with the other Services Contractors and the Principal Contractor, be responsible for arranging a scheme for “Instruction and Training of Client Personnel”.

Draft proposals of the scheme content shall be submitted to the Employer's Agent for their comment in writing not less than 8 weeks before the handover date for any portion of the works. Thereafter the proposals will be finalised and a timetable shall be provided for the scheme.

It is envisaged that the scheme shall comprise a minimum of a 2-day period for up to 10 persons. During these periods formal classroom instruction on the systems and their operation, including controls operations, under normal and fault conditions shall be given. This will occupy approximately 50% of the session with the remaining period consisting of field demonstration.

The Electrical Services Contractor shall provide each person with a comprehensive set of teaching notes and diagrams based on the documents to be supplied under the various sections of this document.

2.51 Spares and Tools

The Electrical Services Contractor shall supply a complete set of the manufacturer's recommended spares, together with the two sets of tools required for the maintenance of plant installed under this Contract to cover the defects liability period. Spares shall be provided in a lockable cabinet per switchroom/plantroom. This is in addition to any other spares called for in this specification.

The Electrical Services Contractor shall provide a complete list of tools that they consider a prerequisite for system maintenance as part of their tender return. The above shall include specialist keys etc., but does not include standard hand tools.

3 STANDARD ELECTRICAL TECHNICAL SPECIFICATION

3.1 LV Distribution

3.1.1 LV Switchboards

General:

All LV switchboards shall be:

- a. Cubicle pattern, totally enclosed, neatly and symmetrically arranged for front access.
- b. Manufactured from sheet steel, rust proofed (Zintec) or electro coated rust inhibited, not less than 2.0mm U (14" swg) thick, adequately braced to the satisfaction of the Services Engineer.
- c. Given one coat of rust inhibiting paint and one coat of undercoat where unpainted before construction. The switchboards shall be finished stove enamel BS.4800, colour to be approved.
- d. Manufactured to BS EN 61439-1, Form 4, Type 2 with fully insulated bus bars and incoming and outgoing bus bar interconnections. All bus bars and all outgoing cableways shall be enclosed in separate compartments to allow work to be carried out on outgoing circuits with the switchboard energised.
- e. Free from rust patches before erection and all marks must be resprayed after erection and connection.
- f. Drawings of the panel shall be submitted to the services engineer for approval before manufacture is commenced.
- g. Fitted internally with cable boxes, glanding plates or special connections for incoming cables or feeder bus bars. External cable boxes shall be permissible only where air circuit breakers are double tiered. Vermin plates shall be fitted at the underside of switchboards.
- h. Complete with supports for all cables which run internally. Separated cable channels shall be provided within switchboards to enclose wiring to distribution boards.
- i. ASTA fault rated as follows:

The bus bars and connections shall be able to withstand the rated fault current at any position and as far as the protective device. The design shall be such that a fault on any functional unit can be restricted to that unit leaving the remainder of the switchboard operational and accessible.

Main Switchboard	50 KA for 1 second
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Sub Switchboards	25 KA for 1 second
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- j. Linked between sections by suitably rated copper earth bars.
- k. Suitable for rated operation in ambient temperatures as follows:

Main Switchboard	25°C
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Sub Switchboards 25°C

The LV Switchboards shall comprise switchgear components as shown on the drawings and to the following specifications:

a. Air Circuit Breakers:

Air circuit breakers as called for in the drawings to comply with BS EN 60947 and IEC.947, of the withdrawable type.

b. Contactors:

Contactors shall comply with BS EN 60947, rated in accordance with "Uninterrupted Duty" and "Utilisation Category AC 1". Contactor coils DC or rectified AC wound for 200 volts, complete with fuse link.

c. Fuse Switches:

All fuses to be high rupturing capacity, non-deteriorating type, complying with BS.88, Part 2, Category AC 80.

Fuses to be supplied with all fuse switches. All fuse switches to be fitted in pressed steel cases with lids lined with insulating enamel and so arranged that the front cover cannot be opened unless the switch handle is in the "Off" position.

All switch contacts must be fully shrouded and no loose shields employed. Fuses to be mounted on the moving part of the switch.

d. Miniature Circuit Breakers:

Miniature circuit breakers shall be installed on distribution boards as required. These shall be of the air break pattern having electromagnetic and thermal tripping devices.

The tripping mechanism shall be of the trip free type to ensure that the circuit breaker cannot be hold closed under fault conditions. Arc chutes shall be fitted to each pole. The circuit breakers and cases shall be manufactured from high dielectric shock and trackproof mouldings. All connections shall be accessible from the front. The "On" and "Off" positions shall be clearly shown as shall the breaker rating. The breakers shall be manufactured to BS EN 60898. Current limiters shall not be used to uprate units. Circuit breaker types shall be suitable for the proposed applications.

e. Moulded Case Circuit Breakers:

Moulded case circuit breakers shall be acceptable alternatives to fused switches provided the units offered can satisfy the various parameters of the design calculations. This will only be allowed with prior agreement from the services engineer.

f. Bus bars:

Bus bars shall be totally enclosed in a housing constructed of sheet steel complying with BS EN 61439-6:2012.

Bus bars to consist of hard drawn high conductivity copper, mounted on all insulated flame retardant, non-tracking insulators.

Bus Bars arranged to allow the largest size conductors to be connected without undue bending. Neutral bar as same cross section as phase bars.

Connectors to be of the split clamping type to eliminate drilling of bus bars to be used with an appropriately rated cable sheathing socket.

The length and current rating of bus bars to allow for possible future additions to the switchboard.

Conspicuous colour marking (e.g. PVC sleeves) to be fitted on each section of bus bar for phase identification.

g. HRC Fuses:

These shall be high rupturing capacity, non-deteriorating type complying with BS.88, Part 2, Category AC 80, suitably related to the safe current rating of the circuit loads and cables.

h. Distribution Boards:

All distribution boards shall be:

- (a) Metal construction for surface use, as specified.
- (b) Manufactured to comply with BS EN 61439-3:2012, and have a 500-volt rating.
- (c) SP & N, DP, TP or TP & N, as scheduled or as indicated on the drawing.
- (d) Of the type and current carrying capacity as indicated on the drawings.
- (e) Fitted with neutral bars have a separate terminal for each outgoing way.
- (f) Fitted with MCB's of ratings shown on the drawings or in the schedules.
- (g) Mounted over suitably sized adaptable boxes where surface distribution boards are used on recessed installations. Access apertures shall be cut in the distribution boards in such cases, the edge of any cut outs shall be fitted with PVC or fibre bushes.
- (h) Firmly secured to the building fabric by means of rawlbolts or other approved method, or to metal framework by means of nuts and bolts.
- (i) Fitted with spare ways as indicated on the drawings.
- (j) Provided complete with locks. All locks shall be capable of being opened by the same key.
- (k) Fitted at a height of not more than 1800 mm to the bottom of the switchboard, unless otherwise stated on the drawing or called for by the services engineer.
- (l) Fitted with typewritten circuit charts mounted inside and protected by transparent double film. Charts shall provide full details of outlets, controlled, circuit number, fuse and cable size.
- (m) Fitted with identifying labels, as specified.

i. Time Switches:

Time switches shall be electrically wound of the synchronous type, totally enclosed and shall incorporate two "On" and two "Off" adjustable settings and day release, day omission and manual operation facilities. A 12-hour spring reserve mechanism shall be provided.

Time switches for the control of outside lighting shall be of the solar dial type.

Approved manufacturers are: Sangamo-Weston, Venner or equal.

j. Labels:

Labels fitted to switchboards, distribution boards and separate items of switchgear shall be:

- (a) Of Ivoryine, perspex or laminate, reverse engraved, coloured Black or as specified, with lettering approved by the services engineer and secured by round head brass screws or instrument screws.

Labels on switchgear shall indicate:

- (a) Reference number of the switch.
- (b) The specified current rating.
- (c) The part of the distribution controlled.

Labels on distribution boards shall indicate:

- (a) The reference number.
- (b) The services, e.g. lighting, sockets, small power, etc.
- (c) Reference number of controlling fuse switch.

The lettering of all labels shall not be less than 5 mm.

The schedule and details of the labels shall be submitted to the services engineer for approval by the contractor to suit the Programme of Works.

k. Switchboard Connections:

- (a) The switchboard shall be provided with sealing boxes to suit the type of cable connected to the units.
- (b) Cable terminations shall be sweated cable lugs, compression type cable lugs, clamp type terminals or thimbles. Where compression type terminations are specified, they shall be made using an approved type of cable lug and compression tool which is specifically designed for the purpose of a cable manufacturer and in which the crimping action and pressure is automatically controlled by the tool.
- (c) Cables shall, in all cases, be taken direct to the terminals of the switchgear.

- (d) Pinching screws which bear directly on the cables shall not be used on equipment having a current rating exceeding 15 amps.
- (e) Outgoing cables shall not pass through bus bar chambers unless authorised either on the drawings or in the schedule or in writing by the services engineer. Where PI sheathed cables enter switchboards, they shall do so using standard or back/reverse entry sealing chambers.
- (f) Connections between bus bars and sub main control units will consist of high conductivity copper rods or strips having a current rating of not less than that of the fuse switch or circuit breaker controlling the sub main and not less than half the current rating of the fuses or circuit breaker protecting the bus bars.
- (g) A copper earth bar is to be fitted throughout the full length of the switchboard. Where the board is sectionalised for transportation purposes, suitable copper links for bonding together adjacent sections are to be provided. Compartments are to be adequately earthed by means of copper earth bar.

I. Instrumentation:

The Main Switchboards shall be complete with a multi-meter capable of measuring the following:

- Volts
- Amps
- kW
- kVAr
- kWh
- kVArh
- kWh Peak Demand
- kVArh Peak Demand
- Frequency
- Power Factor

A Pulsed output unit shall be provided for connection to the BMS system to provide data for kW, kVA and kWh.

3.1.2 Manufacturers

The low voltage switchgear shall be manufactured by one of the following:

- a. Low Voltage Switchgear:

Schneider Electric

3.1.3 HV Cable Construction

XLPE PVC SWA PVC:

XLPE PVC SWA PVC cables shall: -

- a. be in accordance with BS 6622/IEC 502.
- b. be XLPE insulated, with a PVC inner sheath, single wire armoured and with a PVC outer sheath.
- c. have a voltage rating 6350/11000 Volts.
- d. have stranded Class 2 copper conductors to BS EN 60228:2005.
- e. have a XLPE insulation with an extruded semi-conducting layer and a plain copper tape screen.
- f. have a PVC inner sheath Type 9 to BS.7655 and mild galvanised steel wires to BS EN 10257-1:2011.
- g. have a PVC outer sheath Type 9 to BS.7655 and flame retardant to BS EN 60332-2:2004 + A1:2015.
- h. have a red coloured oversheath
- i. be manufactured by only one maker.

3.1.4 LV Cable Construction

All cables shall be sized and rated in accordance with the current edition of the IET Wiring Regulations.

XLPE LS0H SWA Power and Control Cables:

XLPE LS0H SWA cables shall: -

- a. be in accordance with BS 5467, 6622, 7835, 7889 and IEC 60502.
- b. be XLPE insulated, with a LS0H inner sheath, single wire armoured and with a LS0H outer sheath.
- c. have a voltage rating of 600/1000 Volts.
- d. have stranded Class 2 copper conductors to BS EN 60228:2005.
- e. have a XLPE insulation Type GP8 to BS 7655
- f. have a LS0H inner sheath to BS 6724 and mild galvanised steel wires to BS EN 10257-1:2011.
- g. have a LS0H outer sheath to BS 6724 and flame retardant to BS EN 60332-3-10:2009 NMV 1.5 as a minimum (IEC 332 Part 3 Category C).
- h. be manufactured by only one maker.

LS0H Cables (Single Core) shall: -

- a. be in accordance with BS 7211.
- b. be low smoke zero halogen insulated.

- c. have a voltage rating of 450/750 Volts.
- d. have standard Class 2 copper conductors to BS EN 60228:2005.
- e. be flame retardant to BS EN 60332-1-2:2004 + A1:2015.
- f. coloured in accordance with the current edition of IET Wiring Regulations.
- g. be insulated to BS 7655.
- h. be manufactured by only one maker.

Mineral Insulated Copper Sheathed Cables shall be:

- a. sheathed with solid drawn copper and complying with BS 6207, BS EN 60702.
- b. 750-volt grade heavy duty for all LV circuits and 450-volt grade for ELV circuits.
- c. LSOH sheathed overall (colour to suit specified requirements)
- d. have copper conductors
- e. be manufactured by BICC or approved equal.

3.1.5 Cable Insulation

General:

All cables shall be installed:

- a. With each length of cable marked at each end and at access points by a label indicating the cable size and circuit.
- b. In such a manner that the cable and the cleats do not come into contact with gas, oil, steam, hot or cold water or any other service.
- c. In ducts and on the walls of buildings using Silicone aluminium claw type cleat supports as indicated on the drawings or in the schedules, or other purpose made supports as approved by Hulley & Kirkwood.
- d. Using cleats of the correct type and size to suit the overall diameter of the cable. The cleats or other specified supports shall be installed in accordance with the IET Wiring Regulations as regards radius of bends and to manufacturer's recommendations as to spacing between supports, and in a manner that no undue strain is put on the cables or the gland.
- e. With fire resisting infill where passing through floors or walls, to comply with IET Wiring Regulations.
- f. Protected from mechanical damage to a height of 2m above floor level, where run on the surface of walls.
- g. In short lengths of glazed earthenware, pitchfibre, or glazed fibre cable conduit, so designed and installed, where cable access to buildings is required, that the cable is not damaged when drawn into the conduit and the entry point is sealed to prevent the ingress of moisture and vermin.

- h. Buried in trenches where run externally, in accordance with the following requirements detailed in paragraph for 'Excavation'.

XLPE SWA LS0H:

Cables shall be:

- a. Supported as necessary either by cleats to the structure or on cable tray to meet the requirements of the current edition of the IET Wiring Regulations.
- b. Terminated in suitable compression glands of the type which provide an anchorage and a cross joint bonding of the armouring. The glands shall then be fitted with PVC shrouds that completely encase them.
- c. Run on routes indicated on the drawings. Any deviation shall be approved by the Engineer before laying commences. The routes shall be measured on site by the Contractor and he shall be responsible for ensuring that the correct lengths are ordered. Any length found to be measured too short will be replaced with cable of the correct length.

Cables shall be delivered to site in one continuous length on a drum ready for laying. No "through" or "T" joints shall be permitted. Cable ends shall be kept sealed before installation by means of wiped joint end caps.

XL-LS0H Cables (Single Core) shall be:

- a. Delivered to site with each coil having seal intact
- b. Installed without joints
- c. Fitted with shake proof or spring washers on all bolted connections
- d. Terminated with compression type lugs, and ferrule markers indicating cable size and circuit
- e. Terminated in boxes
- f. Cables shall not pass through light fittings, or be coupled directly to lampholders

Mineral Insulated Copper Sheathed Cables shall be:

- a. Fixed by means of copper or aluminium saddles respectively to match the sheath of the cable. Saddles shall be fixed to the structure as detailed for conduit work.
- b. Saddles shall be spaced as given below:

Overall dia. of Cable mm	Maximum Spacing of Fixings mm	
	Horizontal	Vertical
Not more than 9 mm dia.	600 mm	800mm
Above 9 mm not more than 15mm	900 mm	1200mm
Above 15 mm not more than 20mm	1500 mm	2000 mm

Where several cables are run together, multiple saddles shall be used. Fixings shall be as detailed for conduit work.

- c. Run on cable trays where multiple runs occur. Saddles shall be fixed using brass round head screws and nuts.
- d. Delivered to the site having manufacturer's seals and identification labels intact.
- e. Tested in the presence of Hulley & Kirkwood or their representative not less than 24 hours after installation and completion of seals. Any cables not giving 1 megohm reading when tested with a 500-volt insulation resistance tester shall be resealed.
- f. Tested before and immediately after covering by concrete, plaster, or being buried in the ground, for continuity and insulation resistance to verify that mechanical damage has not occurred.
- g. Protected as detailed for conduit installations where the final finish of floor screed, plaster, etc., is not carried out immediately after installation.
- h. Protected by fibre sleeves where passing through floors, walls, ducts or trenches.
- i. Protected by means of cable trunking or conduit to a height of 1 m on walls after passing through floors, and arranged to provide a neat finish.
- j. Terminated with brass locknuts and female bushes in equipment where clearance holes are provided and clearance is available.
- k. LS0H sheathed with LS0H hoods and shrouds provided at all terminations.
- l. Installed by tradesmen who have had a course of instruction in the handling and jointing of this cable.
- m. Installed using only the bending, stripping and sealing tools recommended by the manufacturer.

3.1.6 XLPE SWA LS0H Cables

Joints shall not be permitted.

3.1.7 XL-LS0H Cables (Single Core):

Joints shall not be permitted.

3.1.8 MICS Cables:

Joints shall not be permitted.

3.1.9 Termination of Cable Conductors:

Cables shall be:

- a. Terminated by glands, deemed suitable for the purpose by the cable manufacturers.
- b. Identified at each termination by cable markers of the push on or heat shrink type.

Conductors shall be:

- a. Terminated by one of the following methods unless otherwise stated:
 - Sweated lugs of the appropriate size for the cable used
 - Compression type lugs
 - Pinch screw type terminals of a type that do not spread the conductors
 - Clamp type terminals
- b. Doubled back on themselves for all single connections of conductors size up to and including 4 mm².
- c. Terminated in a box or within the lighting fittings or other appliance to be connected.
- d. Identified at each termination by cable markers of the push on or heat shrink type. The information covered by such marking shall be sufficient to allow the installation to be maintained easily and safely.

3.1.10 Flexible Cables and Cords:**Flexible cables and cords shall:**

- a. Have conductors not smaller than size 24/0.20 unless otherwise specified.
- b. Be of circular construction, finish White.
- c. Be of either LS0H or Butyl rubber to BS 6007 where used in higher temperature conditions.
- d. Have LS0H insulation where used for pendant lighting fittings, adjustable lamps or other portable appliances, unless otherwise specified.
- e. Be of the heat resistant type of silicone rubber, complying with the appropriate British Standard where used for connections to lighting fittings.
- f. Have an earth conductor of sufficient length to ensure that no undue stress is placed on this conductor.

Multicore PVC Cables (Twin & Earth, etc.) shall:

- a. NOT be used. T&E cabling shall be LS0H.

3.1.11 Excavation

- a. The Electrical Services Contractor shall be responsible for clearly marking out all cable routes on Site. The excavation, back filling and reinstatement of the ground will be carried out by the main contractor.

The supply and laying of sand, the delivery and storage on Site, will be the responsibility of the main contractor.

Any work carried out on information given wrongly by the Electrical Services Contractor shall be charged to the Electrical Services Contractor including the cost of making good.

- b. The trench shall be excavated for a minimum cable depth of 0.5 metre in undeveloped ground. (1.0 metre for HV cables).
- c. The trench shall be excavated for a minimum cable depth of 0.6 metre (1.1 metre for HV cables) earthenware, pitch fibre, or glazed fibre cable conduits of minimum diameter 100 mm (4") and extended 1 m (3'0") on either side of the roadway.
- d. The trench shall be filled with a layer of 75 mm of sifted sand to support the cable and 75 mm of sand shall cover the cable after laying, with a PVC marker tape laid on the sand directly over the cable throughout the length of the cable route. Marker tape to be supplied by the contractor.
- e. The trench shall be back filled with the excavated earth, which shall be well rammed down. Not more than 150 mm of soil shall be rammed down at any one time. The work shall be inspected by the engineer before backfilling is commenced.
- f. Where cables are buried in lawns, grass verges, or paved areas, their positions shall be indicated by concrete markers which shall be spaced at intervals of 45 metre on straight runs and at all changes of direction. Markers shall be supplied and fixed by the main contractor.
- g. Where changes of direction occur, the markers shall be fitted with an arrow indicating the direction. Markers shall be 200 mm x 200 mm x 50 mm formed of concrete and fitted with lead insert giving the voltage, direction, depth of cable and type of joint where applicable. In unmade ground, markers shall be concrete posts 600 mm long sunk into the ground to a depth of 300 mm complete with lead insert giving the information specified above. The supply and erection of the cable markers shall be the responsibility of the main contractor.
- h. The position of the cables shall be indicated where entering buildings by a brass plate, fitted to the wall, engraved with the size and voltage of the cable. Engraving details will be given during the course of the Contract.
- i. The correct positioning of the cable markers shall at all times be the responsibility of the main contractor.
- j. All surplus excavated material shall be removed from site and disposed of by the main contractor
- k. The responsibility for the safety of the trenches and ensuring that they are adequately guarded and supported, shall be by the main contractor.
- l. Cable laying shall not take place when the ambient temperature is below 0°C.
- m. Where more than one cable is laid in a trench, the horizontal spacing between cables shall be at least 225 mm. Tracks wider than 500 mm shall have two marker tapes placed throughout the length of cables.

Until all cables have been covered by the first layer of consolidated backfill, no sharp metal tools such as picks, spades or fork shall be used in the trench, or placed in such a position that they may fall into the trench.

- n. The surface of the refilled trench shall be temporarily reinstated and left and maintained in a thoroughly safe condition, to the satisfaction of the Surveyor of the Local Authority, body or person concerned until the work of permanent reinstatement is carried out.

All excavations in tarmac asphalt or concrete roadways shall be temporarily reinstatement with a 50 mm layer of coated macadam. Flag or slab paving shall be temporarily reinstated by relaying the existing flags or slabs on a 50 mm bed of sand or ashes. Other temporary reinstatement shall normally consist of a 50 mm layer of pebble free quarry dust or equivalent rolled level with a suitable roller, except where a 25 mm layer of tarred chips is approved by the engineer. All spoil shall be removed from Site and all surfaces shall be left and maintained in a clean and tidy condition. Settlement shall be dealt with as agreed, particularly following wet weather.

- o. The permanent reinstatement of roads, footpaths and other surfaces to the approval of the engineer and any other Authority interested shall be carried out by others and shall fulfil the statutory obligation in respect of reinstatement and maintenance under the Public Utilities Street Works Act, 1950. Permanent reinstatement shall include for all necessary keying into existing road surfaces.
- p. Compliance with the requirements of the Traffic Safety Code for Roadworks, and provision of any necessary traffic controls or traffic lights, which may be required, shall be by others.
- q. The excavation work shall be fully comprehensive covering all the aforementioned work, and shall include all guarding, watching, lighting, timbering, slinging, shoring, pumping, and bailing and the provision of all necessary labour, plant, tools, water, fuel or motive power for such purpose. The provision of watchmen as the Local Authorities and other public undertaking deem it necessary for the protection of the public and assistance of traffic, shall be by the main contractor.

3.2 Conduit and Cable Trunking Installations

3.2.1 Segregation of Services

Where multiple trunking systems or multi-compartment trunking is required, services to trunkings or compartments shall be detailed on the drawings.

Independent conduit systems shall be provided for:

- Lighting and Power (LV)
- Monitoring Systems
- Data and Voice Cabling
- Security Systems
- Fire Alarms

3.2.2 Steel Conduits, Generally

Conduits shall be:

- a. Class 2, Medium Protection welded conduit to BS EN 61386-1:2008 for screwed conduit installations. Class 4 Heavy Protection, solid drawn and screwed for flame proof installations.
- b. Galvanised for installation in damp or humid conditions where indicated in the specification, or drawings. They shall be hot galvanised inside and out during manufacture.
- c. Stove enamelled Jet Black, unless otherwise stated Silverlac conduit shall be used where indicated in the Specification, or on the drawings.
- d. Threaded to the correct length in accordance with BS EN 61386-1:2008 and each length shall be reamed at both ends to remove all sharp edges and burrs after screwing.
- e. Cleaned of all lubricants and swarf before installation. Threads already cut shall be cleaned by having dies run over them and wiped clean.
- f. Protected from weather and mechanical damage during storage and installation at site.

3.2.3 Conduit Installation, Generally

All conduits shall be:

- a. Installed neatly and as unobtrusively as possible, parallel to general building lines when run on the surface of walls and ceilings.
- b. Routed as approved by Hulley & Kirkwood before installation. Spaced at the standard dimensions of multiple saddles where two or more conduits are run together.
- c. Checked for rigidity and mechanical damage where run in floor screed, before the floor screed is laid. Any damaged conduit runs shall be renewed.
- d. Laid in straight line from point to point when concealed.
- e. Protected at terminations by plugs or caps until installation of cables and swabbed dry and proved clear before wiring is commenced.
- f. Provided with temporary protection where run in floors to prevent damage to the finish, until floor screeds are laid.
- g. Painted with rust inhibiting paint after erection where threads are exposed or where the finish is damaged.
- h. Screwed and butted solidly into boxes, couplings and conduit fittings and satisfactorily mechanically continuous throughout.
- i. Tested for satisfactory electrical continuity before plastering or screeding and before cables are drawn in. The tests shall be witnessed by the Hulley & Kirkwood or their Representative.
- j. Installed with the minimum of running couplings other than those provided under (o) below. Where provided, couplings shall have machined end faces for locknuts having machined faces.
- k. Bent or set using a bending machine and with minimal deformation of bore.

- l. Threaded parallel with the bore. All conduit shall be held in an efficient pipe vice for screwing. Where coupled to equipment or trunking not having tapped conduit entries, smooth bore male brass bushes shall be used inside the equipment and circular milled locknuts to be installed at all terminations and on each side to ensure electrical continuity. All bushes shall be fitted with spring, shakeproof or compression washers.
- m. Installed in accordance with the current edition of the IET Wiring Regulations with respect to the maximum allowable number of cables in conduits.
- n. Provided with draw in facilities for easy installation or withdrawal of any one or all cables.
- o. Installed with a running coupler socket inserted within 300 mm above the floor or below the ceiling on all vertical drops or risers.
- p. Installed only horizontally or vertically in wall chases or on the surface of the walls. Horizontal runs shall be avoided where practical.
- q. Supported 150 mm each side of any bend, set adaptable or draw in box.
- r. Installed using spacer bar saddles for surface runs exposed to view.
- s. Installed using pressed steel or spacer bar saddles, or approved proprietary fixing when installed in roof spaces, above suspended ceilings, or in other spaces as agreed with Hulley & Kirkwood.
- t. Installed using crampets for fixing when installed in screeds or in chases that will be rendered and plastered.
- u. Installed with saddles or crampets spaced at distances of:

Conduit Size	Vertical Horizontal Spacing
20 mm - 25 mm	1.2 m
32 mm - 40 mm	1.5 m
50 mm	1.8 m

- v. Installed with saddles rigidly fixed to the structure by means of proprietary make of wall plug and screws to a depth to suit the structure.
- w. Installed with all fixing holes in walls etc. drilled with masonry drills. Subject to the engineer's prior agreement before commencement of work, shot fired fixings may be used.
- x. Installed so that where condensation in the conduit is likely, the sections shall be isolated by means of a conduit box filled with plastic compound of the non-hardening type, located in the higher position in the conduit run.
- y. Provided with adequate drainage points where condensation is likely to occur.
- z. Of 20 mm² minimum.

Conduit Installations shall NOT:

- a. Be concealed before inspection and approval by Hulley & Kirkwood.
- b. Have more than two right angle bends in any run without the provision of a draw in box.
- c. Have runs of more than 10 metres without a draw in box on straight lengths or 7.5 metres on lengths containing a bend or bends.
- d. Incorporate manufactured bends, tees, or elbows. Circular junction or adaptable boxes may be used instead.
- e. Be fixed by means of crampets on the surface of walls.
- f. Have cables drawn in until erection is completed.
- g. Be dismantled for cabling.
- h. Be scored, marked or have the bore deformed.
- i. Have damaged or poorly cut threads.
- j. Be installed in contact with steam water or gas or heating pipework. A distance of 150 mm shall be maintained from all other services wherever possible.
- k. Have any untreated rust patches on surfaces.

Galvanised Conduits shall be:

- a. Fixed using galvanised saddles and sheradised or galvanised screws.
- b. Painted with Zinc rich paint where threads are exposed.
- c. Installed with all necessary galvanised accessories.
- d. Galvanised conduits shall be installed where conduits are installed in floor screeds, and where surface installation is required.

Metallic Flexible Conduit shall be:

- a. Used only to items of equipment that are withdrawable or subject to vibration or adjustment.
- b. PVC sheathed and of ample capacity for the number of cables.
- c. Have a minimum length of 300 mm and have sufficient length to allow the full range of withdrawal, adjustment, or movement necessary.
- d. Terminated at each connection with factory made clamps. Run with earth conductors of minimum size 1.5 mm insulated cable installed externally, neatly taped to conduit and fixed at each end of the conduit with earth clamps when being used as an earth path.
- e. In accordance with BS EN 61386-1:2008.

Metallic Flexible Conduit shall NOT be:

- a. Used externally to a building or exposed to the weather or in any position where ingress of moisture may occur.

3.2.4 Conduit Fittings**Circular Conduit Boxes shall be:**

- a. Of malleable cast iron to BS EN 61386-1:2008 finished Black enamel silverlac or galvanised as appropriate and provided with lids of mild steel 1.6 mm U 816 swg) thick, finished to suit the box and secured in position by brass roundhead or cheesehead screws.
- b. Provided with tapped spout entries except where arranged for back entry looping.
- c. Of heavily galvanised weatherproof type where installed externally, with mineral jelly between surface of the joint, or alternatively fitted with a gasket.
- d. Of the tangent type at right angle changes of direction where necessary to form a neat and unobtrusive run.
- e. Installed in such a manner that the edge of the box is flush with the finished surface, or alternatively extension rings shall be used. The engineer shall be informed where extension rings are proposed, prior to installation.
- f. Firmly grouted in where provided for switch and socket outlet points in brick and concrete.

Adaptable boxes shall be:

- a. Manufactured from sheet steel or cast iron.
- b. Used instead of BS EN 61386-1:2008 type boxes where two or more parallel conduit lengths are jointed together.
- c. Provided with earthed steel barriers where necessary to segregate services.
- d. Galvanised malleable cast iron type with heavy lids made watertight where used externally.
- e. Fitted with overlapping lids where used on flush installation.
- f. Heavily galvanised after manufacture, where used with galvanised conduit.
- g. Fixed in accessible positions and secured to the fabric of the building.
- h. Of adequate size for the number and size of cables entering and leaving and for the largest size of conduit connected to the box.

3.2.5 Cable Trunking Installation

All cable trunking shall be:

- a. Installed neatly and as unobtrusively as possible, parallel to general building lines when run on the surface of walls and ceilings, or where concealed in ceiling or other service voids.
- b. Routed as approved by Hulley & Kirkwood before installation.
- c. Checked for rigidity and mechanical damage where run in floor screed, before the floor screed is laid. Any damaged runs shall be renewed.
- d. Provided with temporary protection where run in floor to prevent damage to the finish, until floor screeds are laid.
- e. Butted solidly at intersections and joints between lengths, and satisfactorily mechanically continuous throughout. Earth links shall be provided for electrical continuity.
- f. Tested for satisfactory mechanical continuity before plastering or screeding and before cables are drawn in. The tests shall be witnessed by Hulley & Kirkwood.
- g. Galvanised for exposed and underfloor runs.
- h. Joined between lengths and at changes of direction using the manufacturer's factory-made accessories.
- i. Installed in accordance with the current edition of the IET Wiring Regulations with respect to the maximum allowable number of cables in trunking.
- j. Installed with cable supports to all vertical drops or risers in accordance with the current edition of the IET Wiring Regulations.
- k. Installed with fire barriers where runs pass through floors or fire division walls.
- l. Supported 150 mm each side of any bend or set.
- m. Installed clear of the structure utilising purpose made brackets.
- n. Installed on walls with fixings by means of proprietary make of wall plug and screws to a depth to suit the structure.
- o. Of the one manufacture throughout for each type of trunking.
- p. The dimensions of cable trunking shall be as detailed and are in accordance with the requirements of the current edition of the IET Wiring Regulations.
- q. The trunking shall be heavy gauge 16 swg 1.6 mm type single or multi compartment as indicated on the drawings.
- r. Cables shall be retained in the trunking by the manufacturer's retaining clips.
- s. Fixed or bracketed to the structure at intervals not exceeding 2 metres.
- t. The trunking shall have removable lid over its entire length, which shall be fixed at 1 metre intervals.

- u. Where the trunking passed through walls or floors, the lid shall be neatly cut 75 mm on each side, to allow removal or adjacent lengths.
- v. The union between conduits and trunking shall be by male bush and coupling with a serrated washer between the bush and the trunking tightly screwed up for earth continuity.

Trunking Installations shall NOT:

- a. Be concealed before inspection and approval by Hulley & Kirkwood.
- b. Have cables drawn in.
- c. Be dismantled for cabling.
- d. Be scored, marked or otherwise deformed.
- e. Be installed in contact with steam water or gas or heating pipework. A distance of 150 mm shall be maintained from all other services wherever possible.

3.3 Cable Tray and Basket Installations

3.3.1 Segregation of Services

Independent cable tray and basket systems shall be provided for the cables of the following distribution networks.

- LV Mains
- Fire Alarm Wiring
- ELV Wiring – Telephones / Data / Security / CCTV Systems

3.3.2 Fire Barriers

All fire barriers for cable trays, and basket shall comply with BS 476 Part 20: 1987 with a minimum 2-hour protection.

When electrical services pass through plant room walls or floors great care must be taken to ensure that the gaps between the services and structure are properly sealed for acoustic and fire rating properties.

The gaps shall be completely filled to the full thickness of the structure with mineral fibre having a minimum density of 150 kg/m³. Both faces of the mineral fibre shall be coated with a fire-resistant ablative mastic to dry film thickness of at least 1 mm. Fire barriers shall only be installed where services pass through pre-determined fire compartments which shall be highlighted by the contractor.

It shall be the responsibility of the contractor to ensure that all holes surrounding are filled for both acoustic and fire rating properties. However, it is also the contractor's responsibility to fill all tray, ladder and basket internal spaces/voids with mineral fibre as detailed above.

3.3.3 Straight Dividers

Straight dividers shall be fixed to cable trays, ladders and baskets, where indicated on the drawings, by means of M6 x 12 mm roofing nuts and bolts.

3.3.4 Galvanised Cable Trays

All Cable Trays shall be manufactured from pre-galvanised mild steel, to BS EN 10346:2015 and BS EN 10143: 2006 with a minimum coating weight of 275 g/m². Cable tray and cable fittings shall be fully perforated, slot sizes shall be 20 mm x 7 mm (or similar), running parallel to the length of the cable tray and 13.5 mm by 11 mm (or similar) running perpendicular to the length of the cable tray.

Pre-galvanised cable trays for internal applications shall comply with the general requirements of GDCD Standard No.23 March 1979 and shall be: -

a. Light duty non-return flange:

Gauges shall be a minimum of 1.0 mm for tray up to 225 mm, 1.2 mm between 225 mm and 300 mm, and 1.5 mm above 300 mm. Flange height shall be a minimum of 12 mm

Heavy duty non-return flange:

Gauges shall be a minimum of 1.0mm for tray up to 225 mm, 1.2 mm between 225 mm and 600 mm, and 1.5 mm over 600 mm. Flange height shall be a minimum of 35 mm.

Medium duty return flange:

Gauges shall be a minimum of 1.0 mm for tray up to 225 mm, 1.2 mm between 225 mm and 300 mm, and 1.5 mm above 300 mm. Flange height shall be a minimum of 25 mm and a minimum return flange of 5 mm.

Heavy duty return flange:

Gauges shall be a minimum of 1.0 mm for tray up to 225 mm, 1.2 mm between 225 mm and 600 mm, and 1.5 mm over 600 mm. Flange height of 50 mm and a minimum return flange of 18 mm.

Extra heavy duty return flange:

Gauges shall be a minimum of 1.0 mm for tray up to 225 mm, 1.2 mm between 225 mm and 600 mm, and 1.5 mm over 600 mm. Flange height shall be a minimum of 75 mm.

- b. In general, heavy duty, return flange, pre-galvanised perforated, cable tray shall be used for mains and sub-main cabling with light duty, galvanised perforated cable tray used for fire alarm, emergency lighting and communications cables.
- c. Supported on purpose-made suitably treated mild steel supports which shall permit easy adjustment and modification or by suitable channel, brackets and accessories to BS 6946 at intervals necessary to provide a rigid fixing in accordance with the manufacturers recommended fixing centres. Channels to BS 6946 shall be manufactured from 2.5mm material conforming to BS EN 10346: 2015 and BS EN 10143:2006. Brackets to BS 6946 shall be manufactured from 6mm mild steel, 40mm wide, hot dip galvanised after manufacture to BS EN ISO 1461:2009 and shall have a minimum hole size of 14 mm² holes to accept M12 setscrews.

- d. Capable of carrying without undue deflection, the total weight of cable likely to be carried on the tray regardless of the location of the joints.
- e. Fixed to the fabric of the building by means of expansion type masonry plugs or bolts. Fixed to steelwork and purlins with proprietary fixings approved by the structural engineer and purlin manufacturer.
- f. Installed with a space between the structure and supported tray as follows:

Tray	Space
Up to 100 mm wide	75 mm minimum
Above 100 mm wide	100 mm minimum

- g. Installed using factory formed bends and tees. Where cut sections are used for sets they shall be free from sharp edges, and joined by means of fish plates or couplers bolted to each section in accordance with the manufacturer's recommendations.
- h. Painted with zinc rich paint to BS 4652 where cuts have been made.
- i. Suitably protected where holes have been cut to allow cables to pass through or exit the tray.
- j. Installed and coupled together using fish plate and/or flat bar couplers secured with the appropriate number of M6 x 12 mm roofing bolts and nuts or stainless-steel clips as required in accordance with the manufacturer's recommendations.
- k. Fitted with inverted cable tray through and extending to 300 mm either side of fire barriers.
- l. Earth continuity connectors shall be fitted between each length of cable tray to ensure compliance with BS 4678. The earth continuity connectors shall be manufactured from copper braid to BS.4109 complete with copper lugs to BS 6017 and BS 1977 or copper earth links with a minimum conductor area of 4 mm² and with an electro-tinned finish. The connectors shall be fastened by M6 x 12 mm roofing nuts and bolts. The connectors shall be fixed in accordance with the cable tray manufacturer's recommendations.
- m. Supported by trapeze hangers up to 450 mm wide by M10 threaded rods and M12 threaded rods for 600 mm widths and above.

Channel nuts shall be:

- a. Manufactured from steel bar to BS 970: Part 3: 1971. Channel nut shall be zinc plated to BS 3382: Part 2: 1961 clear passivated.

Bolts shall be:

- a. Manufactured to BS EN 24018: Grade 4.6. The bolt shall be zinc plated to BS.3382: Part 2: 1961 clear passivated.

Cable Tray Covers:

- a. Ventilated cable tray covers shall be provided as described on the drawings. The covers shall provide an adequate gap along either side through which air can circulate.
- b. Ventilated cable tray covers shall be secured using proprietary clips and fixings in accordance with manufacturer's recommendations.
- c. All straight covers shall be supplied in lengths of 1.5 metres or 3 metres.

Cables shall be fixed to the tray:

- a. By means of proprietary forms of LSOH or copper cable clips, hot dip galvanised cleats, saddles or straps with zinc plated or serrated bolts or nuts and washers at intervals of not more than 1200 mm. Plastic wraps shall not be permitted.
- b. By means of copper or brass saddles and clips where high temperatures or humid conditions are likely to be experienced. All saddles, clips, straps, etc, shall be fixed to the tray by means of brass screws or bolts and nuts.

Cables shall not be fixed to the tray:

- a. By means of strips of steel wire e.g. wire armour steels, ceiling grid support steel.
- b. With lengths of any material not specifically intended for the fixing of cables or capable of sustaining the cables respective maximum fault level.

Nylon Coated Cable Trays shall be:

- a. Nylon coated and comply with the general requirements for galvanised cable tray.
- b. Channel nuts shall be manufactured from stainless steel to BS EN 10088-1: 1995 Grade X2CrNiMo17-12-2 or X5CrNiMo17-12-2.
- c. Bolts shall be manufactured from stainless steel 4A Grade.
- d. Supported on purpose-made suitably treated insulated mild steel supports which shall permit easy adjustment & modification or by suitable channel, brackets, and accessories to BS 6946 at intervals necessary to provide a rigid fixing in accordance with the manufacturers recommended fixing centres. Channels to BS 6946 shall be manufactured from 2.5 mm stainless steel to BS EN 10088-2: 1995 grade X2CrNiMo17-12-2 or X5CrNiMo17-12-2. Brackets to BS 6946 shall be manufactured from 5mm stainless steel to BS EN 10088-1: 1995 grade X2CrNiMo17-12-2 or X5CrNiMo17-12-2, 40 mm wide, and shall have a minimum hole size of 14 mm² holes to accept M12 setscrews. Proposals for prevention of bi-metallic corrosion shall be submitted for approval.
- e. Installed and coupled together using M6 x 12 mm A4 stainless steel fixings in accordance with the cable tray manufacturer's recommendations.

3.3.5 Galvanised Wire Baskets

All galvanised wire baskets shall be manufactured from mild steel wire to BS 1052: 1980 (1986) and shall be zinc plated to BS 1706: 1960, Grade Zn02, with a clear or yellow passivated finish. Zinc plated and passivated wire baskets for internal applications shall be: -

a. Light Duty:

Flange height shall be a minimum of 25 mm. Wire diameter shall be 3.5 mm to 5 mm with a maximum grid size of 100 mm long by 50 mm wide.

Medium Duty:

Flange height shall be a minimum of 50 mm. Wire diameter shall be 3.5 mm to 5 mm with a maximum grid size of 100 mm long by 50 mm wide.

Heavy Duty:

Flange height shall be a minimum of 100 mm. Wire diameter shall be 3.5 mm to 5 mm with a maximum grid size of 100 mm long by 100 mm wide.

- b. In general, cable baskets shall be used for voice and data communications cables and for sub-mains cables where indicated.
- c. Capable of carrying without undue deflection, the total weight of cable likely to be carried on the basket regardless of the location of the joints.
- d. Installed using on-site fabricated bends and tees. Where cut sections occur, they shall be free from sharp edges, and joined by means of clamps or couplers bolted to each section in accordance with the manufacturer's recommendations.
- e. Installed and coupled together using clamps and/or couplers secured with the appropriate number of M6 x 12 mm roofing bolts and nuts as required in accordance with the manufacturer's recommendations.
- f. Supported on purpose-made suitably treated mild steel supports which shall permit easy adjustment and modification or by suitable channel, brackets and accessories to BS 6946 at intervals necessary to provide a rigid fixing in accordance with the manufacturers recommended fixing centres. Channels to BS 6946 shall be manufactured from 2.5 mm material conforming to BS EN 10142: 1991 and BS EN 10143: 1993. Brackets to BS 6946 shall be manufactured from 6mm mild steel, 40mm wide, hot dip galvanised after manufacture to BS 729: 1971 (1994) and shall have a minimum hole size of 14 mm² holes to accept M12 setscrews.
- g. Fixed to the fabric of the building by means of expansion type masonry plugs or bolts. Fixed to steelwork and purlins with proprietary fixings approved by the Structured engineer and purlin manufacturer.
- h. Painted with zinc rich paint to BS 4652 where cuts have been made.
- i. Fitted with inverted wire basket through and extending to 300 mm either side of fire barriers.
- j. Installed with a space between the structure and supported basket as follows:

Basket	Space
Up to 100 mm wide	75 mm minimum
Above 100 mm wide	100 mm minimum

- k. Earth continuity connectors shall be fitted between each length of cable basket to ensure compliance with BS 4678. The earth continuity connectors shall be manufactured from copper braid to BS 4109 complete with copper lugs to BS 6017 and BS 1977 with a minimum conductor area of 4 mm² and with an electro-tinned finish. The connectors shall be fastened by M6 x 12 mm roofing nuts and bolts. The connectors shall be fixed in accordance with the cable basket manufacturer's recommendations.
- l. All accessories shall be formed from on-site standard straight lengths of cable basket by using manufacturers bolt cutters and form the basket to the exact shape or size required and clamp up.
- m. Fixing of the cable basket to the floor slab shall be by means of adhesive. The contractor shall ensure that the environmental conditions are suitable before applying the adhesive fixing. In addition to the adhesive fixing, one in ten supports shall be screw fixed by M6 bolts. The basket shall be raised clear of the floor slab by means of twin wire leg supports no more than 15 mm high at spacings not exceeding 610 mm. The basket and supporting legs shall be finished in passivated zinc plate.
- n. Support on trapeze hangers up to 450 mm wide by M6 threaded rods and M10 threaded rods for 600 mm widths and above.

Channel nuts shall be:

- a. Manufactured from steel bar to BS 970: Part 3: 1971. Channel nut shall be zinc plated to BS 3382: Part 2: 1961 clear passivated.

Bolts shall be:

- a. Manufactured to BS EN 24018: Grade 4.6. The bolt shall be zinc plated to BS 3382: Part 2: 1961 clear passivated.

Wire Basket Covers:

- a. Wire basket covers shall be provided for all external wire baskets.
- b. Wire basket covers shall be secured using proprietary fixings in accordance with the wire basket manufacturer's recommendations.
- c. All straight covers shall be supplied in lengths of 1.5 metres or 3 metres.

Cables shall be fixed to the wire baskets:

- a. By means of proprietary forms of LS0H or copper cable clips, hot dipped galvanised cleats, saddles or straps with zinc plated or serrated bolts or nuts and washers at intervals of not more than 1200 mm. Plastic wraps shall not be permitted.
- b. By means of copper or brass saddles and clips where high temperatures or humid conditions are likely to be experienced. All saddles, clips, straps, etc., shall be fixed to the basket by means of brass screws or bolts and nuts.

Cables shall not be fixed to the wire baskets:

- a. By means of strips of steel wire e.g. wire armour steels, ceiling grid support steel.

- b. With lengths of any material not specifically intended for the fixing of cables or capable of sustaining the cables respective maximum fault level.

3.4 Lighting Installation

3.4.1 Ceiling Roses

Ceiling Roses shall be:

- a. Manufactured of porcelain or plastic and comply with BS 67 or BS 5733.
- b. Of approved manufacture, Scolmore, Schneider Electric, MK Limited or equal.
- c. Coloured White as indicated on the drawings or in the schedules.
- d. Fitted with integral enclosure and earthing plate or connection to comply with IET Wiring Regulations.
- e. Fitted with break joint ring where used on recessed BS conduit boxes.
- f. Two plate type and shall where necessary:
 - Incorporate a loop in terminal.
 - (i) Earthing terminal plate.
- g. Of the plug and socket type where used as termination in connection of lighting fittings to concealed conduit installations, as Rock KLIK2, MK Limited LSC range or equal and approved.

3.4.2 Lighting Fittings

- a. Lighting fittings of the type indicated on the drawing and in the Employer's requirements shall be supplied and installed by the contractor.
- b. Fitting types shall be verified with Hulley & Kirkwood before orders are placed by the Trade contractor.
- c. Lighting fittings with tube suspensions shall be fitted with non-rigid joints of the ball and socket type, which shall be provided with an earth connection independent of the ball joint.
- d. Surface mounted fittings shall have fixing and cable entry arrangements suitable for conduit boxes.
- e. All lighting fittings shall be manufactured to relevant British Standards.
- f. Where fittings are installed on suspended ceilings, supplementary metal supports shall be provided to enable the ceiling to carry the weight of the fittings.

Where suspended ceilings are of the demountable type, the conduit system will terminate adjacent to the fitting in a BS box, to which should be fitted a plug and socket type ceiling rose. The flexible cable will be taken from this ceiling rose, and enter the fitting by means of a grommeted hole in the housing. Where ceilings are not demountable the conduit system shall be of the loop in type.

- g. All luminaires shall be priced inclusive of lamps where applicable.
- h. Fluorescent luminaires shall be fitted with high-frequency control gear.
- i. All luminaires shall operate over the temperature range 5°C to +40°C.
- j. Where indicated, high frequency control gear shall be fitted. Luminaires with high frequency control gear shall operate using the specified lamps.
- k. All prismatic diffusers to be manufactured from acrylic material, TP(A) rated where appropriate.

3.4.3 Lamps

- a. The Electrical Services Contractor shall allow in their contract price for the fitting of all lamps of the wattage, colour and type as indicated on the drawings or in the Schedule of Lamps and Fittings.
- b. Fluorescent lamps shall generally be White in colour, T8 or T5 Triphosphor, unless specified otherwise.

3.4.4 LED Luminaires (Solid-State Lighting Products)

LED luminaires shall comply with the requirements of:

- IES/PAS 62717 – Performance Requirements, LED modules for General Lighting
- IES/PAS 62722 – Performance Requirements, LED luminaires for General Lighting

LED luminaires shall be tested in accordance with IESNA LM-79-08, IES Approved Method for the Electrical and Photometric Measurement of Solid-State Lighting Products.

Absolute photometry of LED luminaires conducted according to IES LM-79-08 Photometric Measurements of Solid-State Lighting Products should be quoted by the LED luminaire manufacturer.

LEDs within the luminaire shall be tested in accordance with IESNA LM-80-08, IES Approved Method Measuring Lumen Maintenance of Light Emitting Diode Light Sources.

LED luminaire maintenance (rated life) shall be extrapolated in accordance with IESNA TM-21-11, IES Approved Method Making useful LED Lifetime Projections.

After 50,000 hours, 90% of the LEDs used shall still achieve 70% of their original luminous flux (L70/B10 50,000h) at 25°C (based on LM 80 data).

LEDs shall have a colour temperature of 3,000K for warm white (WW) and 4,000K for neutral white (NW).

LED luminaires shall have a colour rendition index (CRI) in the range of 80 (neutral white NW) to 90 (warm white) WW and shall have high luminous efficacy above 70 luminaire lumen per circuit watt (Real Lumen Value initial lumens x light output ratio (L.O.R)).

All key measured data for the luminaire should be presented for an ambient temperature of 25°C. (15°C for Exterior luminaires).

Linear fittings shall preferably incorporate SMD (Surface Mounted Device) LEDs whilst COB (Chip on Board) LEDs shall be utilised for spot type luminaires.

The LEDs shall not be subject to colour shift when used in conjunction with a dimmer (unless required for tunable white applications 2700K to 6500K).

LEDs shall have a colour deviation (chromaticity variation) of SDCM value ≤ 3 . (Standard Deviation of Colour Matching). Tolerances beyond a 7-step ellipse are unacceptable for general illumination purposes (in compliance with IEC / PAS 62716).

LEDs shall have a failure rate better than 0.2% per 1,000 hours of operation.

The luminaire shall be designed to minimise component failure upon power up.

Drive currents and junction operating temperatures shall be in accordance with the LED manufacturers' requirements.

Drivers shall preferably be of the Constant Current type, with LEDs having an operating current of 350mA to 750mA.

Cooling shall be achieved by passive heat sinks integral to the luminaire. Active cooling shall not be utilised.

All LED luminaires shall be CE and ENEC marked.

The luminaire luminous output shall comply with the details as listed in the luminaire schedule and be suitable for the ambient temperature in which the luminaire will operate. Any deviation from this that might affect the calculated lighting levels and/or the number of fittings required to meet the installation requirements as originally designed shall be advised by the Contractor at the time of tender and again prior to the order for the fittings being placed.

3.4.5 Lighting Switches

General Lighting Switches:

- a. These shall be supplied by the contractor and be of the Rocker type with rating 10 amps single, double pole, or 2 way and off retractive, as necessary.
- b. Switch rockers shall be finished to match the plates.
- c. Switches shall be manufactured in accordance with BS EN 60669-1:1999 + A2: 2008.
- d. Switch boxes shall be fitted with adjustable grids.
- e. In multigang units the manufacturer's approved phase barriers shall be fitted, or separate multigang units provided for each phase.
- f. Switches shall be mounted in multigang assemblies where grouped.
- g. Shall be suitable for the nature of the supply to which they are to be connected e.g., quick make and break for DC and slow make and break for AC.
- h. Flush lighting switches shall be of approved manufacturers. A schedule of manufacturers accessory finishes is contained within this document.

Architrave Switches:

- a. These shall comply with relevant paragraphs of specification for general lighting switches.
- b. Switches shall be manufactured by same manufacturer to match general lighting switches.

Cord Operated Pull Switches:

- a. These shall comply with relevant paragraphs of specification for general lighting switches.
- b. Cords shall have a minimum length of 1.5 metres and shall be White in colour.
- c. Switch plates shall be fitted with a grommeted hole for cord outlet.
- d. Terminals shall be provided for earth conductors.
- e. Switches shall be manufactured by same manufacturer as general lighting switches.

Surface Switches:

- a. These shall comply with the relevant paragraphs of specification for general lighting switches. In other than those indicated in (b) below where surface switches are required these shall be as general lighting switches but shall be surface pattern mounted in cast iron surface boxes.
- b. Lighting switches in the Plant rooms shall be surface pattern mounted in boxes, and shall be of the Rocker type.
- c. Weatherproof switches shall be of a minimum IP56 rating.

Mounting Height and Submission of Samples:

Refer to the table in a later section of this document.

The contractor shall submit samples of each type of lighting switch for approval before placing them on order

3.4.6 Schedule of Lighting Fittings

All fittings scheduled within each group/range shall be by one manufacturer, although different manufacturers can be used for different groups/ranges.

3.5 Power Installations**3.5.1 Socket Outlets (Spurs and Isolators)****General Socket Outlets (250 volts, 13 amp):**

Socket Outlets shall be:

- a. Supplied and installed by the Electrical Services Contractor and shall be 13 amp. 3 pin, shuttered type flush pattern finished to match lighting switches, by the same manufacturer and of the same range as lighting switches, except for the outlets within floor boxes.
- b. Manufactured in accordance with BS 1363.
- c. Switch, or RCD. controlled as indicated on the drawings. Where RCD's are required, these shall be 30 mA rated current operated.
- d. Mounted in multi assemblies where grouped.
- e. Fitted with an earth terminal in accordance with IET Wiring Regulations for earthing the plate to the box by means of an earth wire.
- f. Outlets to be fitted with neon pilot lamps where indicated on the drawings.

Surface Socket Outlets:

- a. These shall comply with the relevant paragraphs of the specification for general socket outlets. In areas other than those detailed in (b) below where surface sockets are required, these shall be as general socket outlets but shall be surface pattern mounted in steel surface boxes.
- b. Weatherproof sockets shall be capable of maintaining their stated IP rating whether in use or not.

Spur Outlets:

- a. These shall comply with relevant paragraphs of the specification for general socket outlets and shall be manufactured by the same manufacturer and of the same range.
- b. Outlets shall be rated 13 amp, but shall be fused to suit the appliance controlled.
- c. Outlets shall be switched or unswitched, with or without flex outlets, with or without pilot lamps as detailed in the drawings.
- d. Plates shall be engraved in red to identify equipment controlled.

DP Switches:

- a. These shall comply with relevant paragraphs of the specification for general socket outlets and shall be manufactured by the same manufacturer and of the same range.
- b. Double Pole switched, rated 20 amps minimum.
- c. Units shall be with or without flex outlets and pilot lamps as detailed in the drawings.
- d. Plates shall be engraved in red to identify equipment controlled.

Flush Isolators:

- a. These shall be used throughout all areas where installation is flush for control of equipment and shall match socket outlets manufactured by the same manufacturer.
- b. Isolators shall be of the rating and number of poles as detailed in the drawings.

- c. Isolators shall have pilot indication.
- d. Plates shall be engraved in red to identify equipment controlled.

3.5.2 Plant Isolators

These shall be 500-volt front handle steel switches, fitted with pilot lamp indications suitable for motor circuit isolation. The front handle shall have a rotary action.

Units to comply with IET Wiring Regulations, Electricity (Factories Act), Special Regulations and relevant sections of BS EN 60947-3: 2009 + A2: 2015.

The isolators should be suitably sized to suit the cables being fitted.

In some instances, the units shall be wall mounted but elsewhere they are mounted adjacent to plant on purpose made angle iron frames, which shall be bolted to the floor. The Electrical Services Contractor shall include for all fixings and frames.

3.5.3 Connection of Equipment

- a. Where equipment is controlled by DP switches or spur units with flex outlets, the circuit XL-LSOH wiring shall be terminated and final connection shall be made to the equipment by silicone rubber insulated flexible cable. The rating of the cable and number of cores shall be suitable for the equipment being connected.
- b. Where equipment is controlled by DP switches, spur units or flush isolators without flex outlets the circuit XL-LSOH wiring shall be terminated. From the DP switch, spur outlet or isolator box a concealed conduit shall be installed to a position adjacent to the equipment, terminating in a BS box with blank plate which shall have a hole for flexible cable entry. The method of final connection shall be determined to suit the equipment but shall either be silicone rubber insulated cable or XL-LSOH cables in conduit and flexible conduit.

The rating, number of cores required and conduit size shall be suitable for the equipment being connected.

- c. Where equipment is controlled by surface isolators, the XL-LSOH circuit wiring shall be terminated and final connections to the equipment shall be made directly to the equipment by silicone rubber insulated flexible cable with compression glands or XL-LSOH cables in flexible conduit. The method of final connection shall be determined to suit equipment.

3.6 Earthing

3.6.1 Earthing Requirements

The earthing of the installation covered by this contract shall comply with the following requirements.

- a. It shall be carried out in accordance with appropriate sections of the current Edition of the Regulations for Electrical Installations as issued by the Institution of Engineering and Technology.
- b. At all main switchgear positions an earth conductor consisting of copper strip having a minimum cross-sectional area of 80 mm² shall be provided and all equipment including

the metal sheath and armouring of cables, the metal case of all switches, distribution boards and metal frames shall be bonded directly to it.

- c. All strips shall be of soft high conductivity copper, untinned except where otherwise specified and where fixed externally, run in the ground, through walls, floors etc., and liable to corrosion they shall be served with corrosion resisting tape or coated with corrosion resisting sheath. Where run in the ground they shall be laid in sand and protected with tiles.
- d. Earthing of sub main distribution equipment shall be made by means of connections to the sub main cable where these are lead-covered and armoured, MICC or conduit, the installation to be carried out in accordance with relevant clauses of this specification. On test, the earth continuity resistance shall not exceed the value specified in the IET Wiring Regulations.
- e. A main earth bus bar on porcelain insulators shall be erected on the wall in the earthing point locations for each system with connections to the equipment as follows:
 - Insulated copper tape to LV switchgear neutral
 - Insulated copper tape to transformer frames
 - Insulated copper tape to HV switchgear frame
 - Insulated copper tape to LV switchgear frame
 - Insulated conductors to lightning protection system
 - Insulated conductors to incoming gas and water services
 - Insulated conductors to dry riser locations
 - Insulated conductors to clean earth system
 - Insulated Stranded conductor to Sub Station Earth Point
 - All underground joints shall be brazed and all above ground joints will be bolted and soldered.
 - The earth resistance shall be tested in the manner described in the IET Wiring Regulations by the Electrical Services Contractor in the presence of the Hulley & Kirkwood and the Electrical Services Contractor shall be responsible for the supply of all test equipment.
 - Where copper strip is fixed to the building structure it shall be by means of purpose made brass or bronze saddles.
 - Fixings shall be made using purpose made plugs and clamps.
 - Where the strip is run in the ground or fixed externally and is liable to corrosion, it shall be wrapped with corrosion resistant tape, alternatively PVC sheathed strip should be used.
 - Where holes are drilled in the earths tape, these shall be brass of the high tensile grade of where liable to corrosion they shall be bronze.

- Where holes are drilled in the earth tape for connection to items of equipment the effective cross-sectional area of the connection must not be less than required to comply with the IET Wiring Regulations.
- Bolts, nuts and washers for any fixing of the earth tape shall be brass of the high tensile grade or where liable to corrosion they shall be bronze.
- Isolated metalwork shall be bonded to the earth network including dry risers.

3.6.2 Supplementary Bonding

Supplementary bonding for all systems shall be provided by the Electrical Services Contractor in accordance with BS 7671.

Bonds shall be 4 mm² green and yellow LSOH insulated minimum, and in concealed parts of the installation shall be concealed as far as is practicable in voids, partition walls or buried direct in plastered walls. Generally, bonding lugs will not be available on extraneous conductive parts and allowance shall be made for purpose-made clamps or clips, drilling or utilising fixing or connecting bolts with the permission of the installer of the service or equipment.

Supplementary bonding connection shall not be made to terminals inside socket outlets or spur units due to the possibility of accidental contact being made with live terminals, all earth bonding shall be made external to such fittings.

Ceiling framework shall be bonded locally to the electrical system adjacent to each distribution board via minimum 4 mm² green and yellow LSOH cable.

3.7 Testing and Starting Up

3.7.1 Test Instruments

Test instruments shall be:

- a. Provided by the contractor.
- b. Correctly calibrated and certified for the limits of accuracy necessary.
- c. For Insulation Resistance testers, these shall be electronic with digital LCD display, and shall deliver a minimum voltage of 500 volts for LV circuits.
- d. For line-earth loop impedance testers, these shall be electronic with digital LCD display, and shall have a lowest resolution of 0.01Ω. The testers shall typically have three loop impedance ranges; 20Ω, 200Ω and 2000Ω.
- e. Provided with an insulated and shrouded probe with flexible lead for testing metalwork such as switch plates. They shall not be of the stop go type but shall show the impedance value directly in Ω, on an easy to read scale and shall have means of measuring and correcting for voltage variations.
- f. Operated by personnel who shall be properly trained and competent in the use of instruments.

3.7.2 Method of Testing

The test shall include: -

- a. A visual inspection of the whole of the installation shall be carried out in accordance with the IET Wiring Regulations and supplementary Guidance Notes, and shall also cover, equipment and cabling installed in sub-ways, walk-ways, crawl-ways and false ceilings, where accessible.
- b. The operation of all accessories and items of equipment and a check for proper function, including such items as may have been installed by the contractor, but supplied by others (e.g. mechanical services contractor) under this Contract. These tests shall be made under normal operating conditions and the results noted.
- c. Insulation tests shall cover all circuits and shall be made between phases, phase to neutral, phase to earth and neutral to earth.

3.7.3 Test Requirements

Switchgear

All overload devices shall be carefully checked against the duty and rating of the apparatus concerned. These shall be set to the proper values in accordance with the manufacturer's instructions.

All trip devices shall be mechanically checked to ensure that they function properly.

All circuits shall be checked for phasing, polarity and correct fusing.

The end of all cables shall be clearly marked to indicate phase connections.

All control and alarm circuits shall be insulation resistance and functionally tested prior to start up at twice working pressure.

The Electrical Services Contractor shall replace, at their own expense, all fuses that may become inoperative during the testing period.

Check operation and readings of meters and instruments.

Cabling

All cables shall be pressure tested at twice working pressure and only after cable jointing and glands have been fitted.

Insulation, continuity and polarity tests may be undertaken during the progress of the works in lieu of testing at completion, but only if this is considered to be more practicable.

Before mains or final circuits are energised, all tests must be undertaken and a proper record kept of all tests carried out.

It is a requirement that all tests must be witnessed by Hulley & Kirkwood or their representative, and the contractor must give at least 5 working days' notice prior to conducting tests.

To test the effectiveness of the circuit protective conductors an earth fault loop impedance tester of the current injector type is to be used.

General

The contractor shall be responsible for the testing and collecting of all test results which must be typed and submitted in duplicate (in addition to the requirements outlined in the section about documentation to be included in the operating and maintenance manual).

Testing and inspection of installation shall be carried out in accordance with the current edition of the IET Wiring Regulations and supplementary Guidance Notes. Before tests main equipotential bonding connections to the structure, gas and water pipes must be removed.

Tests shall comprise the following: -

1. Continuity of ring circuits
2. Continuity of circuit protective conductors
3. Earth electrode resistance
4. Insulation resistance
5. Insulation of site-built assemblies
6. Flash testing of site assembled switchboards
7. Flash testing of factory assembled switchboards
8. Protection by electrical separation
9. Protection by barriers or enclosures
10. Insulation by non-conducting floors and walls etc
11. Polarity
12. Earth fault loop impedance
13. Prospective short-circuit current measured at mains and all distribution boards
14. Operation of residual current devices

Test shall be carried out to the full satisfaction of the engineer and the cost of any re-testing required following failure to comply with these requirements shall be borne by the contractor.

The following paragraphs summarise the minimum requirements for the main tests outlined above: -

Earth Continuity Tests

These tests shall be taken during progress of work to ensure that all circuit protective conductors, joints in metal conduit and trunking etc, to be used as protective conductors, are electrically and mechanically continuous.

The contribution of the earth continuity conductors to the total earth fault loop impedance should not exceed, at any point in the installation, the value of 1.0Ω .

Verification of Polarity

These tests shall be carried out to ensure polarity has been observed throughout the installation, i.e. single pole switches and protective devices are connected into phase conductors, not neutral. The polarity of three phase plant and equipment shall also be confirmed.

Insulation Resistance Tests

The voltage used for these tests shall be a DC voltage not less than twice that which will be normally applied to the installation (i.e. twice the rms, value of the supply is AC) except that it need not exceed 500 volts for low voltage circuits.

The insulation resistance tester to be used shall be of the constant voltage type.

Where a test is made in accordance with the above paragraph, any final sub-circuit should have a reading of not less than $1.0M\Omega$ and any test carried out in the entire installation from the main switchboard should have a reading of not less than $1.0M\Omega$.

Insulation test method shall be as described in the current edition of the IET Wiring Regulations and supplementary Guidance Notes.

Line-Earth-Loop Impedance Tests

In order to indicate whether a protective device affords adequate protection against dangerous earth leakage current and to ensure compliance the current edition of the IET Wiring Regulations the above tests should be carried out on the complete installation, including all final sub-circuit.

All test results must be tabulated and presented alongside the maximum values prescribed in the IET Wiring Regulations to achieve safe disconnection within the respective time limits.

The above tests should be achieved by using an instrument such that: -

- a. A minimum current of 20 amperes is passed through a fault path, i.e. the circuit formed by the phase conductor, the circuit protective conductor and the earth fault path.
- b. The test current is produced by the full mains voltage.
- c. A direct impedance reading is obtained from the instrument.
- d. In using such an instrument, care should be taken to ensure that no ill effects can arise if the earthing circuit is in fact defective.

3.7.4 Starting Up

General

The Electrical Services Contractor shall include in their tender for starting-up, setting to work and leaving in proper working order after completion of all testing and proving and at such time as is convenient to the engineer, the completed engineering works of this Contract.

The contractor shall, in addition, allow for demonstrating all plant and instructing the employer's staff, representatives and nominees in its proper operation and use.

3.7.5 Operating and Maintenance Instructions

The Operating and Maintenance Instructions for, and specific to, all plant included in the electrical contract shall be provided. This information shall be adequately contained to the engineer's approval, in separate ring binder type folders provided with durable board covers to withstand continual usage.

The standard of operating and maintenance manuals expected from the contractor dictates that it may be advisable to employ the skills of a specialist technical author to ensure that good quality final documentation is provided and fully complies with 'C' of the BSRIA publication titled; Operating and Maintenance Manuals for Building Services Installations.

Each set/volume shall incorporate specific detailed description of operating procedures, together with details of the regular maintenance routines, recommended by the manufacturers. In addition, lists of spare parts, which the manufacturers recommend should be kept in store, shall be given.

Each set/volume shall also contain Manufacturer's Data and information for all plant, fully detailed drawings showing the construction of all plant and fully detailed internal and external wiring diagrams for all electric plant.

All copies of the Operating and Maintenance manual covering all items of Plant and its ancillary equipment supplied under this contract shall contain the following chapters:

Introduction

The introduction shall describe the nature and type of installation, and contain a list of abbreviations, details of the Electricity at Work Regulations 1989, plus an index and details of the reference and cross-reference systems adopted in the manuals.

Project Details

Details of the project Design Team members, main contractor and Specialist contractors shall be included.

Description of Installations and Equipment

A full description of each electrical system installed shall be included, with main plant and equipment identified and locations clearly stated. The description shall also include details of both manual and automatic control systems installed.

Details of Plant and Equipment

Full details of all plant and equipment installed shall be included: -

1. Manufacturers' names and addresses
2. Suppliers' names and addresses
3. Type, size and catalogue numbers
4. Serial numbers (where appropriate)

5. Ratings and duty
6. Electrical characteristics
7. List of specialist tools and keys, etc. handed over to the User (including signed receipt)
8. Special requirements

It is acknowledged that the above information will be provided by the respective manufacturer; however, it is the contractor's responsibility to inspect the plant and equipment to confirm the accuracy of the information prior to its inclusion in the Operating and Maintenance manual.

Operating Procedures

The operating procedures shall describe in detail the method of energising plant and equipment, starting-up, running and shutting down individual plant and equipment, including control systems.

Where plant or equipment has selection and individual facilities together with alarm and safety interlocks, these shall also be fully described in respect of the operating procedures outlined above.

Planned and Preventative Maintenance

This section shall identify individual plant or equipment maintenance requirements, and shall give a recommended frequency for luminaire and lamp cleaning, lamp replacement, any inspections, tests and adjustments, etc. The manufacturer's advice and recommendations shall be included.

A Schedule shall be included confirming the anticipated average lamp life (hours), based on the Industry standard 3 hour switching cycle, of all lamps installed in the installation.

Emergency Procedures

Emergency Procedures shall describe procedures to be adopted by personnel engaged in the operation and/or maintenance of the respective plant or equipment installed. Instructions shall be included for action required for the following typical circumstances:

1. Fire
2. General failure of the electrical system
3. General failure of plant or equipment
4. Recommended action if plant or equipment malfunctions
5. Call out procedures for maintenance personnel during normal working hours
6. Call out procedures for maintenance personnel outwith normal working hours

List of Recommended Spares

All consumables items shall be listed with recommended stock numbers. The list shall also include manufacturer's and supplier's recommendations.

List of Manufacturers and Suppliers

A comprehensive list of all manufacturers and suppliers shall be included and will comprise company names, addresses, telephone numbers and contacts etc.

All manufacturer's literature, including guarantee certificates etc. supplied with plant or equipment shall be photocopied and included in this section.

Schedules of Equipment, Accessories and Luminaires

Schedules of equipment, accessories and luminaires shall be included in this section. All schedules shall be supplemented with photocopies of manufacturer's equipment shown in trade catalogues. All catalogue extracts (photocopies) shall be clearly cross-referenced to the respective schedules.

The luminaire schedule shall include details of the lamps installed in each respective luminaire. The lamp information shall include details pertaining to the colour temperature (CCT) in degrees Kelvin, wattage, type, No of pins, manufacturer, type, catalogue number and local supplier.

4 PROJECT SPECIFICATION

4.1 Nature and Extent of Work

The works undertaken in this Sub-Contract covers the manufacture, works testing, supply and delivery to site, erection, connecting up, testing, adjusting and setting to work of the complete electrical services installation described in this specification and on the drawings.

The works shall comprise the complete electrical services installations required with the redevelopment of Manchester Metropolitan University's Righton Building study space refurbishment.

The works shall comprise the whole of the labour, plant and, unless otherwise indicated, all of the materials necessary to form a "complete installation" including their manufacture, works testing, and such commissioning and testing as are prescribed in subsequent sections of this document and as may otherwise be required to give an effective working installation.

The Electrical Services Contractor shall allow within his tender for the full electrical services as described within the specification and the associated tender drawings for all areas identified.

4.2 Schedule of Drawings

Drawing No.	Title
50953(60)RIG-001	Existing Small Power & Data Services & Strip Out Layout
50953(60)RIG-002	Existing Lighting & Fire Alarm Services & Strip Out Layout
50953(62)RIG-001	Proposed Small Power & Data Services Layout
50953(62)RIG-002	Proposed Lighting & Fire Alarm Services Layout

4.3 Removal of Existing Services

The Electrical Services Contractor shall make provision to strip out the existing services identified on the (60) series drawings and shall modify any circuits to ensure retained services remain functional.

Where an electrical circuit is to be removed completely, all final circuit wiring is to be removed in its entirety back to the supply source. It will not be permitted for redundant wiring to be left in situ post completion.

It will be deemed that the Electrical Services Contractor has visited site to ascertain and familiarise themselves with the extent of the strip out requirements. Under no circumstances, will Hulley & Kirkwood validate variations in relation to these works unless previous consent has been given.

Prior to any strip out works commencing on site, the Electrical Services Contractor shall make themselves familiar with the asbestos register and make the project manager aware of any potential issues that arise during the construction programme. The Electrical Services Contractor shall also note that the Righton building is a listed building and as such any builder's works such as drilling through floors, ceilings and walls shall be discussed with the Building Control Officer prior to any action to gain approval.

4.4 General Characteristics

Electricity Supply:

The building is connected to the local authority's LV electrical supply network. The incoming supply to the building is currently provided via Electricity North West (ENWL) LV infrastructure. The existing electrical supply to the Righton Building shall be retained.

4.5 Switchboards and Distribution Boards

The contractor shall be responsible for the design, installation, testing and commissioning of the LV distribution throughout the building as identified on the drawings in full compliance with BS 7671, 18th Edition IET Wiring Regulations including all current amendments.

The Electrical Services Contractor is responsible for installing all electrical distribution system modifications within the building to accommodate the requirements detailed further within this document and on the drawings.

Each sub distribution board shall be fully protected via miniature circuit breakers (MCBs) to BS EN 60898 and all socket outlets shall be provided with RCBO's to BS EN 61009 on completion of works at handover.

Local final distribution circuits supplied from the distribution boards shall be wired in single core LS0H 6491B cabling installed in a network of cable containments systems, trunking, conduit and dado trunking etc.

Any new distribution equipment shall be of the type and manufacture indicated below:

SCHEDULE OF EQUIPMENT		
Item	Description	Manufacturer/Suppliers
TP&N Distribution Boards	MCB TP&N Distribution Board to BS EN 61439-3: 2012 with integral 125A isolators complete with type B or C MCBs, sizes as required and blank space covers and lockable hinged door.	Schneider Electric, Merlin Gerin, Or approved equal and approved by Hulley & Kirkwood

4.5.1 Volt Drop

For calculation purposes, the BS.7671 percentage permissible shall assume the source of supply to be the Main LV Switchboard.

4.5.2 Sub-Mains Cables

All sub-main cables shall comply with the relevant British Standards Specification and be BASEC approved where applicable.

The cables used on this installation shall be, so far as reasonably practicable, of one manufacturer only. All cables shall be delivered to site as complete coils with wrapping and

seals intact. Each coil shall be complete with manufacturer's test certificate and date of manufacture. Cable manufactured six months or more prior to delivery on site shall not be accepted.

The electrical contractor shall be responsible for all off-loading and handling of cables etc., on site he shall ensure that cables are delivered to site on drums properly protected against mechanical damage.

Armoured XLPE/SWA/LS0H insulated multi-core cables shall be manufactured in accordance with BS.5467. They shall be XLPE insulated and bedded single wire armoured with LS0H over-sheath. Unless otherwise specified the sheath colour for low voltage cables shall be black and cables shall be copper cored.

The minimum bending radius of any cable shall comply with the requirements of the IET Wiring Regulations 18th Edition, BS 7671.

All cables run between defined terminal points shall be installed without intermediate joints, cable joints will not be permitted.

Cables laid on cable trays shall be fixed at intervals (with metal cable ties) to prevent sag, in accordance with BS 7671.

Cables passing through walls and floors shall have oversized sleeves permanently fixed, packed with a fire-resisting infill.

The cores of multi-core cables shall be coloured in conformity with the BS in order to provide easy identification.

Cables fixed on the surface shall be installed in a straight and uniform manner.

Where a number of cables are installed together they shall be installed in such an order that crossovers are eliminated unless absolutely necessary, cables shall be kept well clear of other service lines, pipes or ducting.

All XLPE/SWA/LS0H cables fixed to building fabric shall be secured with cable cleats at spacings not exceeding 1 metre on straight runs with additional cleats at bends and on vertical runs as directed and as described in the current edition of the IET Wiring Regulations, by means of approved type cleats securely bolted to the structure. Cable cleats shall consist of two identical half racks.

The cables shall be secured in the proper manner and terminations shall not be subjected to weight or strain.

It is the Electrical Contractors responsibility to ensure that the wire armouring of any cable is not subject to caging.

4.6 Containment Installations

The Electrical Services Contractor shall allow for the installation of all necessary containment systems required to undertake the cabling installations including single-compartment medium duty hot dip galvanised steel tray, multi-compartment and single-compartment galvanised steel cable trunking and conduit systems.

The trunking / tray shall be complete with all necessary prefabricated "tees", "90 degree" bends, earthing continuation plates, etc to provide a complete and continuous system.

The trunking installation where installed fixed to the soffit shall be supported from the building structure by means of a suitably fabricated unistrut / girder clamp configuration.

The trunking installation where fixed to the building structure shall be installed as per the manufacturers recommended method.

Due regard must be given to the co-ordination with other trades when installing the trunking and conduit wireway facilities.

Trunking shall be as manufactured by Legrand Limited or equal and approved.

The conduit installations shall be as previously described for the trunking installation and as described in future parts of this specification.

As noted earlier the building is listed and as such existing containment systems shall be utilised where possible.

4.7 Lighting Installations

The Electrical Services Contractor shall be responsible for the supply, management, security, storage, wiring, installation and setting to work of the lighting system to all areas as detailed within this section and on the drawings.

The Electrical Services Contractor shall be responsible for the supply and installation of all pattresses and fire hoods where required to all lighting systems proposed. Final selection of luminaires to be discussed and agreed before the placement of any orders.

The Electrical Services Contractor shall allow for automatic switching of the lighting within the areas identified on the drawings. All light switches shall be recessed and as manufactured by MK or equal and approved within all areas.

Fire hoods shall be provided to all luminaires as necessary to retain the fire rating of the ceiling to which they are installed.

The method for the final sub-circuit cabling shall be 1.5mm² 6491B LS0H single core cabling within trunking/conduit as described earlier and this shall include flexible cables from plug in ceiling roses to luminaires.

The Electrical Services Contractor shall refer to AHR Architects documentation for the specification of decorative luminaires indicated on the drawings.

Automatic Lighting Controls:

The automatic lighting controls shall be utilised as indicated on the (63) series drawing and shall comprise of ceiling mounted units, set to achieve the required coverage. Detectors selected shall be suitable for the environment in which they are to be installed.

4.8 Emergency Lighting Installations

The Electrical Services Contractor shall include for the supply, install, testing and commissioning of a full emergency lighting installation to BS.5266-1 and shall provide 3 hours duration on mains failure and also on the respective sub-circuit failure. Emergency lighting luminaires, whether they form part of a general lighting luminaire or remote fitting shall be of the switched/non-maintained self-test type excluding the 'Exit' signs which shall be unswitched/maintained.

Emergency lighting will be required in all internal areas and in the vicinity of emergency exit doors.

The Electrical Services Contractor shall install test and commission the emergency lighting system and complete this package of as indicated upon the tender drawings.

There is a requirement for each emergency luminaire to have an LED be permanently fixed to the luminaire in a suitably visible position to indicate the battery is charging. Each emergency is to be given an exclusive number so that identification and recording of tests may be simplified. The exact numbering arrangement is to be agreed with Hulley & Kirkwood prior to manufacture of the labels. Each emergency luminaire is to have an individual test/record sheet which will be submitted in the Operating and Maintenance manuals prior to handover.

The testing facility for new emergency luminaires shall be by via self-test luminaires. 1.5mm² 6491B LSOH single core cabling installed within existing and new containment systems as detailed on the relevant drawings and schedules.

4.9 General Power Installations

The Electrical Services Contractor shall supply, install, test and commission the general small power installation within all areas of the building as detailed in this specification and indicated on the drawings.

All socket outlets shall be provided with RCD protection via the installation of RCBOs.

The Electrical Services Contractor shall include for the supply, delivery, erection, testing and commissioning of the complete power installation as shown on the drawings and detailed in this specification.

Wiring shall be carried out in 2.5mm² 6491B LSOH single core cabling unless otherwise indicated enclosed in the proposed high-level cable trunking, new containment systems and mechanical protection on all vertical drops.

4.10 Wiring to Mechanical Services

Description:

The mechanical installation referred to in this sub-contract shall comprise the electrical supplies to all items of mechanical plant as detailed / identified on the drawings and within this specification.

The Electrical Services Contractor shall supply, install, test and commission all electrical services associated with the mechanical services installation.

The Electrical Services Contractor must obtain all connection details from the Mechanical Services Contractor before commencing work on site.

Wiring shall typically be 6491B single core cabling complete with mechanical protection on all vertical drops if installed internally or XLPE/SWA/LSOH for external installations.

4.11 Data Installation

The Electrical Services Contractor shall supply, install, test and commission the data installation as detailed on the aforementioned drawings.

The Electrical Contractor shall make provision for recessed screened twin RJ45 outlets located as indicated on the relevant design drawings. The Electrical Services Contractor shall ensure the existing comms cabinet is retained including all existing supplies as detailed earlier.

Wiring shall be CAT 6A cabling, as per the existing infrastructure, complete with mechanical protection on all vertical drops. Wiring shall be as prescribed in section 3 of this specification in a star topology from the data/comms cabinet position. Contractors shall include for all terminations, labelling and testing of the new circuits.

The Electrical Services Contractor shall liaise with Manchester Metropolitan University IT team prior to commencing any data work.

4.12 Fire Alarm Installation

General:

The Electrical Services Contractors shall include for the supply and installation of a fire alarm system in accordance with BS.5839-1: 2017 to the areas of the building identified within this section. This shall also include providing an updated mimic diagram capturing the new layout.

The existing panel shall be retained. This proposed system has been designed in line with the existing arrangement, which is believed to be Category L2. The Electrical Services Contractor shall retain all existing fire alarm services as identified on the aforementioned drawings.

Wiring Installation

The installation shall be carried out utilising Firetuf F120 / FP200 Gold (red) multicore cables installed in a concealed manner.

Supply and install multi-core 1.5mm² Firetuf F120 / FP200 Gold (red) cables to loop between each of the smoke detectors. These shall be installed in true parallel circuits. Branching off will not be permitted.

The wiring to the trunking mounted accessories (i.e. smoke detectors) shall be terminated in the device.

Description

The current system is believed to be L2. The Electrical Services Contractor shall retain the existing fire alarm panel as detailed on the drawings.

Fire alarm interfaces (FAI) shall be provided to mechanical equipment and automatic doors as identified on the drawings.

Manufacturers/Installers

The existing fire alarm panel is 6400 series panel as manufactured by Protec with a repeater panel located in the Righton Building entrance lobby. The Electrical Services Contractor shall ensure new devices are compatible with existing retained and reused fire alarm panel.

Testing & Commissioning:

Upon completion of the fire alarm modifications and provision of a new cause & effect, the complete system shall be tested and commissioned by the manufacturer's engineer in the presence of the Hulley & Kirkwood, the successful Tenderer, the Client's representative and the local Fire Prevention Officer. Test results shall be submitted in duplicate to the Hulley & Kirkwood.

The Electrical Services Contractor shall include for new zone chart(s) and shall update the building fire alarm schematic and text on the fire alarm panel(s).

4.13 Communication Systems**Disabled WC Alarm**

No new or modifications to the existing disabled WC alarm(s) are required as part of these works.

4.14 Door Entry System, Access Control & Security

The Electrical Services Contractor shall allow for the supply, delivery, manufacture, works testing, off-loading, erection/installation, setting to work, commissioning, demonstration, making good of defects during the Defects Liability Period, provision of all documentation and O&M Manuals and Test Certificates to form the complete and fully operational door entry system, access control system and security systems installation.

The extent of the services shall be as indicated on the drawings and detailed below.

4.14.1 Door Entry System

No new or modifications to the existing door entry system(s) is required as part of these works.

4.14.2 Access Control System

No new or modifications to the existing access control system(s) is required as part of these works.

4.14.3 CCTV System

No new or modifications to the existing access control system(s) is required as part of these works.

4.14.4 Intruder Alarm

No new or modifications to the existing intruder alarm system(s) is required as part of these works.

4.15 Builderswork

The Electrical Services Contractor shall be responsible for all builderswork associated with this contract. These works include all core drilling, fire-stopping, fire rated enclosures to cables passing through all relevant openings, acoustic barriers, joinery work, roof, ground and floor finish alterations etc that may be required as part of the works. The contractor must allow to undertake all noisy works, particularly drilling, outside of normal working hours.

The contractor will be responsible for removal of all redundant materials left on site as part of these works.

The Electrical Services Contractor shall also note that the Righton building is a listed building and as such any builder's works such as drilling through floors, ceilings and walls shall be discussed with the Building Control Officer prior to any action to gain approval.

4.16 Asbestos

The Tenderer shall make themselves fully aware of the building's Asbestos register and identify any areas which may affect his work. This shall be brought to the attention of the Principal Contractor. Asbestos in buildings is a hazardous material and as such should be properly managed under the provisions of the Health & Safety at Work etc. Act 1974.

4.17 Equipotential Bonding Installation

All bonding shall be in accordance with the requirements of the current edition of the IET Wiring Regulations.

Supplementary Bonding:

The Electrical Contractor shall include for the supply and installation of the supplementary bonding throughout which shall be as follows:

Supply and install at stainless steel sink positions 6mm² LS0H Green/Yellow cable between taps, water pipes, metal waste and sink body.

The following are typical samples of the items to be bonded and which is covered more comprehensively within Section 3 of this specification.

- Hot and cold water supplies
- Metal waste pipes
- Stainless steel sink units

Bonding cables shall be in the form of unbroken conductors so that disconnection from one point will not cause a break in the bonding circuit to other services.

All bonding shall be carried out using proprietary bonding clamps which shall be compatible with the pipework, etc to ensure that there is no possibility whatsoever of electrolytic action taking place.

All bonding clamps shall be placed in accessible positions.

4.18 Mounting Heights

For the purpose of tendering allow for the following mounting heights.

The Electrical Services Contractor shall also take cognisance of the fact that any points and equipment indicated on the aforementioned drawings are approximate only and are for guidance in the preparation of their tender.

The Electrical Services Contractor shall also include for the determination on site of the finalised positions of all points and equipment, in collaboration with the Architect, Hulley & Kirkwood and/or Contract Administrator before any work is commenced.

The Electrical Services Contractor will be held responsible for all alterations made necessary due to non-compliance with the requirements of the Clause.

Unless otherwise indicated, all the following mounting heights are taken from the finished floor level to the bottom of the equipment/accessories.

Item	Mounting Height FFL To the Bottom Edge
Lighting switches	1200 mm
Low Level 13 amp switched socket outlets	450 mm
13 amp switched socket outlets above worktops	150 mm above worktop
Mid Level 13 amp switched socket outlets	1200 mm
High level 13 amp switched socket outlets	1800 mm

Electrical Services Contractors shall also take note of the specific mounting height of items requiring precise hand movement and subject to use by persons in wheelchairs as depicted in the extract from BS 8300-2:2018. Any discrepancies or contradictions between these shall be raised for clarification from the Client.

Figure 18 — Heights to the centre of outlets, switches and controls

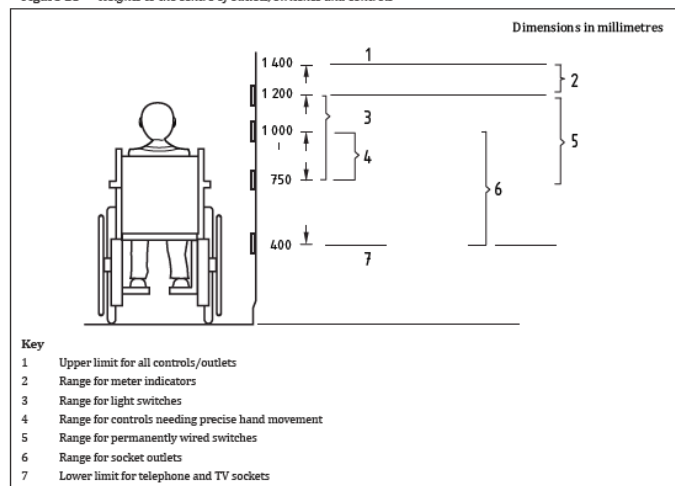
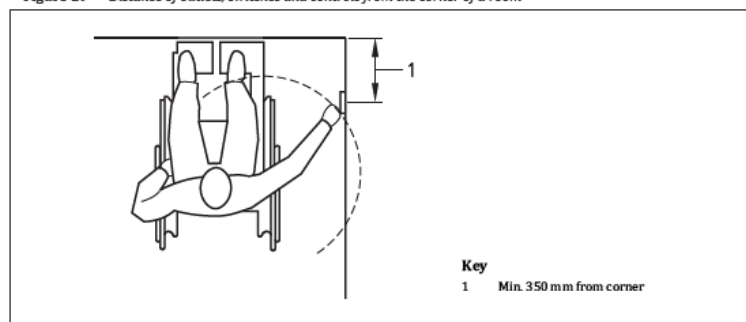


Figure 19 — Distance of outlets, switches and controls from the corner of a room



APPENDICES

APPENDIX 1: ELECTRICAL ACCESSORIES SCHEDULE

AREA	FINISH	MANUFACTURER	RANGE
Store	White Plastic	MK	Logic Plus
Main areas	White Plastic	MK	Logic Plus
External	Minimum IP55	MK	Commando Safetyswitch

Note

The above manufacturers have been identified to highlight the level of specification that is required. Alternative manufacturers shall be considered; however, acceptance of alternatives will have to be equal and approved by Hulley & Kirkwood and by Manchester Metropolitan University Estates.

The Electrical Services Contractor shall provide full details of the proposed accessories and luminaire schedule as part of the tender submission.

APPENDIX 2: ELECTRICAL SUMMARY OF PRICES**General**

1.	Removal of Existing Services	£	:
2.	LV Supply Infrastructure	£	:
3.	Switchgear and Submains Distribution	£	:
4.	Containment Installations	£	:
5.	Lighting Installations	£	:
6.	Emergency Lighting Installations	£	:
7.	General Power Installations	£	:
8.	Wiring to Mechanical Services	£	:
9.	Data Installation	£	:
10.	Fire Alarm Installation	£	:
11.	Communication Systems	£	:
12.	Door Entry System, Access Control & Security	£	:
13.	Builderswork	£	:
14.	Equipotential Bonding Installation	£	:
15.	Installation Drawings	£	:
16.	As Fitted Drawings & Maintenance Manuals	£	:
17.	Testing & Commissioning	£	:
18.	Electrical Installation Prelims	£	:

Total to Collection	£	:
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