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CTC WORKSHOP RELOCATION

230114

[MEP] Specification

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Document Revision History

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230114 CTC Workshop Relocation

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Section One (A)

Contract Preliminaries

Section One (A) **Contract Preliminaries**

Job No. 230114



Refer to the Main Contract Preliminaries. The Building Services Contractor (or Mechanical Contractor and Electrical Contractor) shall ensure that all due allowances are made in respect of the project preliminary requirements during the tender period as disclosed by the Main Contractor (or Principal Contractor).

Section 1B

Preliminaries, M&E Requirements



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1B-1 INTRODUCTION AND INTERPRETATION

The Mechanical and Electrical Contractors shall complete the installations as detailed within this specification and associated documentation i.e. drawings, reports etc., employing skilled personnel and Specialist Contractors as necessary to achieve the standards described.

1B-1-1 DEFINITIONS

Authority having jurisdiction (AHJ) - Refers to organization, office, or individual responsible for enforcing the requirements of legislation or standards, or for approving equipment, materials, an installation, or a procedure

Contract Administrator – Refers to a representative of the company administering the project as defined in the Contract preliminaries.

Building Contractor – Where this term is used within the specification, it shall be taken as the Contractor mainly responsible for completing the building works as detailed herein.

Building Services Contractor – Where this term is used within the specification, it shall be taken as the Contractor mainly responsible for completing the combined mechanical and electrical installation works as detailed herein.

Contractor – Where this term is used within the specification, it shall refer to the Contractor completing the Works detailed herein and shall refer equally to Mechanical Main Contractor or Building Sub-contractor or any of the other “contractor” terms defined within this clause.

Electrical Contractor – Where this term is used within the specification, it shall be taken as the Contractor mainly responsible for completing the electrical installation works as detailed herein.

Engineer – Refers to a representative of Couch Perry Wilkes.

Fire Advisor – Refers to organization, office, or persons responsible for approving the fire safety design, equipment, materials, installation and procedures such as Authority Having Jurisdiction (AHJ), Fire Officer, Fire Brigade, Building Control, Fire Consultant etc.

Main Contractor (or Principal Contractor) – Where this term is used within the specification, it shall be taken as the Contractor with overall responsibility for the completion of the Works on behalf of the Employer.

Mechanical Contractor – Where this term is used within the specification, it shall be taken as the Contractor mainly responsible for completing the mechanical installation works as detailed herein.

Specialist – Refers to a specialist company employed by any of the above to complete a part of the Works on their behalf. The employing Contractor shall remain fully responsible for all works undertaken by the Specialist.

Note: None of the above terms imply a contractual relationship this will depend on the contract arrangements.

DEFINITIONS			
BESA	Building Engineering Service Association	CDP	Contractor's Design Portion
BREEAM	Building Research Establishment Environmental Assessment Method	CDM	Construction Design Management (Regulation)
BS	British Standard	CIBSE	Chartered Institution of Building Services Engineers
BS EN	British Standard European Norm	IET	Institution of Engineering and Technology
BS EN ISO	British Standard European Norm International Standard	NICEIC	National Inspection Council for Electrical Installation contracting
BSRIA	Building Services Research and Information Association	TN-S	Separate protective earth and neutral conductors
CCTV	Closed Circuit Television	TN-C-S	Combined Earth and Neutral conductor separate protective earth and neutral downstream

1B-1-2 REFERENCE TO OTHER SECTIONS OF THIS SPECIFICATION

This section of the specification shall not be used in isolation and must be read in conjunction with the particular sections, commissioning and standard clauses, all of which further define the requirements for the works.

1B-1-3 STANDARDS APPLICABLE

Works shall be completed in accordance with all applicable industry standards. Some of the most relevant standards associated with this section are scheduled below:

STANDARDS	
BSRIA BG 6 Design Framework for Building Services	Electricity at Work Regulations
BSRIA BG 28 Soft Landing BREEAM	F Gas Regulations
BSRIA BG 38 Soft landing Core Principles	Gas Safety Regulations
BSRIA BG 54 Soft Landing Framework,	Health and Safety at Work Act
BSRIA BG 61 Soft landings and Government Soft landings	Health and Safety Executive ACOP and HS Guides
Building Regulations	IET Wiring Regulations (BS7671)
COSHH Regulations	Insurance Company Requirements
Clean Air Act	Pressure Systems Safety Regulations
Clean Air Strategy	(The) Public Health (Infectious Diseases) Regulations
Construction (Design and Management) Regulations	Liquid Petroleum Regulations
Control of Asbestos Regulation	Local Authority Building Control (LABC)
Control of Pollution Act	London Building Act and / or Building (Inner London) Regulations where applicable.
Dangerous Substances and Explosive Atmosphere Regulations	Management of Health and Safety at Work Regulations
Electricity Safety, Quality and Continuity Regulation	National Joint Utilities Group Publications
(The) Health & Safety (Miscellaneous Amendments) Regulations	Water Supply Regulations
Requirements of the Environmental Health Officer (EHO), Fire Officer and Building Control Officer	

Any EU legislation cited within this specification will continue to be required for the specific services described and forms part of the "retained EU legislation" detailed within the European Union (Withdrawal) Act 2018.

Where the above standards refer to supporting documentation and standards these shall be fully complied with in all respects.

Where discrepancy is found between this specification and the relevant standards, the Contractor shall obtain written clarification from the Engineer prior to submission of the tender. Where a discrepancy has not been clarified prior to tender submission, the Contractor shall include the most onerous requirements.

1B-1-4 CURRENCY OF INDUSTRY STANDARDS

In general, all works shall be completed in accordance with the latest versions of the relevant standards that are applicable at the time of contract commencement.

These standards may be updated, or new standards issued, during the execution of the works and if so the Contractor shall:

- 1) Comply with all new or updated statutory requirements that come into force during the contract period. Where notice of a change to these is in place during the tender period then compliance is deemed to be included in the tender price.
- 2) Advise the Engineer of all other relevant new or updated standards when these become known.
- 3) Obtain confirmation, from the Engineer, as to whether the works shall comply with these new or updated standards with respect to:
 - Subsequent phases.
 - Variations.

1B-2 GENERAL REQUIREMENTS

This Section of the Specification identifies general requirements which are applicable to all services and all sections of this specification.

1B-2-1 CONTRACT CONDITIONS

The contract conditions shall be as detailed

- In section ONE(A) of this specification

1B-2-2 PROJECT DESCRIPTION

The project involves the *modification of existing installations and* supply, installation, testing and commissioning of the Mechanical and Electrical Services. Scheduled below is a brief list of the services - this list is not exhaustive and is provided to give a general understanding of the works only:

- *Isolation and draining down ready for demolition of services*
- *LTHW heating system*
- *Mains cold water and Domestic water systems*
- *General Ventilation systems*
- *LV electrical distribution system*
- *General and Emergency Lighting systems*
- *Security detection and alarms*
- *Fire detection and alarms*
- *Earthing and bonding systems*
- *Data Systems*

Please refer to Main Contract Documentation for a full description of the overall works.

1B-3 SITE VISIT

A site visit shall be undertaken during the tender period to obtain satisfactory knowledge of the following:

- 1) Local conditions
- 2) Nature and accessibility of the site
- 3) The nature and extent of the operations
- 4) The supply of and conditions affecting labour
- 5) Storage space for materials
- 6) Position of underground services and drains
- 7) Space available for the execution of the works generally
- 8) Site Permit schemes and any restrictive site practices

9) Access and site restrictions

The tenderer shall include for all costs necessary to take account of the above. Arrangements for the delivery of materials to site shall be such that no congestion occurs and shall include for all additional handling and transporting due to site conditions.

No additional cost/claim shall be considered due to the failure to undertake a visit site and obtain the necessary knowledge.

1B-4 CONTRACT INCLUSION

The specific contract details are laid out in section ONE(A) of this specification. The Mechanical and Electrical Contractors shall include for all items necessary for the due and proper completion of the works according to the true intent and meaning of the Tender documentation and this shall include, but not be limited to, all:

- 1) Materials
- 2) Labour
- 3) Carriage
- 4) Offloading and positioning
- 5) Tools
- 6) Minor items such as screws, fixings etc.
- 7) Items shown on Tender drawings but not detailed in specification
- 8) Items detailed in specification but not shown on Tender drawings

All materials shall be new unless otherwise specified and of a type and rating matched to the duty for which they are intended. Samples of proposed fittings, materials and construction quality, where required by the Engineer, shall be submitted without delay and in good time to suit the project programme. All systems shall be complete and operational unless otherwise specified.

All test requirements at manufacturer's works, as listed in relevant British Standards or elsewhere in this specification, shall be met prior to dispatch of equipment.

All items of plant and equipment shall arrive on Site in good condition and be suitably protected from all hazards once there and all prime movers etc. shall be in working order. If items of plant are found not to function correctly after installation and this causes a delay to the Contract, the Mechanical and/or Electrical Contractor shall be charged for any costs incurred.

Care shall be taken to maintain services to areas that need to remain operational during the works. The Mechanical and/or Electrical Contractors shall not disconnect any services until they have established, in writing and through survey, the extent of these areas, and agreed an exact timing and methodology for the necessary isolation and diversion of services.

Where a client/site permit to work scheme (or similar) exists this shall be complied with in full together with necessary notice periods etc.

Should any of the tender information be found to be incompatible or ambiguous with other information, then this shall be raised as a query during the tender period and if no response is provided prior to the tender return date, the tender return shall include for the most onerous option available.

1B-5 SPECIFIED EQUIPMENT

Where materials are specified in this document they shall be included in the tender without adjustment or alteration. The Engineer may consider alternatives (as a below line tender sum option), at their discretion. Any alternatives must be provided with all supporting information to prove that it is at least equivalent to the specified product particularly regarding the following:

- 1) Performance
- 2) Physical size
- 3) Appearance
- 4) Longevity (robustness)
- 5) Energy efficiency

- 6) Certification
- 7) Product support and Warranty.

Where the specified product satisfies the criteria for enhanced capital allowances and hence is published within the energy technology product list, the alternative product must do likewise.

1B-5-1 CONSTRUCTION PRODUCT MARKING – (DECLARATION OF CONFORMITY)

Following on from Great Britain leaving the European Union changes in product marking now apply. Products shall comply with the Construction Product Regulation as detailed below:

Timeline	GB Market. (England, Scotland & Wales)	Northern Ireland Market	European Market (EEA)
Until 31/12/2024	CE or UKCA or CE&UK(NI)	CE or CE&UK(NI)	CE
01/01/2025 onwards	UKCA	CE or CE&UK(NI)	CE

1B-6 PRE-TENDER ENQUIRIES

Prior to issue of this tender package, enquiries to the marketplace may have been undertaken by Couch Perry Wilkes to obtain quotations from suppliers, manufacturers and specialist installers etc. These may have been requested at varying times through the design development and therefore may not reflect the final design requirements of the project as tendered and may be out of date.

The Contractor shall not rely on the accuracy of pre-tender quotations and shall be responsible for obtaining new quotations based on the final design information contained within the tender specification, drawings, schedules and accompanying tender documentation. Where the specification package is issued as Performance information only, the Contractor shall obtain new quotations based on their final design requirements.

No additional cost/claims shall be considered due to the failure to obtain quotations against the final design information.

1B-7 SUPERVISION

Site supervision for the services work is required and shall be by a dedicated Services Site Manager or equivalent permanently based on site throughout the project.

It may be acceptable for a working Charge hand to provide this service, but only with prior permission/acceptance by the client.

The supervisor shall be:

- 1) Present on site whenever work is in progress by or on behalf of the Mechanical or Electrical Contractor.
- 2) Appropriately qualified and have previous experience for the class of work specified.
- 3) Approved by the Engineer
- 4) A responsible representative to whom site working instructions shall be transmitted.

The site supervisor may be changed only after permission to do so has been granted by the Engineer and in exceptional circumstances only.

1B-8 WATER

Water and electricity consumed during the construction of the works shall be chargeable. For details of any variance refer to Main Contract.

1B-9 DESIGN RESPONSIBILITIES

1B-9-1 CONTRACTOR DESIGN PORTION

The Contractor/Specialist shall assume design responsibility for part(s) of the works as detailed in this clause.

This shall include the following in relation to all systems:

- 1) Provide details of all builder's work requirements associated with the services installation.
- 2) Provide fully co-ordinated fabrication drawings.

- 3) Provide and design all necessary services supports/fixings, including guides and anchors, but excluding any primary steelwork. All such systems shall be appropriately fire rated for the service supported.
- 4) Provide and design all necessary means for expansion and contraction for the Mechanical Services.
- 5) Routing and sizing of electrical conduits, cable trunking and cable trays other than principal runs, to facilitate the complete installation and make due allowance for 25% spare capacity within all cable management systems.
- 6) Undertake co-ordination of all services installations with all other trades on site and the building structure and fabric.
- 7) Check all attenuation and anti-vibration requirements following completion of fabrication / installation drawings and final plant selection. Provide and design final attenuators and anti-vibration equipment to meet the performance criteria detailed in the specification.
- 8) Include for "workshop" meetings associated with the ongoing development of each service provided. The number of meetings per service will depend on the complexity of design and the Contractor/Specialist should allow suitable time within the design programme to accommodate these. The Client's design team shall be invited to all such meetings as appropriate (e.g. the Architect should be invited where design has implications on the building aesthetics)

In addition, the following systems require the Contractor/Specialists to assume design responsibility for the works which shall be developed from the tender package information (as far as these systems are provided within the scope of the Contract):

- 1) Fire Alarm and detection systems
- 2) Intruder/Access Control/CCTV alarm systems
- 3) Voice/data systems

Refer to appendix for CDP responsibility schedules.

1B-10 DESIGN SUBMISSIONS

The Contractor shall provide design submissions for all systems and equipment for which they have design responsibility. This shall include, where relevant to the system, the following:

- 1) Detailed design philosophy statements along with any assumptions made.
- 2) Detailed calculations to determine size of plant/equipment/distribution, etc.
- 3) Audibility calculations e.g. fire alarm sounders
- 4) Visibility calculations e.g. fire alarm beacons
- 5) Calculations for the category of the lightning protection and surge suppression system.
- 6) Detailed and complete schematic drawings.
- 7) Detailed design layout drawings.
- 8) Detailed distribution systems design drawings to include design values, e.g. peak loading, fault levels, fire stopping, flow rate, velocity, resistance and reference for each section/leg.
- 9) Detailed schedules of all equipment with duties, sizes, redundancy and any other pertinent information.
- 10) Commissioning engineer's report on commissionability of the concepts and solutions proposed.
- 11) Detailed controls (BMS) descriptions in plain, clear and concise English.
- 12) The proprietary names of all significant products to be included in the Works but not covered by the above items.
- 13) Any other written or drawn information the Contractor considers necessary to submit to further explain their proposals.
- 14) Identification of any ambiguities, inconsistencies or errors found by the Contractor in the documents provided by the Employer and a statement of how these issues have been dealt with.
- 15) Identification of any items or work not included in the tender sum but which are necessary for the completion of the Project.

- 16) A schedule of all comments received along with details of agreed actions taken or clarification to resolve any issues raised. The schedule shall be a “live” document updated on a regular basis as the design develops and the commenting procedure progresses.

Any work that commences without the submission of the relevant calculations, schedules and drawings being submitted shall be deemed to have been undertaken at the Contractor's risk and any installations subsequently found to be non-compliant with the design parameters shall be rectified at the tendering Contractor's own expense with no detriment to the programme.

A statement shall be provided as to whether or not, in each case, products specified by proprietary name, (either stated as specifically required or specified as examples meeting the requirements) are included in the Contractor's Proposals and, if not, the alternative being offered. Any departure from design intent shall be highlighted to be easily identified.

1B-11 TECHNICAL SUBMISSIONS

In addition to the design submissions, the Contractor shall provide full detailed technical submissions to demonstrate that they have understood the requirements of the criteria outlined in the tender documents and have provided a fully compliant solution.

The Contractor shall provide Technical Submissions for all items as listed below:

- 1) The chosen equipment from the list of manufacturers identified within the specification
- 2) Where manufacturers provide working drawings (equipment or system)
- 3) Any alternative item offered that differs from that specified (manufacturer, material, range etc.)
- 4) Any bespoke manufactured equipment.
- 5) Equipment with project/user specific programming, labelling or controls

Each Technical Submission shall be complete with the following information:

- A completed schedule for each item to show capacity/ duty, efficiencies, redundancy and design parameters used for the selection. (Use schedules within the specific sections of this specification where given.)
- Clear identification of the component/equipment/system being submitted with catalogue information, e.g. number or reference or title.
- Specific data sheets for equipment which shall include maintenance and any commissioning requirements.
- Working drawings as appropriate.
- All relevant information required to evaluate the proposal.

1B-12 COORDINATION

The tender drawings show design intent. They are not construction or working drawings and therefore do not show all bends, tees, sets etc. that are necessary to locate services correctly to avoid clashes and ensure good maintenance access. The Contractor shall:

- 1) Include for all materials etc. as required to provide a complete, fully co-ordinated installation for their services.
- 2) Complete co-ordination in conjunction with the Main Contractor, the Electrical/Mechanical Contractor and the Contract Administrator, both individually and jointly.
- 3) Be responsible for co-ordination of their Sub-Contractors and/or Specialists' installation
- 4) Ensure that all services are co-ordinated with the building itself and any other services present and agree the sequence and timing of each element of the installation in a manner that maintains the agreed co-ordinated arrangements and programme.
- 5) Where services are exposed to view or of architectural merit, mark out on site the positions of all equipment and services routes, including trunking, conduit and pipework etc. prior to their fixing and agree the same with the Architect/Engineer/ Contract Administrator.
- 6) Review architect's room layouts and elevations where available to determine exact locations.
- 7) Pay particular attention to ensure that accessories are positioned to suit door openings, fitted furniture, etc.

- 8) At all "pinch points", heavily serviced areas, congested service routes or corridors and as otherwise specified elsewhere in this specification, produce drawings/sketches/details/REVIT models allocating space for all mechanical and electrical services and demonstrate that crossover points etc. have been agreed in a manner that allows sufficient access to all maintainable items. These drawings/sketches/details shall be produced by the Mechanical Contractor who shall also lead the associated co-ordination process.
- 9) Produce co-ordinated Mechanical and Electrical ceiling drawings at 1:50 scale, based on Architect's ceiling layouts, showing all ceiling mounted mechanical and electrical equipment. All necessary mechanical information shall be provided by the Mechanical Contractor. The Electrical Contractor shall take the lead to produce these drawings.
- 10) Submit all drawings etc. following the requirements for working drawings detailed in this specification.
- 11) Liaise with the Contract Administrator and CDM Principal Designer with regard to the assessment and reduction of hazard and risk in accordance with the current CDM regulations.
- 12) Include for all necessary aspect ratio changes of ductwork where needed to achieve a fully co-ordinated layout or to allow the systems to fit within available voids / under structural steels. These shall be deemed to have been included within the Tender Sum.
- 13) Take particular care to obtain uniform and tidy arrangements of pumps, valves, switchgear, outlets and ceiling mounted equipment. The precise position of a piece of equipment shall normally be determined as follows: -
 - a) Single items of equipment which are visually remote from other electrical or mechanical equipment shall be erected at the mounting heights stated in the Specification or shown on the drawings.
 - b) Two or more items of equipment, whether electrical or mechanical or both, which are to be erected on the same wall or ceiling, or which will otherwise be visually close to each other, shall be arranged in a neat and symmetrical group. Symmetry of arrangement shall be obtained by horizontal and vertical alignment through the centre lines and not the edges of equipment; for this purpose the stated mounting heights may, with the Contract Administrator's approval, be varied slightly.
- 14) Not install any services in an uncoordinated manner. Any services installed that have not been co-ordinated or as shown on the co-ordinated drawings shall be re-positioned at the Contractor's own expense as necessary.

Any disputes shall be referred to the Main Contractor, who has overall responsibility for co-ordinating the construction activities.

1B-13 BUILDER'S WORK

Allowances are included in the tender for the provision of builder's work for the works such as:

- 1) Formation of brick or concrete bases for engineering plant.
- 2) Formation/excavation of trenches.
- 3) Provision of anchor thrust blocks.
- 4) Formation of horizontal and vertical service ducts, covers and access panels as appropriate.
- 5) Cutting/forming of holes and chases, etc., and making good.
- 6) Cable tiles, marker tapes and cable markers, which shall be provided by the Contractor, shall be installed by the Building Contractor.

The Contractor shall provide

- 1) Detailed information to the Building Contractor for all builders work required for the Contract works based on working drawings produced by the Contractor and manufacturers' drawings, etc.
- 2) Dimensioned drawings showing the sizes and positions of all builders work requirements.

Where it is not practical to indicate on the drawing the positions of small (<100mm dia) holes and chases, they shall be marked out on site by the Contractor; this does not apply to holes through structural concrete or beams, which shall be shown on the drawings.

The Contractor shall be responsible for the preparation of builder's work details of all their Sub Contractors / specialists.

Section 1B Preliminaries, M&E Requirements

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The above shall be provided in good time to enable provision to be made for the same during the construction process. The Contractor shall provide builder's work drawings that are:

- 1) Based upon the installation drawings.
- 2) Fully co-ordinated as detailed elsewhere in this specification.
- 3) Provided in electronic format and:
 - a) The Contractor shall agree the number of paper copies to be issued for comment by the Engineer,, for tender purposes assume 3 (three).
 - b) The Contractor shall agree the number of paper copies to be issued for construction, for tender purposes assume 6 (six).

1B-14 INSTALLATION (WORKING) DRAWINGS

The Tender drawings issued are provided to show primary routes, design intent, component order etc. They shall not be used as working or fabrication drawings. The Contractor shall develop the tender drawings in order to provide a complete set of co-ordinated working and fabrication drawings for the installation works. The drawings and installed systems shall:

- 1) Include all fittings etc. required to comply with this specification.
- 2) Be based upon measured site dimensions - under no circumstances shall scaled dimensions from drawings be accepted.
- 3) Include minimum spacing as specified.
- 4) Be fully co-ordinated as detailed elsewhere in this specification.
- 5) Be provided to the following scales:

DESCRIPTION	SCALE
Plant rooms, external compounds and the like, risers, electrical switch rooms and cupboards and meter rooms	1:20
Internal wall elevations for positioning of outlets, components etc.	1:20
Site distribution, incoming services etc. 1:100 as long as sufficient detail can be shown	1:100
Site distribution where insufficient detail can be shown	1:50
Details of brackets, supports and any special fixings	1:10
Manufacturers detail drawings of items of equipment	1:20
Any drawing not listed above	1:50

- 1) Be provided in electronic format and:
 - a) The Contractor shall agree the number of paper copies to be issued for comment with the Engineer - for tender purposes assume 3 (three).
 - b) The Contractor shall agree the number of paper copies to be issued for construction with the Engineer - for tender purposes assume 6 (six).
 - c) Manufacture / installation works shall not commence until the drawing has been returned without any outstanding comments from the engineer, all comments shall be addressed prior to final copy being issued for manufacture / installation.

1B-15 FURTHER DOCUMENTATION TO BE PROVIDED BY CONTRACTOR

In addition to those items discussed in the preceding clauses, the Contractor shall provide all required documentation detailed within this specification, which shall include the following:

1B-15-1 PROGRESS DRAWINGS

The Contractor shall keep on site, available for reference by the Contract Administrator or other authorised persons, a full set of installation drawings on which the contractor shall record the work as installed.

1B-15-2 RECORD DRAWINGS

The Contractor shall provide record drawings that are:

- 1) Based upon the installation drawings.
- 2) An accurate record of the actual installation including any deviations from the working drawings that have occurred on site.
- 3) Fully co-ordinated as detailed elsewhere in this specification.
- 4) Indicative of the layout identity, size and position of all services installed.
- 5) Provided in electronic format.

The Contractor shall agree the number of paper copies to be issued for comment with the engineer - for tender purposes assume 2 (two).

The Contractor shall provide one full set of record drawings for each maintenance manual to include:

- 1) Reduced A3 colour copy inserted unfolded in A3 clear plastic wallets, all drawings to be visible without removing from wallets.
- 2) Full size copy folded and inserted into clear plastic wallets.
- 3) USB drive containing electronic copy in formats described elsewhere in this specification.

1B-15-3 VALVE LABELLING AND VALVE CHARTS

A chart mounted in a neat frame and glazed, indicating clearly the duty, size and purpose of all valves in each Plant Room, Tank Room, etc., shall be provided and fixed in the room to which it refers.

Traffolyte labels with clear lettering, corresponding with the markings on the charts, shall be neatly fixed to the valves concerned and shall be screwed or bolted on as necessary.

1B-15-4 OPERATING AND MAINTENANCE MANUALS

The Contractor shall produce all information necessary for inclusion in the building Health and Safety file, referred to as Operating and Maintenance (O&M) manuals below.

Program for production of O&M manual.

- 1) 2 (two) hard copies of the manuals are required, to include record drawings as outlined elsewhere
- 2) Manuals and record drawings shall be compiled during the contract and an initial draft copy shall be available for the first commissioning of the engineering services. (Minimum 21 days before contract completion.)
- 3) Practical completion shall not be given until final copies (without unresolved comments from the Engineer) are provided.
- 4) Allow a minimum of seven days for the Engineer to comment.
- 5) Incorporate all comments, re-issue for comment if substantial change required.
- 6) Prior to Practical Completion supply final copies.

The O&M manuals shall be presented as a complete and coordinated package and shall include:

- 1) Bound in covers capable of withstanding continual heavy use.
- 2) An Index.
- 3) Helpful telephone numbers.
- 4) Instructions for dealing with emergency conditions for each plant.
- 5) All information to enable operational staff to comprehend fully the extent, purpose and method of operation of the plant(s) including a full description of operation.
- 6) Detailed schedules of all plant and equipment installed, including model numbers, serial numbers and capacities and with reference numbers which agree with the detailed labelling strategy agreed with the engineer.
- 7) Schedule of manufacturers' names, addresses and telephone numbers.
- 8) Detailed instructions on the starting up, running and shut-down of all systems

- 9) Description of operational routines, together with diagrams showing the functions of all controls.
- 10) Clearly set out schedules showing the extent and frequency for which maintenance is required, in detail, and how it should be carried out
- 11) Maintenance and lubrication schedules listed in order of frequency.
- 12) Information to facilitate the ordering of spares and replacements
- 13) Common fault finding measures and remedial actions.
- 14) Any precautionary measures necessary to prevent corrosion or freezing etc.
- 15) Care required of plant which is or may be subject to seasonal or occasional use
- 16) A final copy of the report(s) prepared during testing and commissioning, including all test certificates.
- 17) Maintenance instructions provided by the suppliers of equipment and/or plant to support (not replace) the maintenance information
- 18) A full set of Record or 'As Fixed' Drawings.
- 19) Circuit and Test charts for each distribution board.
- 20) NICIEC/IET Test and Completion Certificates
- 21) Emergency lighting test certificates and record sheets.
- 22) Fire alarm test certificates.
- 23) Valve charts referenced to coincide with the marking of valve labels etc. called for in this Specification.
- 24) The size, type and length of each LV cable (to the nearest metre) together with the measured earth fault loop impedance
- 25) Interconnections between items of equipment, including those provided by others and terminal numbering and cables core identification for all alarm and control circuits
- 26) Drawings that include the work of Sub-Contractors, e.g. laboratory / medical gases and ventilation ductwork etc.
- 27) Schematic diagrams of the application of automatic controls and instruments etc. including a "Description of Operation".
- 28) The location and depth of buried services including those installed by Gas, Water and Electricity Authorities etc.
- 29) Schedules and/or diagrammatic presentations to amplify the drawings where necessary for clarification.
- 30) Building Regulations Part L Log Book.
- 31) Pressure Regulations documentation.
- 32) Building users guide.

Each manual to contain a DVD or USB memory device to contain the following:

- 1) CAD drawings (Latest AutoCAD version) and PDF copies of all Record and 'As Fitted' drawings.
- 2) Microsoft Word (Latest version) and PDF of all of Mechanical and Electrical Contractors' written instructions.
- 3) PDF copies of all manufacturers O&M manuals (in separate directory, named and cross referenced to match O&M manual descriptions).
- 4) PDF Copies of all certificates, commissioning results, test certificates etc.
- 5) Electronic copy of control strategies as final commissioned state.
- 6) Electronic copies of models, Building Regulation Part L assessments and log book etc. where prepared by the Mechanical and Electrical Contractors.
- 7) Pressure Regulations documentation.

1B-15-5 BUILDING LOG BOOK

The Building Logbook shall be completed in accordance with Part L of the Building Regulations.

- 1) In contracts where the Electrical contractor is employed as the Main contractor the log book shall be compiled and issued by the Electrical contractor.

- 2) In contracts where both Electrical and Mechanical contractors are employed, or where Mechanical contractor is employed as Main contractor, the log book shall be compiled and issued by the Mechanical Contractor

The relevant electrical or mechanical information shall be provided to the contractor compiling the Log book as follows:

- 1) Information to be provided by the Contractor compiling Logbook (Mechanical and/or Electrical Contractor)
 - a) The location of relevant plant and equipment, including simplified schematic diagrams.
 - b) The installed capacities (input power and output rating) of the services plant.
 - c) A report confirming that the building services equipment has been satisfactorily commissioned.
 - d) Simplified Operating and Maintenance instructions that include provisions enabling the specified performance of equipment to be sustained during operation (this may be cross-referenced to O&M manual documentation).
 - e) The locations, identifications and descriptions, including instructions of use of all building energy supply meters and sub-meters.
 - f) A statement regarding air tests and air permeability carried out on the building. (Information may be required from other parties, such as the Main Contractor or Architect).
 - g) A simple description of the operation and control strategies of the energy consuming services in the building. (Control Specialist to develop from Engineers statements included in Specification).
 - h) A statement regarding how energy performance of the building (or each separate tenancy in the building) can be calculated from the individual metered energy readings. (Control Specialist to develop from Engineers statements included in Specification).
 - i) A schedule of floor areas of each of the building zones categorised by environmental servicing type (e.g. air conditioned, naturally ventilated, etc.).
 - j) Microsoft Excel spreadsheets set up for this particular project to allow recording all meter readings and energy consumption.
- 2) Information provided by the Engineer or Mechanical Contractor where they are the designer:
 - a) A description of the whole building, its intended use and design philosophy and the intended purpose of the individual building services systems.
 - b) Final Part L model output report and energy certificate / display energy certificate as appropriate to the building.

The contractor compiling the information shall be responsible for providing the Building Logbook as part of the O&M documentation. The format of any necessary input to the above items shall be agreed with the contractor compiling the Building Logbook. It shall be the responsibility of either the Electrical or Mechanical Contractor to provide the information in the agreed format.

The contractor compiling the Building Logbook shall be responsible for obtaining the relevant information from the Engineer and other parties in a timely manner to allow the Building Logbook to be provided with the other O&M documentation for comment and final handover.

In the event of this clause not being complied with to the Engineer's satisfaction, the Engineer reserves the right to recommend to the Contract Administrator that the Certificate of Practical Completion to the contractor compiling the documentation be delayed until such time that these items are approved and/or commission independently a Specialist in this field to provide the information, and to deduct the Specialist's cost from the contractor's final account.

The contractor compiling the Building Logbook shall be responsible to ensure the sign off of this takes place prior to Practical Completion.

1B-16 FORMAT OF DOCUMENTATION TO BE PROVIDED BY CONTRACTOR

The Contractor shall include for all information issued to the client and design team to be provided in the following electronic formats:

REQUIRED FORMATS	
DESCRIPTION OF DOCUMENT	FORMAT REQUIRED FOR ISSUE
Drawings, to be issued in both of these formats concurrently:	AutoCAD, issued in .dwg format with any xrefs bound to the drawing. PDF, without any restrictions on printing, copying, searching etc. (applies to all PDF's described below.)
Document issue sheets, Technical submittals etc.	PDF
Request For Information (RFI)	Word or Excel Document to enable responses to be added to document.
Output from calculation, modelling or part L software. To be issued in both of these formats concurrently:	ZIP compressed file of calculation input files with all information necessary to allow others to run the same calculations. PDF of any output / summary reports with sufficient information to allow results to be viewed and commented on by all parties.
Manufacturer's instructions, certificates, warranties etc.	PDF, original from manufacturer where available, else colour scanned in version by Mechanical and Electrical Contractors
Commissioning Results	PDF generally until final versions agreed then issue in PDF and editable version such as Excel spread sheet.
Certificates etc.	Original signed copy, along with PDF of the same.
H&S O&M manual	Bound printed copies and electronic copy of the same.
Any information / document not already detailed above.	PDF, original from manufacturer / supplier where available, else colour scanned in version by Mechanical and Electrical Contractors
All format versions shall be the latest version generally available at time of issue.	

The above is in addition to the issue of official / hard copies as required by the contract documents.

1B-17 CONTRACTOR SUBMISSION REVIEW PROCEDURE

All information submitted by the Contractor shall be subject to a review process, with the submission being graded as follows:

- Status A – Proceed with design/installation in accordance with the submission
- Status B – Proceed with the design/installation in accordance with the submission incorporating the comments provided in the process.
- Status C – Do not proceed. Re-submit for further evaluation.

Only works graded A or B shall be progressed. No certification or payment shall be given for works undertaken at Status C.

Any drawings or documents prepared by the Contractor shall be prepared in good time to allow for the inspection procedure outlined above and having due regard to site progress and deliveries of materials.

The time allowed for comment by the Contract Administrator / Engineer shall be at least 10 days, subject to an agreed information release schedule. This period shall be allowed for within the program for preparing the above documents.

The above process does not apply to final documentation produced for completion, e.g. as fitted drawings, Building Log book etc. In this case the information shall be updated as required until free of comments, after which the Contractor shall submit final versions in the agreed format.

1B-18 SITE CLEANLINESS

The Contractor shall allow for cleaning up and removal from site of any rubbish as it accumulates during the progress of the works, including that of their Sub-Contractors/specialists. On completion of work the Contractor shall clear up and remove from site all superfluous materials, clean down external faces of buildings affected by the works, scrub paving and floors, clean out gullies and gutters etc., clean glass inside and out, remove all spots, splashes and stains and leave the works and all parts of the premises affected by them clean and in good order to the entire satisfaction of the Contract Administrator.

The Contractor shall ensure that all rubbish, waste and offcuts etc. are cleared away in accordance with the Main Contractor's waste management plan.

1B-19 DAMAGE DUE TO FROST OR RAIN BEFORE PRACTICAL COMPLETION OF THE WORKS

The Contractor shall make good at their own expense damage caused by frost or rain ingress due to building fabric leaking or equipment being inadequately protected. It is the contractual responsibility of the construction team not to store or install services and equipment in a building that is not sufficiently weather proof or water tight to avoid this damage. Any damaged services and equipment shall be either replaced or repaired to the satisfaction of the contract administrator and all costs for the remedial works shall be borne by the contractor.

1B-20 ARTIFICIAL LIGHTING AND POWER

All artificial lighting and power required for the whole of the works including Mechanical or Electrical Contractor's works shall be the responsibility of the Main Contractor who shall arrange for temporary supplies as necessary, temporary metering and for payment of cost involved.

Temporary metered electrical supplies to Mechanical and Electrical Contractor's site accommodation for heating and lighting purposes shall be provided by the Main Contractor. Special electrical supplies for use by the Mechanical and/or Electrical Contractors, e.g. workshop facilities, shall be provided by the Mechanical or Electrical Contractors.

Mechanical and Electrical Contractors shall allow for picking up from the temporary services provided by the Main Contractor with temporary leads to service their own requirements and they are to allow for reimbursing the Main Contractor the cost of electricity used in the Mechanical and/or Electrical Contractor's site huts.

All temporary electric wiring is to be to the satisfaction of the Contract Administrator.

1B-21 WINTER WORKING - ARTIFICIAL LIGHTING

The Mechanical and/or Electrical Contractors shall at their own expense provide adequate artificial lighting to ensure that normal weekly working hours may be worked on site despite the loss of natural light.

1B-22 TEMPORARY WORKS

1B-22-1 PLANT, TOOLS AND SCAFFOLDING

Allow for providing everything necessary for the proper execution of the work, including all requisite vehicles, plant, scaffolding, gantries, chutes, stages, fans, ladders, trestles, tarpaulins, tools, rods, moulds, templates, levels, tackle and other implements required for expeditious carrying out of the work in proper sequence, together with the carriage and cartage thereof, maintenance, adapting, shifting and removal of same when no longer required.

The Contractor shall provide and remove on completion, temporary screen and tarpaulins required to give adequate protection against wind, weather and prevent the spreading of dirt, dust and rubbish.

1B-22-2 DELIVERY AND OFF-LOADING

The Contractor shall carry out and shall provide all the necessary equipment for the off-loading, site transport and hoisting to the required level of all materials and equipment supplied under this Contract.

1B-23 OVERTIME OR NIGHT WORK

Overtime and Night work shall only take place as detailed within the Contract Preliminaries.

Where applicable the Contractor shall provide and allow for any overtime as stated within the Specification. The Contract Administrator shall receive not less than 24 hours' notice specifying times and locations of the work to be done. Any concealed work executed during overtime for which notice has not been given may be required to be opened up for inspection and reinstated at the Contractor's expense.

Should the Contract Administrator issue specific instructions, in writing, for overtime working other than that specified within the Tender Documentation, then the net difference between normal time and overtime rates shall be added in the final account; provided that accurate and detailed returns are submitted each week to the Contract Administrator.

1B-24 FIRE PRECAUTIONS

The Contractor shall take all reasonable precautions to avoid the outbreak of fire, particularly in work involving the use of naked flames. The Contractor shall set in place and rigorously enforce procedures to minimise the risk of an outbreak of fire, which shall address the following general issues as well as any site-specific issue:

- 1) Disposal of flammable materials
- 2) Accumulation of rubbish on site
- 3) Hot works procedures including:
 - a) Use of fire resisting mats, to prevent scorching or fire.
 - b) Provision of firefighting equipment during the work.
 - c) Fire watch during and after hot works.
 - d) Hot works to stop at least two hours before leaving site.
- 4) Obtaining and clearing any required work permit from the client and following any additional requirements in their safety procedures.
- 5) Fire escapes being maintained clear and usable at all times.
- 6) Safe storage of highly flammable materials and gas cylinders.

The above procedure shall be detailed in a method statement issued to all parties for comment, and any comments incorporated, prior to commencing works.

1B-25 TESTING AND COMMISSIONING OF ENGINEERING SERVICES

Detailed Requirements for testing and commissioning are laid out later in this specification. In general:

- 1) All testing shall be carried out as recommended by the current edition of the IET wiring regulations (BS7671), relevant British and European Standards and Codes of Practice and current legislation.
- 2) The Contractor shall draw up a detailed testing and commissioning programme indicating critical dates of external influences.
- 3) The Contractor shall allow for their Commissioning Engineers being in attendance whilst the Engineer verifies the results and ascertains that the various elements of each system are in full working order. A minimum period of 1 week per month of the contract period (Minimum 2 weeks) shall be allowed for this procedure.
- 4) The Contractor shall allow for their Commissioning Specialist to demonstrate to the Employer that the design intent of the systems has been achieved.

1B-26 SOAK TEST PERIOD

Upon completion of the setting to work and commissioning of the services the Contractor shall perform a soak test of the systems installed. The soak test shall:

- 1) Be included in the programme for the works.

- 2) Continue until seven continuous days of plant operation have occurred without fault or failure of any component / function.

During the soak test period the Contractor shall:

- a) Monitor all functions (pressures/temperatures/starts per hour etc.) which shall be trend logged using the microprocessor controls equipment where installed.
- b) Monitor each type of space served by the plant and equipment using digital data recorders (supplied by the Mechanical or Electrical Contractor) to verify the performance.
- c) Carry out any specified heat load and noise performance surveys
- d) Download/convert all data to Excel spreadsheet format (disc and hard copy).
- e) Send all data and monitoring results to the Engineer for acceptance by both the Employer and the professional parties

Should the soak test fail for any reason, then the results shall be null and void and the test period shall recommence upon rectification of the problem/failure.

All costs associated with the soak test such as test equipment, attendance and supervision shall be included by the Contractor.

Any costs incurred as a result of or a consequence of having to restart the soak test shall be at the Contractor's expense.

A successful soak test as described shall be carried out prior to practical completion being granted by the Contract Administrator.

1B-27 USE OF BUILDING SERVICES

The Contractor is reminded that they are responsible for the permanent engineering installation provided as part of this Contract until such time as the Certificate of Practical Completion is issued.

These installations shall not be used either directly for, or in connection with carrying out Contract works without the written consent of the Contract Administrator and appropriate Contractors and Manufacturers.

Should any systems be used in this way, the following applies:

- 1) The Employer does not undertake that it will be available.
- 2) It shall not be used until the plant has been tested to the satisfaction of the Contract Administrator and Engineer.
- 3) The Contractor shall take responsibility for operation, maintenance (and remedial work) and arrange supervision by and the indemnification of the appropriate Sub-Contractor and pay all costs arising including extending all associated warranties accordingly.
- 4) The Contractor shall effect any additional insurances required and pay all additional costs associated.
- 5) The Contractor shall pay costs of fuel or water used.
- 6) The Defects Liability Period shall commence from the date of Practical Completion of the works, and not from the date when parts of the installation(s) are brought into use for the above reasons.
- 7) The Contractor shall indemnify the Employer against the reduction in manufacturer's guarantee resulting from use before practical completion.
- 8) If it has been agreed that the Contractor may use the permanent lighting then the following shall apply:
 - a) Diffusers shall be replaced with new just before Practical Completion.
 - b) Exposed parts of the luminaire shall be protected against paint splashes and other marks.
 - c) Any separate (e.g. fluorescent) lamps that are used during this period shall be removed and replaced by new, permanent lamps immediately prior to Practical Completion.
 - d) Where LED fittings with integral lamps are used, the Contractor shall provide financial compensation for the proportion of the fitting life that has been lost due to this usage. This shall be based on the total cost of the fitting and an expected lifespan of 60,000 hours. The running hours shall be logged by the Contractor and certified by the Contract Administrator.

- e) Use of the permanent lighting installation and temporary / replacement lamps shall not incur any additional cost to the contract.

1B-28 SCHEDULE OF RATES

The Contractor shall provide a full quantified schedule of rates which shall:

- 1) Be provided with 14 days of being appointed
- 2) Shall be a Bill of Quantities with a total that matches the contract price.
- 3) List all materials, equipment and quantities applicable to the works.
- 4) Be broken down into 1st fix, 2nd fix and fit out for each service element as defined in the Tender Analysis.

1B-29 CDM REGULATIONS

CDM regulations documentation, specific risk assessments etc. shall be provided as follows:

- 1) In electronic format
- 2) Mechanical and Electrical Contractors shall agree number of paper copies to be issued for comment with the Principal Contractor/Principal Designer and Engineer, for tender purposes assume 2 (two).
- 3) Manufacture / installation works shall not commence until the documentation has been returned without any outstanding comments from the Principal Contractor/Principal Designer and Engineer, all comments shall be addressed prior to final copy being issued for inclusion in the Health and Safety File.

1B-30 LABELLING OF EQUIPMENT

Each item of plant and equipment shall bear a metal nameplate giving the maker's name, serial number and relevant performance data. In addition all items of plant and equipment shall be provided with site specific reference labelling, for details refer to Section 3 of this specification.

1B-31 EXISTING ASBESTOS INSTALLATION

Reference to the Contract preliminaries shall be undertaken to ascertain any work associated with removal of existing asbestos. The Contractor shall also review the Client's Asbestos Register to become cognisant with all known locations of asbestos and any risks associated with the presence of asbestos

1B-32 PRESSURE REGULATION DOCUMENTATION AND COMPLIANCE

All certification/documentation in compliance with the Pressure Equipment Directive (97/23/EC) and all latest amendments shall be provided.

All equipment installed under this contract and subject to this regulation must be certified and all documentation included within the O & M Manuals.

Failure to provide necessary certification shall render the equipment/system non-functional.

The Mechanical Contractor and Main Contractor shall be liable for any subsequent costs associated with the non-compliance.

The entire installation shall comply in full with the pressure regulations and shall include:

- 1) Provision of all safety pressure, combined temperature & pressure relief valves and the like.
- 2) Provision of individual pressure test certificate for all components covered by the regulations. Type testing is not acceptable.
- 3) Provide, or update an existing when modifying a system, a written scheme of examination in accordance with the regulations, employ a competent person to complete this on the Mechanical Contractor's behalf if this cannot be completed in house.

All necessary attendances shall be included by the Mechanical Contractor and for compiling all necessary paperwork required to enable the written scheme of examination to be compiled.

1B-33 CONSTRUCTION (DESIGN AND MANAGEMENT) REGULATIONS

For the purposes of the Construction (Design and Management) Regulations, the Main Contractor shall be nominated as and assume the duties of Principal Contractor as defined and set out in those Regulations.

Notwithstanding the requirements of the above clause, the Contractor shall be bound to abide by and implement all regulations, byelaws or other legislation relevant to the health, safety and welfare of all persons on or about the works or likely to be affected by the execution of the works.

1B-34 HEALTH AND SAFETY PLAN

The Contractor shall, in conjunction with the CDM Principal Designer, where necessary, amend, adapt, and expand the Health and Safety information provided contained within the tender documents to produce a coherent Construction Phase plan for the project. The plan shall be implemented and monitored and where necessary, adapted, amended or expanded to reflect changes in circumstances which may arise during the construction phase of the project.

1B-35 PERSONNEL

The Contractor shall:

- 1) Ensure suitably qualified personnel are responsible for preparing, implementing and monitoring the Health and Safety Plan for the duration of the construction phase of the project.
- 2) Obtain the prior written approval of the CDM Principal Designer before changing any of the personnel referred to above.

1B-36 HAZARDS OF HEALTH AND SAFETY GENERALLY

The Contractor shall advise the CDM Principal Designer immediately of any deficiencies in the Pre-tender Health and Safety information provided or of unforeseen hazards to health and safety which may become apparent as the project proceeds.

1B-37 CONTRACTORS

The Contractor shall take all necessary measures to satisfy themselves that all Contractors, whether appointed by them directly or not, are competent and have allocated sufficient resources to comply with the requirements on Contractors imposed by the latest Construction (Design and Management) Regulations.

1B-38 INSTRUCTION OF EMPLOYER'S STAFF

The Contractor shall, in conjunction with their Specialists and Commissioning engineer, instruct the employer's staff.

Instruction shall not commence until the following has been achieved:

- 1) Full commissioning of all services.
- 2) Checking Verification of Systems.
- 3) Random Checks of system(s) by Engineer.
- 4) Note: client instruction shall not take place on same day as commissioning activities for any system.

A programme for all instruction / demonstrations shall be developed in advance and issued to the following parties:

- 1) Main Contractor
- 2) The Contractor and their Specialists / Sub-Contractors.
- 3) Commissioning specialist
- 4) Electrical/Mechanical Contractor
- 5) Client's facilities management representatives.
- 6) Client user group(s) representative.
- 7) Contract Administrator
- 8) Engineer

For each system the following procedure shall be used:

- 1) Prepare documentation for instruction including:
 - a) Relevant as fitted drawings / technical drawings.
 - b) Relevant section of the O&M manual, including Job specific information, operating instructions, maintenance instructions etc.

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- c) Final commissioning results.
- 2) An invitation to attend the client instruction shall be issued to the parties detailed above at least seven days before the date of the instruction. Invitation shall include:
 - a) Electronic (PDF) copies of all of the documentation for commissioning described above.
 - b) Agenda for the day's activities developed from the minimum requirements detailed below.
 - c) Pro-forma sign off sheet for all attendees.
- 3) The following parties are required to attend from the contracting team.
 - a) The Contractor and their Specialists / Sub-Contractors.
 - b) Commissioning specialist
 - c) Main Contractor
- 4) Agenda for system instruction, the following sets out the minimum requirements:
 - a) Tour of installed system including identifying all key parts of the system and demonstrating these are correctly indicated on the as fitted drawings.
 - b) Presentation of commissioning results and demonstrate system operating correctly.
 - c) Presentation of operating and maintenance manuals.
 - d) Demonstrate day to day and emergency operating procedures.
 - e) Any discrepancies identified during the demonstration shall be scheduled by the Contractor along with actions / programme for rectification.

Formal acceptance of the system shall occur when all parties are satisfied with the system and understand correct operation, all parties shall then sign the pro-forma described above.

The Contractor shall include in their tender and programme sufficient time to incorporate the client instruction methodology described above.

APPENDIX I - CDP RESPONSIBILITY SCHEDULES

Key

- Lead Input/Responsibility
- Secondary Input

Electrical Installation

LV DISTRIBUTION SYSTEMS		CPW	Contractor
1	Initial Design Concepts	●	
2	Location of main distribution equipment, sizing of the same and design of associated spaces	●	
3	Detailed design including sizing of all cables and primary containment (ladder, rack, main runs of basket and trunking)	●	
4	Specification including all cable types	●	
5	Design of secondary containment (conduit, supplementary runs of trunking and basket.)		●
6	Support systems including necessary liaison with Building Contractor and Structural Engineer and Fire Advisor. All such systems shall be appropriately fire rated for the services supported.		●
7	Cable referencing systems based on the principles outlined in the Specification.		●
8	Liaison with others to identify number, location and technical requirements of all interfaces.		●
9	Panel layout and compliance check for all bespoke switchgear and factory built assemblies	○	●
10	Controls wiring and software for all bespoke switchgear and factory built assemblies.		●
11	Fabrication drawings to include specific requirements of finally selected manufacturers		●

GENERATOR SYSTEMS		CPW	Contractor
1	Initial Design Concepts	●	
2	Location of main equipment, sizing of the same and design of associated spaces	●	
3	Route and sizing of primary containment (ladder, rack, main runs of basket and trunking)	●	
4	Performance specification for installation	●	
5	Installation design coordinating all components (fuel system, noise attenuation, air intakes etc.)		●
6	Design of all interfaces with HV/LV distribution systems		●
7	Design of secondary containment (conduit, supplementary runs of trunking and basket.)		●
8	Noise calculations		●
9	Fuel storage and distribution sizing		●
10	Support systems including necessary liaison with Building Contractor and Structural Engineer and Fire Advisor. All such systems shall be appropriately fire rated for the services supported.		●

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GENERATOR SYSTEMS		CPW	Contractor
11	Controls wiring and software.		•
12	Fabrication drawings		•

INTRUDER ALARM SYSTEMS		CPW	Contractor
1	Initial Design Consultation with client, insurer, CPO	•	
2	Scheme designed to suit Building Security strategy, alarm zones identified	•	
3	Detector Types, control points, alarm annunciators & Layout Drawings	•	
4	Specification	•	
6	Identify Systems to be interfaced	•	
7	Wiring Types	○	•
8	Size and route of primary cable containment (tray, basket, trunking)	•	•
9	Design check, advise of any additional equipment necessary to achieve compliance		•
10	Installation Drawings with Address References, fully coordinated with services, structure.		•
11	Liaison with others to identify number, location and technical requirements of all interfaces.		•
12	Sizing of cables, Power Supplies, System Capacity	○	•
13	Size and location of secondary cable containment (conduit and supplementary tray/basket)		•
14	Support systems including necessary liaison with Building Contractor and Structural Engineer and Fire Advisor. All such systems shall be appropriately fire rated for the services supported		•
15	System/Panel Software		•
16	Design compliance statement. Acceptance of design responsibility for certification purposes		•
17	Verify Maintenance access and maintainability	○	•
18	Any required changes to achieve fully working system following testing & commissioning	○	•
19	Insurer, CPO Sign off		•

CLOSED CIRCUIT TELEVISION (CCTV)		CPW	Contractor
1	Initial Design Consultation with client, insurer, CPO	•	
2	Scheme designed to suit Security strategy, risk locations identified	•	
3	Camera locations, types, lens performance & Layout Drawings.	•	
4	Specification	•	
5	Review Lighting levels for suitability with CCTV	•	
6	Identify Systems to be interfaced	•	
7	Size and route of primary cable containment (tray, basket, trunking)	•	

Section 1B Preliminaries, M&E Requirements

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8	Wiring Types	○	●
9	Design check, advise of any additional equipment necessary to achieve compliance		●
10	Installation Drawings with Camera References, fully coordinated with services, structure.		●
11	Liaison with others to identify number, location and technical requirements of all interfaces		●
12	Cause & Effect Schedule of pre-sets and alarm inputs	○	●
13	Sizing of cables, Power Supplies, Matrix & Recording System Capacity	○	●
14	Camera Lens Specification.	○	●
15	Size and location of secondary cable containment (conduit and supplementary tray/basket)		●
16	Design of camera supports, towers and coordination with external lighting design		●
17	System Software		●
18	Design compliance statement. Acceptance of design responsibility for certification purposes		●
19	Verify Maintenance access and maintainability	○	●
20	Any required changes to achieve fully working system following testing & commissioning	○	●
21	Insurer, CPO Sign off		●

ACCESS CONTROL		CPW	Contractor
1	Initial Design Consultation with client, insurer, CPO	●	
2	Scheme designed to suit Building fire & security strategy, alarm zones identified	●	
3	Device locations, types & Layout Drawings.	●	
4	Specification	●	
5	Identify Systems to be interfaced	●	
6	Size and route of primary cable containment (tray, basket, trunking)	●	
7	Wiring Types	○	●
8	Design check, advise of any additional equipment necessary to achieve compliance		●
9	Installation Drawings with ID References, fully coordinated with services, structure.		●
10	Liaison with others to identify number, location and technical requirements of all interfaces		●
11	Cause & Effect Schedule of pre-sets and alarm inputs	○	●
12	Sizing of cables, Power Supplies, Matrix & Recording System Capacity	○	●
13	Size and location of secondary cable containment (conduit and supplementary tray/basket)		●
14	Support systems including necessary liaison with Building Contractor and Structural Engineer and Fire Advisor. All such systems shall be appropriately fire rated for the services supported		●
15	System Software		●
16	Design compliance statement. Acceptance of design responsibility for certification purposes		●

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ACCESS CONTROL		CPW	Contractor
17	Verify Maintenance access and maintainability	○	●
18	Any required changes to achieve fully working system following testing & commissioning	○	●
19	Insurer, CPO Sign off		●

FIRE ALARM		CPW	Contractor
1	Initial Design Consultation with client, insurer, building control	●	
2	Scheme designed to suit Building fire strategy, alarm zones identified	●	
3	Detector Types, call points & Layout Drawings	●	
4	Specification	●	
5	Details of required evacuation regime (single/two stage, progressive horizontal)	●	
6	Sounder or PA/VA requirements, sounder locations & outputs	●	
7	Identify Systems to be interfaced	●	
8	Wiring Types to be Specified	●	
9	Main primary cable containment	●	
10	Cause & Effect Schedule	○	●
11	Design check, advise of any additional equipment necessary to achieve compliance		●
12	Audibility calculations, advise of any additional sounders necessary to achieve compliance		●
13	Installation Drawings with Address References, fully coordinated with services, structure etc.		●
14	Liaison with others to identify number, location and technical requirements of all interfaces.		●
15	Sizing of cables, Power Supplies, System Capacity	○	●
16	Secondary cable containment/supports.		●
17	Design compliance statement and acceptance of design responsibility for final system		●
18	System/Panel Software		●
19	Verify Maintenance access and maintainability	○	●
20	Any required changes to achieve fully working system following testing & commissioning	○	●
21	Building Control Sign Off		●

EMERGENCY LIGHTING		CPW	Contractor
1	Initial Design Consultation with client and building control, agreement of muster point	●	
2	Agree requirements for safety lighting and standby lighting (as defined by BS 5266)	●	
3	Review and integration of agreed strategy on exit signage and self-illuminated exit signage	●	
4	Consideration of central vs local batteries and agreement of strategy	●	
5	Initial discussion on open areas and high risk task rooms and provision of draft list	●	

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EMERGENCY LIGHTING		CPW	Contractor
6	Agreement of requirement for lighting (and hence emergency lighting) for plant on roof	●	
7	Scheme design to suit agreed building evacuation strategy and BS 5266	●	
8	Specification, including wiring types and containment, luminaire type selection and aesthetics	●	
9	Sizing and location of battery room (Central battery system only)	●	
10	Attendance at Consultation and Risk Assessment workshops	●	
11	Agree final list hazard rooms, open plan areas, points of emphasis, etc. as BS5266		●
12	Design check, advise of any additional equipment necessary to achieve compliance		●
13	Lighting calculations including horizontal and vertical illuminance, glare and uniformity		●
14	Installation Drawings with References, fully coordinated with services, structure etc.		●
15	Sizing of batteries		●
16	Secondary cable containment/supports.		●
17	Design compliance statement and acceptance of design responsibility for final system		●
18	System/Panel Software (for automated test)		●
19	Verify Maintenance access and maintainability	○	●
20	Any required changes to achieve fully working system following testing & commissioning	○	●
21	Building Control Sign Off and Occupier Instruction	○	●

LIGHTNING PROTECTION AND SURGE PROTECTION		CPW	Contractor
1	Initial Design Consultation with client, Access consultant.	●	
2	Specification	●	
3	Input details for risk assessment	●	
4	Defining the level of surge protection	●	
5	Design of the LPS		●
6	Design of the Surge Protection		●
7	Submission of Calculations for comment	○	●
8	Liaison with other specialists e.g. CCTV, Comms etc.		●
9	Installation drawings for LPS & Surge Protection		●
10	Verify maintenance access & maintainability	○	●
11	Any required changes to achieve fully working system following testing & commissioning	○	●
12	Insurer sign off		●

AUDIO VISUAL SYSTEMS		CPW	Contractor
1	Initial Design Consultation with client.	●	
2	Scheme designed to suit building use and layout	●	
3	Device locations, types (speakers, sound systems, screens) & Layout Drawings.	●	
4	Specification	●	

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AUDIO VISUAL SYSTEMS		CPW	Contractor
5	Identify Systems to be interfaced (Data system, DVD, Blue ray, Sound/music, stage etc.)	●	
6	Size and route of primary cable containment (tray, basket, trunking)	●	
7	Wiring Types to be Specified	○	●
8	Installation Drawings with ID References, fully coordinated with services, structure.		●
9	Liaise with other specialists to identify number, locations of all interfaces.		●
10	Sizing of cables, Power Supplies, Speakers, Amplifiers, Media players, Screens.	○	●
11	Size and location of secondary cable containment (conduit and supplementary tray/basket)		●
12	Verify Maintenance access and maintainability	○	●
13	Any required changes to achieve fully working system following testing & commissioning	○	●
14	Client Sign off		●

VOICE / DATA SYSTEMS		CPW	Contractor
1	Initial Design Consultation with client.	●	
2	Wiring standard to be agreed.	●	
3	CPW/Client responsibility matrix to be agreed	●	
4	Specification	●	
5	Server and wiring cabinet locations and design of associated spaces.	●	
6	Identify Systems to be interfaced (telephone, BMS, Fire Alarm etc.)	●	
7	Size and route of primary cable containment (tray, basket)	●	
8	Design check to confirm suitability of containment proposals (space and cable bend radius)		●
9	Design check of cable routes to confirm 90m distance limit will be achieved		●
10	Installation Drawings with ID References, fully coordinated with services, structure.		●
11	Liaise with other specialists to identify number, locations of all interfaces.		●
12	Size and location of secondary cable containment (conduit and supplementary tray/basket).		●
13	Sizing of cabinets, confirming allocation for patch panels, switches, UPS, data storage, servers etc.	○	●
14	Sizing / planning Wi-Fi transmitters.	○	●
15	Verify maintenance access & maintainability	○	●
16	Any required changes to achieve fully working system following testing & commissioning	○	●
17	Client sign off		●

NURSE CALL / WARDEN CALL / DISABLED TOILET ALARM / STAFF ATTACK		CPW	Contractor
1	Initial Design Consultation with client, insurer.	●	
2	Specification	●	

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NURSE CALL / WARDEN CALL / DISABLED TOILET ALARM / STAFF ATTACK		CPW	Contractor
3	Scheme designed to meet requirements and building layout.	●	
4	Identify systems to be interfaced (site paging, drugs cupboard alarms etc.)	●	
5	Device locations, types (call points, over door lights etc.) & Layout Drawings.	●	
6	Size and route of primary cable containment (tray, basket, trunking)	●	
7	Wiring specification	○	●
8	Design check, advise on any additional equipment necessary to achieve compliance		●
9	Installation Drawings with ID References, fully coordinated with services, structure.		●
10	Liaison with others to identify number, location and technical requirements of all interfaces		●
11	Cause & Effect Schedule of pre-sets and alarm inputs	○	●
12	Sizing of cables, Power Supplies, Infra-Red Transmitters/receivers, FM transmitters/Receivers.	○	●
13	Size and location of secondary cable containment (conduit and supplementary basket/trunking)		●
14	System software		●
15	Design compliance statement. Acceptance of design responsibility for certification purposes		●
16	Verify maintenance access & maintainability	○	●
17	Any required changes to achieve fully working system following testing & commissioning	○	●
18	Client, insurer sign off.		●

Mechanical Installation

BMS / AUTOMATIC CONTROLS		CPW	Contractor
1	Initial Design and performance description of key elements	●	
2	Specification	●	
3	Scheme designed to meet requirements and building layout.	●	
4	Schematic drawings showing plant configuration	●	
5	Location of primary control panel in principle	●	
6	Controls functional description	○	●
7	Development of graphics, reports and controls strategies for outstations and front end.	○	●
8	Network infrastructure including switches and interfacing with site wide systems.	○	●
9	Panel design, layout and coordination	○	●
10	Selection of sensors, valves, inverters to meet performance specification	○	●
11	Detailed wiring arrangements and control strategy interfaces to plant and equipment	○	●
12	Sizing of cables, power supplies, invertors	○	●
13	Verify maintenance access & manufacturing	○	●
14	Testing & Commissioning	○	●

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BMS / AUTOMATIC CONTROLS		CPW	Contractor
15	Demonstrations	○	●
16	Client sign off.		●

PIPEWORK EXPANSION AND CONTRACTION		CPW	Contractor
1	Performance specification	●	
2	Initial routing of services in principle	●	
3	Design/Specification of expansion control measures	○	●
4	Design and coordination of fixing methods for brackets, anchors etc., including agreeing with Structural Engineer.	○	●
5	Verify maintenance and accessibility.	○	●
6	Client sign off.		●

FLUES		CPW	Contractor
1	Performance specification	●	
2	Initial routing of services in principle	●	
3	Design/Specification of Flues systems	○	●
4	Design and coordination of fixing methods for brackets, anchors etc., including agreeing with Structural Engineer and Fire Advisor. All such systems shall be appropriately fire rated for the services supported	○	●
5	Verify maintenance and accessibility.	○	●
6	Client sign off.		●

DIRECT EXPANSION (DX) SYSTEMS		CPW	Contractor
1	Performance specification	●	
2	Initial routing of services in principle	●	
3	Initial selection of indoor and outdoor units and controls	●	
4	Design/Specification of DX systems	○	●
5	Design and coordination of fixing methods for brackets, bases etc., including agreeing with Structural Engineer and Fire Advisor. All such systems shall be appropriately fire rated for the services supported	○	●
6	Verify maintenance and accessibility.	○	●
7	Client sign off.		●

SPRINKLER OR OTHER FIRE SUPPRESSION SYSTEMS, SMOKE VENTILATION		CPW	Contractor
1	Performance specification	●	
2	Initial routing of services in principle	●	

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SPRINKLER OR OTHER FIRE SUPPRESSION SYSTEMS, SMOKE VENTILATION		CPW	Contractor
3	Design/Specification of System	○	●
4	Design and coordination of fixing methods for brackets, anchors etc., including agreeing with Structural Engineer and Fire Advisor. All such systems shall be appropriately fire rated for the services supported	○	●
5	Verify maintenance and accessibility	○	●
6	Client sign off		●

Section 2F

Electrical Inspection and Testing

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2F-1 GENERAL DESCRIPTION

This section details the inspection and testing requirements for new installation work (including alterations and additions to existing installations) and the replacement of electrical switchgear).

These requirements shall be followed unless there are explicit instructions to the contrary in a subsequent section of this specification (e.g. site specific witnessing requirements). Where such instructions are unclear or only inferred, written confirmation from the Engineer shall be obtained prior to submission of tender costs to clarify the requirements, and in the absence of such the more onerous requirements shall be included.

Throughout this section references are made to requirements and recommendations detailed within several statutory and non-statutory standards / documents. It shall be noted the information presented herein is in no way intended to replace the detailed information provided within these documents which must be fully adhered to where applicable.

This section does not cover the testing of specialist systems e.g. lighting controls, fire-fighting and life safety systems, security systems, communication systems etc. Requirements for these systems are detailed in the relevant section dealing with that system.

2F-2 DEFINITIONS

Refer to Section 2E / Section 1B of this specification and Part 2 of BS 7671 – IET Wiring Regulations – Requirements for Electrical Installations for further details regarding definitions, symbols and abbreviations.

Additional definitions specifically associated with inspection and testing are as follows: -

Departure – Deliberate decision not to comply fully with the requirements of BS 7671 for which the designer must declare that the resultant degree of safety is not less than that achievable by full compliance.

EIC – Electrical Installation Certificate.

EICR – Electrical Installation Condition Report (formerly known as Periodic Inspection Report).

Inspector – Refers to the person(s) employed by the Contractor responsible for undertaking the inspection and testing works.

Qualified Supervisor – Refers to the person employed by the Contractor responsible for overseeing the inspection and testing works. They shall also be responsible for the review and verification of the certification and/or reports. The Inspector may also be the Qualified Supervisor.

Non-compliance – A non-conformity that may give rise to danger.

New Installation Works – Refers to new installation work, and for alterations or additions to existing installations where new circuits have been introduced. This includes the replacement of existing electrical switchgear such as low voltage switch panels, MCCB panel boards, MCB distribution boards, consumer units etc.

Where referenced within this documentation Electrical Installation Condition Reports (EICR) shall mean the same as Periodic Inspection Reports (PIR), which is an obsolete term still commonly used.

2F-3 STANDARDS APPLICABLE

Works shall be completed in accordance with all applicable industry standards. Some of the most relevant standards associated with this section are scheduled below:

STANDARDS AND DOCUMENTS	
BS 7671	IET Wiring Regulations – Requirements for Electrical Installations – Part 6 Inspection and Testing
IET On-Site Guide – BS 7671 – IET Wiring Regulations – Requirements for Electrical Installations – Section 9 Inspection and testing and Section 10 Guidance on initial testing of installations and Section 11 Operation of RCDs	
IET Guidance Note 3 – Inspection & Testing	
BS 5458	Specification for safety requirements for indicating and recording electrical measuring instruments and their accessories (Superseded / withdrawn and replaced by BS EN 61010,

STANDARDS AND DOCUMENTS	
	this is the standard to which some older instruments that are still in use should have been manufactured)
BS EN 61010	Safety requirements for electrical equipment for measurement, control, and laboratory use
BS EN 61243	Live working – Voltage detectors
BS EN 61557	Electrical safety equipment in low voltage distribution systems up to 1000 V a.c. and 1500 V d.c. – Equipment for testing; measuring or monitoring of protective measures
HSE (Health and Safety Executive) – Guidance Note GS38 – Electrical test equipment for use on low voltage electrical systems	
HSE (Health and Safety Executive) – The Electricity at Work Regulations – Guidance on regulations – HSR25	
HSE (Health and Safety Executive) – Electricity at Work – Safe working practices – HSG85	
Electrical Safety First – Best Practice Guide 2 – Guidance on the management of electrical safety and safe isolation procedures for low voltage installations	
Electrical Safety First – Best Practice Guide 7 – Test instruments for electrical installations: Accuracy and consistency	
NICEIC / ECA / ELECSA – Inspection, Testing and Certification including Periodic Reporting – Practical advice and guidance	
All standards, guidance and statutory regulations detailed within Section 2E-3	

Where the above standards refer to supporting documentation and standards these shall be fully complied with in all respects.

Where discrepancy is found between this specification and the relevant standards, the Contractor shall obtain written clarification from the Engineer prior to submission of the tender. Where a discrepancy has not been clarified prior to tender submission, the Contractor shall include the most onerous requirements.

2F-4 STATUTORY REGULATIONS AND BS 7671 IET WIRING REGULATIONS

All persons undertaking the inspection and testing of electrical installations shall comply with relevant requirements of The Electricity at Work Regulations, where particular attention shall be paid to Regulation 12 ‘Means for cutting off the supply and for isolation’ and Regulation 14 ‘Work on or near live conductors’ and the guidance provided by the HSE (Health and Safety Executive) – Memorandum of guidance on the Electricity at Work Regulations 1989 – Guidance on regulations – HSR25.

The electrical inspection and testing shall be undertaken in accordance with the latest version of BS 7671 IET Wiring Regulations – Requirements for Electrical Installations and all supporting IET documentation.

The Contractor shall be fully responsible for the inspection and testing of the electrical installation, which shall only be undertaken by one or more skilled persons (electrically) as defined in BS 7671 that are competent to undertake the works in such an installation.

Precautions shall be taken to ensure that the inspection and testing of the electrical installation shall not cause danger to persons or livestock and shall not cause damage to property and equipment even if a circuit is defective.

2F-5 ELECTRICAL CONTRACTING CERTIFICATION SCHEMES

The Contractor shall undertake all inspection and testing in accordance with industry best practice and must be registered with an appropriate certification scheme as detailed in Section 2E of this specification. The inspection and testing of the electrical installation shall only be undertaken by persons who meet the minimum requirements to undertake the works as defined by their Electrical Contracting Certification Scheme.

This shall be the National Inspection Council for Electrical Installation Contracting (NICEIC) / ELECSA – Platinum Promise registration scheme, or equivalent.

The Contractor shall directly employ a Qualified Supervisor / Inspector on a full-time basis as required by their Electrical Contracting Certification Scheme. The Qualified Supervisor / Inspector shall also meet the minimum requirements as defined by their Electrical Contracting Certification Scheme e.g., relevant education and experience, hold a recognised inspection and testing qualification etc.

The Qualified Supervisor shall oversee the testing and inspection works and shall ensure that the results of inspection and testing are recorded correctly on the appropriate certificates and/or reports. The Qualified Supervisor shall also be responsible for the review, verification, signing and dating of the certification and/or reports.

The person(s) undertaking the inspection and testing works (Inspector) may also be the Qualified Supervisor.

All due allowances shall be made within the tender submission for the Qualified Supervisor and the person(s) undertaking the inspection / testing works (Inspector) to meet on-site when requested by the Engineer at a mutually agreeable time.

2F-6 CERTIFICATION AND REPORTS

Dependent upon the type of works undertaken, certification and reports shall be provided as required by BS 7671 and Electrical Contracting Certification Schemes.

The certification and reports shall be selected from below as required: -

ELECTRICAL INSTALLATION CERTIFICATES

The EIC shall be used for all new installation work, and for all alterations or additions to existing installations where new circuits have been introduced including the replacement of existing main electrical switchgear such as low voltage switch panels, MCCB panel boards, MCB distribution boards, consumer units etc.

The EIC shall include: -

- 1) Front matter.
- 2) Schedule of items inspected.
- 3) Schedule of additional records (these shall be defined and allocated page numbers within the certification e.g. fire alarm system, emergency lighting etc.).
- 4) Schedule of circuit details.
- 5) Schedule of test results for every circuit.

It shall not be used for the inspection and testing of an existing electrical installation, where an EICR shall be used.

DOMESTIC ELECTRICAL INSTALLATION CERTIFICATES

The Domestic Electrical Installation Certificate shall be used for all new electrical installation work, and for all alterations or additions to existing installations where new circuits have been introduced including the replacement of existing main electrical switchgear such as MCB distribution boards, consumer units etc.

The certificate shall only be used for new installation work where all of the following conditions apply: -

- 1) The electrical installation work relates to a single dwelling (house or individual flat).
- 2) The design, the construction, and the inspection and testing of the electrical installation work are the responsibility of one Contractor with approval by an Electrical Contracting Certification Scheme.
- 3) The installation forms part of a TT, TN-S or TN-C-S (PME) system.
- 4) The protective measure for fault protection is provided primarily by Automatic Disconnection of Supply.

The Domestic Electrical Installation Certificate shall include: -

- 1) Front matter.
- 2) Schedule of items inspected.
- 3) Schedule of circuit details.
- 4) Schedule of test results for every circuit.

It shall not be used for single dwellings where the Engineer is responsible for the design, as the Domestic Electrical Installation Certificate does not include a separate 'DESIGN' section. An EIC shall be used instead.

MINOR ELECTRICAL INSTALLATION WORKS CERTIFICATES

The Minor Electrical Installation Works Certificate shall be used for any alteration or addition to an existing circuit such as: -

- 1) Addition of a socket-outlet to a ring or radial circuit.
- 2) Additional of a lighting point.
- 3) Alterations to lighting switching such as relocation of light switches.
- 4) Replacement of an accessory or luminaire (not switchgear such as DB's etc.).

It shall not be used for new circuits or the replacement of existing main electrical switchgear e.g. MCB distribution boards, consumer units etc. Further reference shall be made to Electrical Contracting Certification Schemes to clarify the acceptable and non-acceptable works associated with Minor Electrical Installation Certificates.

ELECTRICAL INSTALLATION CONDITION REPORTS (FORMERLY PERIODIC INSPECTION REPORTS)

The EICR shall only be used for reporting on the condition of an existing installation.

The EICR shall include: -

- 1) Front matter.
- 2) Schedule of observations and recommendations for actions to be taken.
- 3) Inspection schedule for distribution boards and circuits.
- 4) Schedule of test results for every circuit (unless defined sample rates have been provided).

It shall not be used for new installation work.

The agreed extent of the installation covered by the periodic inspection and testing along with any agreed limitations shall be clearly defined and recorded within the EICR. Where agreed periodic inspection and testing sample rates have been applied these shall be clearly defined and recorded within the EICR.

These should be recorded within the 'Extent of the Installation and Limitations on the Inspection and Testing' within the EICR.

GENERAL REQUIREMENTS FOR CERTIFICATION AND REPORTS

The general requirements for certification and reports are as follows: -

- 1) For new installation work, any defect or omission revealed during the inspection and testing shall be corrected before the certification is issued.
- 2) For any alterations and/or additions to an electrical installation, any defect or omission that will affect the safety of the alteration or addition that is revealed during inspection and testing shall be corrected before the certification is issued.
The Contractor responsible for the alteration or addition shall record on the certification any other defects observed during the course of the works that may give rise to danger.
- 3) For all new installation work, and for all alterations or additions to existing installations where new circuits have been introduced, the certification shall include a recommendation for the interval between initial verification and the first periodic inspection e.g. 'NEXT INSPECTION' entry box.
- 4) Where parts of an existing installation are not required to be inspected and tested (i.e. do not form part of the works) any observed departures or non-compliances shall be recorded within the 'COMMENTS ON THE EXISTING INSTALLATION' section of the certification.
- 5) Where existing circuits have not been modified but have been disconnected and re-terminated (e.g. existing final circuits into new or existing MCB distribution boards etc.) they shall be fully inspected and tested as required by BS 7671.
- 6) They must be completed in accordance with BS 7671, IET Guidance Note 3 and Electrical Contracting Certification Schemes.
- 7) All entry boxes must be completed and contain accurate information. Where an entry box is not applicable to the works that have been undertaken 'N/A' shall be used.
- 8) When incomplete they are deemed to be invalid by Electrical Contracting Certification Schemes.

- 9) All switchgear / equipment reference numbers, circuit references and final circuit references shall be coordinated throughout and be the same as those used in the specification schedules / drawings.
- 10) Where a location is to be defined it shall be co-ordinated with the architectural drawings and the site room referencing system.
- 11) Where a documented risk assessment has determined that RCDs are not required as additional protection for socket outlets with a rated current not exceeding 32A, this shall be noted within the 'DESIGN' section and the documented risk assessment shall be appended.
- 12) 'Schedules of additional records' relating to the electrical installation shall be included and their respective page numbers shall be identified (e.g. fire alarm system, emergency lighting etc.). The requirements for these are detailed in subsequent sections of this specification.
- 13) The 'Circuit line and number' included within the 'Schedule of test results' shall be co-ordinated with the 'Schedule of circuit details'. The 'Schedule of test results' shall include test results for every circuit tested.
- 14) The Contractor / Qualified Supervisor shall be responsible for the review, verification, signing and dating of the certification and/or reports. This shall take into account their respective responsibilities e.g. 'CONSTRUCTION', 'INSPECTION AND TESTING', 'DESIGN, CONSTRUCTION, INSPECTION AND TESTING' entry boxes as necessary.
- 15) On completion they shall be issued to the Engineer for comment. When responsible for the design of the electrical installation the Engineer shall sign and date the 'DESIGN' entry box.
- 16) They shall be provided as part of the Operation and Maintenance Manual and Health and Safety File as required by the Construction (Design and Management) Regulations.
- 17) Schedules / charts shall be provided to all: -
 - a) Low voltage switch panels.
 - b) MCCB panel boards.
 - c) MCB distribution boards.
 - d) Consumer units.

As detailed within Section 2E of this specification.

2F-7 INSPECTION

The electrical installation shall be inspected to ensure all electrical equipment and materials are of the correct type and comply with the appropriate British or Harmonised Standard, or International (IEC) Standard.

The inspection shall verify that the electrical installation: -

- 1) Has been correctly selected and erected in accordance with BS 7671, all supporting IET documentation and manufacturers' instructions.
- 2) Is not visibly damaged or defective or has deteriorated (existing installations) so as to impair safety.
- 3) Is ready and safe to be used.

The electrical installation shall be inspected throughout the installation period with particular attention paid to any electrical services that may become inaccessible upon completion e.g. concealed cable support and containments systems, cabling, accessories, busbar trunking and power track systems etc. etc.

On completion of the electrical installation works a further inspection shall be undertaken prior to any electrical testing (dead or live testing) taking place.

Appendix I of this section provides an Electrical Installation Certificate checklist of some of the principal items that shall be inspected as a minimum. However, it shall be noted that the checklist is not exhaustive and is provided as a guide. The items included within the schedule shall form the Schedule of Inspections to be included with the certification / reports.

The inspection guidance provided in IET Guidance Note 3 Inspection and Testing shall also be followed:

- 1) Section 2.5.2 Comments on individual items to be inspected.
- 2) Section 2.5.3 Inspection checklist.

All items shall also be inspected that are included on the 'Schedules of Items Inspected' list that form part of the certification required by Electrical Contracting Certification Schemes. All entry boxes on the schedules must be completed:

- '✓' shall indicate that an inspection was undertaken, and the result was satisfactory.
- 'N/A' shall indicate that an inspection was not applicable to the installation.

Joint formal inspections shall be undertaken at a mutually agreeable time by the Qualifying Manager, the person(s) undertaking the inspection / testing works and the Engineer.

Any departures from or non-compliances with the requirements of this specification and BS 7671 as a result of inspection(s) must be rectified at no additional cost and in a timely manner to suit the construction programme.

2F-8 TEST EQUIPMENT

Test instruments shall be selected in strict accordance with the performance standards detailed in BS EN 61557 and the safety requirements of BS EN 61010. Test instruments shall also be selected to meet the instrument accuracy and performance criteria detailed within IET Guidance Note 3 Inspection and Testing.

A system shall be in place to ensure the accuracy of test instruments as required by Electrical Contracting Certification Schemes.

As a minimum the accuracy of test instruments shall be confirmed by formal calibration / re-calibration at intervals recommended by the manufacturer and shall be supported by calibration certificates provided by laboratories accredited by the United Kingdom Accreditation Service (UKAS).

More frequent re-calibrations may be required if test instruments are exposed to changes in temperature / humidity and also if they are roughly handled and regularly transported / stored in vehicles. It shall be the Contractor's responsibility to ensure that the test instruments meet the required accuracy and performance criteria prior to testing.

The model and serial number for each test instrument shall be recorded on the certification, reports and schedules. A copy of the calibration certificate for each test instrument shall be provided as part of the Operation and Maintenance Manual.

Voltage indicators, test probes, clips and leads shall be selected and used in accordance with the guidance outlined in HSE – Guidance Note GS38.

2F-9 ISOLATION

Inspection and dead testing shall be undertaken with the appropriate part of the installation disconnected from the electrical supply by some form of isolation. The isolation of the electrical supply shall be undertaken in accordance with the guidance outlined in HSE – Electricity at Work – Safe working practices – HSG85.

As a minimum the isolation of the electrical supply shall be verified by the following safe working procedure: -

- 1) Step 1 – Open the means of isolation and secure the isolation device.
- 2) Step 2 – Prove the correct operation of the voltage detector / indicator to be used against a known source such as a voltage proving unit.
- 3) Step 3 – Test all conductors (including protective conductors in case there is a wiring fault) to verify that no dangerous voltage is present, and the circuit(s) is safe to be worked upon.
- 4) Step 4 – Prove the correct operation of the voltage detector / indicator to verify that it was functioning correctly when the circuit(s) were tested.

Inspection and testing shall be undertaken in such a way as to minimise disturbance of the installation and inconvenience to the user.

Where it is necessary to disconnect part or the whole of the installation in order to carry out a test, the disconnection should be made at a time agreed with the Client and for the minimum period needed to carry out the test. Where more than one test necessitates a disconnection, where possible they should be made during one disconnection period.

All shutdowns and disconnections must be agreed with the Client prior to works commencing.

2F-10 TESTING SEQUENCE

The sequence of testing and test methods shall be undertaken in strict accordance with BS 7671, IET Guidance Note 3 Inspection and Testing and the NICEIC / ECA / ELECSA – Inspection, Testing and Certification including Periodic Reporting – Practical advice and guidance.

For new installation works the sequence of initial testing shall be as detailed below (where applicable): -

DEAD TESTING

Before the supply is connected, or with the supply disconnected as appropriate: -

- 1) Continuity of protective conductors, including main and supplementary equipotential bonding.
- 2) Continuity of ring final conductors (where present).
- 3) Insulation resistance.
- 4) Protection by SELV, PELV or by electrical separation.
- 5) Basic protection provided by a barrier, or an enclosure provided during erection.
- 6) Insulation resistance / impedance of floors and walls.
- 7) Polarity.
- 8) Earth electrode resistance (dependent upon the test method used this may be a live test).

LIVE TESTING

With the supply connected: -

- 1) Protection by automatic disconnection of supply.
- 2) Earth fault loop impedance.
- 3) Prospective fault current.
- 4) Check of phase sequence.
- 5) Operation of residual current devices (the test to be independent of any test facility incorporated in the device).
- 6) Functional testing of residual current devices (RCDs).
- 7) Functional testing of arc fault detection devices (AFDDs).
- 8) Other functional testing e.g. functional testing of switchgear and control gear assemblies, drives, controls, interlocks etc.

2F-11 TESTING PROCEDURES

An overview of the testing procedures is provided below:

CONTINUITY OF PROTECTIVE CONDUCTORS, INCLUDING MAIN AND SUPPLEMENTARY EQUIPOTENTIAL BONDING

This is the measurement of one of the following to verify the continuity of the circuit protective conductors:

- Resistance of $R_1 + R_2$ (Test method 1 of BS 7671 – $R_1 + R_2$ method).
- R_2 (Test method 2 of BS 7671 – Wander lead method).

The measurements are to be made by using a low-resistance ohmmeter or by selecting the appropriate range on a multi-function tester. The measurement at the extremity of the circuit (furthest point) for $R_1 + R_2$ in Ω (ohms) shall be recorded on the Schedule of Test Results. The measurements shall verify that electrical continuity has been achieved and confirm correct polarity (✓) for the circuit.

Testing shall also be undertaken to verify the electrical continuity of all bonding conductors and earthing conductors.

All metallic cable support and containment systems shall be equipotential bonded for protective earthing and to avoid / reduce electromagnetic disturbances as detailed within Section 2E of this specification. Test method 2 shall be used to measure the resistance across all joints to verify electrical continuity. The measured resistance across joints shall not exceed 0.05Ω .

The electrical continuity of cable support and containment systems shall also be verified in accordance with their respective standards, as detailed later within this section of the specification.

Test method 2 shall also be used to verify there is a bonding connection between extraneous conductive parts where it is not possible to see the bonding connection (e.g. where bonding clamps are 'built in' to metallic pipework). The measured resistance shall not exceed 0.05 Ω .

CONTINUITY OF RING FINAL CIRCUIT CONDUCTORS

This is the measurement of:

- 1) Step 1:- The resistance of r_1 , r_2 and r_n to verify the continuity of all conductors.
- 2) Step 2:- Having made the L-N cross connection, the resistance between line and neutral conductors at each outlet to verify the resistance is substantially the same at each outlet and equates to $(r_1 + r_n) / 4$, (subject to outlets wired as spurs from the ring final circuit).
- 3) Step 3:- Having made the L-E cross connection, the resistance between line and earth at each outlet to verify the resistance is substantially the same at each outlet and equates for $(r_1 + r_2) / 4$, (subject to outlets wired as spurs from the ring final circuit).

The measurements are to be made by using a low-resistance ohmmeter or by selecting the appropriate range on a multi-function tester. The measurements for r_1 , r_2 and r_n in Ω (ohms) shall be recorded on the Schedule of Test Results. The highest value of resistance recorded from Step 3 is also to be recorded on the Schedule of Test Results as the $R_1 + R_2$ measurement.

The measurements shall verify that electrical continuity has been achieved and confirm correct polarity (✓) for the circuit.

INSULATION RESISTANCE

This is the measurement of the insulation resistance between all of the live conductors and between each live conductor and the protective conductor, to verify that the insulation of conductors provides adequate electrical insulation, is not damaged and that live conductors or protective conductors are not short-circuited.

The measurements are to be made by applying an appropriate test voltage as indicated below, using an insulation resistance tester or by selecting the appropriate range on a multi-function tester: -

CIRCUIT NOMINAL VOLTAGE (V)	TEST VOLTAGE D.C. (V)	MINIMUM INSULATION RESISTANCE VALUE (M Ω)
SELV and PELV	250	0.5
Up to and including 500 V with the exception of SELV and PELV but including FELV	500	1.0
Above 500 V	1000	1.0

The resistance measurements in M Ω (e.g. >200 M Ω) shall be recorded on the Schedule of Test Results for: -

- 1) Line / Line.
- 2) Line / Neutral.
- 3) Line / Earth
- 4) Neutral / Earth.

The measurements shall be verified against the minimum acceptable insulation resistance values required by BS 7671 which are also detailed in the above table. For new installation works the following are to be brought to the attention of the Engineer immediately in writing: -

- 1) Any values recorded below 20 M Ω (which are above the minimum requirements outlined in BS 7671).
- 2) Where measured values show evident differences between similar circuits.

It is also recommended that insulation resistance testing is undertaken at various stages during the installation works to prove the integrity of the cables and to prevent remedial works towards the end of the contract.

Voltage sensitive electronic equipment (e.g. RCBOs, surge protective devices, dimmer switches, touch switches, timers, controllers or similar) shall be temporarily disconnected prior to applying a test voltage of 500 V d.c. and the recorded measurements shall not be less than 1.0 MΩ.

Following the connection of the sensitive equipment, measurements shall be made by applying a test voltage of 250 V d.c. and the recorded measurements shall not be less than 1.0 MΩ.

Important Note: Some manufacturers may recommend equipment is not exposed to 250 V d.c. testing.

Insulation resistance testing of socket outlets with integral USB (Universal Serial Bus) charging ports shall be undertaken in accordance with manufacturers' recommendations. Generally, the measurements shall be made by applying a test voltage of 250 V d.c.

The measurements shall not be less than 1.0 MΩ (as opposed to 0.5 MΩ for SELV and PELV circuits) which is the minimum acceptable insulation resistance value required by BS 7671 where it is not reasonably practical to disconnect the socket outlets.

PROTECTION BY SELV, PELV OR BY ELECTRICAL SEPARATION

- 1) Protection by SELV, where SELV is used as a protective measure and insulation testing is required.
 - a) Basic insulation test
This is the measurement of the insulation resistance between line conductors and all other circuits including other SELV, PELV and low voltage circuits.
 - b) Line to Earth insulation test:
This is the measurement of the insulation resistance between all SELV line parts and earth.

The measurements are to be made by applying a test voltage of 250 V d.c. using an insulation resistance tester or by selecting the appropriate range on a multi-function tester. The measurements shall not be less than 0.5 MΩ which is the minimum acceptable insulation resistance value required by BS 7671.

- 2) Protection by PELV, where PELV is used as a protective measure and insulation testing is required.
 - a) Basic insulation test: -
This is the measurement of the insulation resistance between line conductors and all other circuits including other SELV, PELV and low voltage circuits.

The measurements are to be made by applying a test voltage of 250 V d.c. using an insulation resistance tester or by selecting the appropriate range on a multi-function tester. The measurements shall not be less than 0.5 MΩ which is the minimum acceptable insulation resistance value required by BS 7671.

- 3) Protection by electrical separation.
 - a) Basic insulation test: -
This is the measurement of the insulation resistance between the electrically separated live conductors and the transformer secondary live conductors.
 - b) Basic insulation of the separated conductors: -
This is the measurement of the insulation resistance between the electrically separated live conductors and their corresponding exposed-conductive-parts.
 - c) Basic insulation of any exposed-conductive-parts associated with separated conductors: -
This is the measurement of the insulation resistance between the any exposed-conductive-parts associated with the electrically separated circuits and any protective conductor, other exposed-conductive-parts or Earth.

The measurements are to be made by applying a test voltage of 500 V d.c. using an insulation resistance tester or by selecting the appropriate range on a multi-function tester. The measurements shall not be less than 1 MΩ which is the minimum acceptable insulation resistance value required by BS 7671.

Additional inspections and tests shall also be undertaken for separated circuits supplying more than one item of current using equipment as required by IET Guidance Note 3 Inspection and Testing. This is to verify that two coincidental faults with negligible impedance will disconnect one of the faulty circuits within the disconnection time required by BS 7671.

BASIC PROTECTION BY A BARRIER OR AN ENCLOSURE PROVIDED DURING ERECTION

These tests only apply to barriers or enclosures constructed on-site during the installation works and do not apply to the barriers or enclosures of factory-built equipment.

Barriers and/or enclosures shall be provided to prevent contact with live parts and shall provide at least the degree of protection (IP code) of IPXXB or IP2X. However, a horizontal or top surface of a barrier or enclosure which is readily accessible shall provide at least the degree of protection (IP code) of IPXXD or IP4X.

This is to verify that each barrier / enclosure gives adequate protection against the risk of electric shock through contact with live parts by fingers or foreign objects (e.g. conductive tools).

These degrees of protection shall be tested as follows: -

- 1) IP2X is defined in BS EN 60529 as protection against the entry of 'Fingers or similar objects not exceeding 80mm in length. Solid objects not exceeding 12.5mm in diameter': -
The test is made with a metallic standard test finger (test finger 1 to BS EN 61032).
- 2) IP4X is defined in BS EN 60529 as protection against the entry of 'Wires or strips of thickness greater than 1.0mm, and solid objects of 1.0mm diameter or greater': -

The test is made with a straight rigid steel wire of 1.0mm diameter applied with a force of 1 N \pm 10 per cent.

INSULATION RESISTANCE / IMPEDANCE OF FLOORS AND WALLS

These tests are not required for standard electrical installations however if required reference shall be made to IET Guidance Note 3 Inspection and Testing.

POLARITY

Polarity testing shall verify: -

- 1) The polarity of the supply shall at the origin of the installation before the installation is energized.
- 2) That where single-pole switching devices are not permitted in the neutral conductor the devices are connected in the line conductor(s) only.
- 3) The wiring has been correctly connected throughout the installation.

Polarity of circuits shall be verified by the visual inspection of all termination points (by checking the core colours) or the measurement of the resistance of $R_1 + R_2$.

Polarity may be verified during the process of testing by:

- 1) Continuity of protective conductors – Test method 1 ($R_1 + R_2$ method).
- 2) Continuity of ring final circuit conductors.

Where polarity is verified during the process of testing the measurements are to be made by using a low-resistance ohmmeter or by selecting the appropriate range on a multi-function tester. Upon verification a '✓' shall be recorded on the Schedule of Test Results.

EARTH ELECTRODE RESISTANCE

This is the measurement of the resistance of earth electrodes to verify the resistance is low enough to assist with disconnection times.

One of the following test methods shall be used: -

- 1) Test method E1: Measurement using dedicated earth electrode tester (fall of potential, three- or four-terminal type)
The entire installation must be isolated from the supply before the means of earthing is disconnected to perform this test. On completion of testing all bonding and protective conductors must be reconnected prior to the installation being energised (or re-energised).
- 2) Test method E2: Measurement using dedicated stakeless or clamp-based earth electrode tester.
The earth electrode under test does not need to be disconnected for this method.

- 3) Test method E3: Measurement using an earth fault loop impedance tester.

(Effectively the same method used for testing external earth fault loop impedance Z_e).

The entire installation must be isolated from the supply before the means of earthing is disconnected to perform this test. It shall be noted this method is a live test and the supply shall be re-energised to perform the testing. On completion of testing the supply shall be isolated and all bonding and protective conductors must be reconnected prior to the installation being re-energised.

Generally, the measurement shall verify that the earth electrode resistance is less than 200 Ω , however the required automatic disconnection times of RCDs shall also be verified for TT systems. Earth electrode resistance values above 200 Ω may not be stable due to ground conditions.

The measurement of earth electrode resistance R_A shall be recorded in the Supply Characteristics and Earthing Arrangements section of the certification / report. Also, the earth electrode type, location and the method of measurement shall be recorded.

PROTECTION BY AUTOMATIC DISCONNECTION OF SUPPLY

The effectiveness of measures for fault protection by automatic disconnection of supply shall be verified for TN systems as follows: -

- 1) Measurement of earth fault impedance.
- 2) Visual inspection to confirm that protective devices are suitable.
(e.g. correct setting, type and ratings for circuit breakers and correct type and ratings for fuses).
- 3) Where used, RCD testing to confirm disconnection times are achieved.

For TT and IT systems reference shall be made to BS 7671 and IET Guidance Note 3 Inspection and Testing.

EARTH FAULT LOOP IMPEDANCE

Electrically continuity testing (as detailed earlier) must have been undertaken prior to the commenced of any earth fault loop impedance measurements.

This is the measurement of earth fault loop impedance (Z_s) to verify that when an earth fault occurs the resistance of the earth fault loop ($Z_s = R_1 + R_2 + Z_e$) shall be low enough for a large fault current to flow and operate a protective device in the required disconnection time, therefore achieving automatic disconnection of the circuit line conductor.

Note: Z_e may be substituted with Z_{db} when testing at a downstream distribution board or similar as the value measured is not external to the installation.

One of the following test methods shall be used: -

- 1) Measurement of total earth fault loop impedance (Z_s) using an earth fault loop impedance tester or by selecting the appropriate range on a multi-function tester. It shall be noted that the measured Z_s may be less than $R_1 + R_2 + Z_e$ due to parallel earth return paths.
- 2) Measurement of ($R_1 + R_2$) during continuity testing using a low-resistance ohmmeter and addition to the measured external fault loop impedance (Z_e) of the same circuit, using an earth fault loop impedance tester.

The latter method is preferred when determining Z_s for final circuits and distribution circuits.

The measurement at the extremity of the circuit (furthest point) for Z_s in Ω (ohms) shall be recorded on the Schedule of Test Results. For ring final circuits the earth fault impedance (Z_s) shall be measured at every outlet / point and the highest value measured shall be recorded on the Schedule of Test Results.

The measurements shall be verified against the maximum earth fault loop impedance (Z_s) values required by BS 7671 which must be adjusted for temperature by applying a factor of 0.8 (80%).

e.g. for a 20A Type B circuit breaker to BS EN 60898, BS 7671 provides a maximum earth fault loop impedance of 2.19 Ω . However, this is at operating temperature, so the maximum acceptable measured value shall be $2.19 \times 0.8 = 1.752 \Omega$.

It shall be noted that adjusted for the industry recognised 0.8 'rule of thumb' are contained within the IET On-Site Guide / IET Guidance Note 3 and can also be obtained from Electrical Contracting Certification Schemes, which can then be used for verification of measurements.

Under no circumstances shall the measurements be verified against the maximum earth fault loop impedance (Z_s) contained within BS 7671 with no adjustment for temperature.

The maximum permitted earth fault loop impedance (Z_s) values included within the 'Maximum Z_s permitted by BS 7671' column of the 'Schedule of circuit details' shall include the Z_s values from BS 7671 which have not been adjusted for temperature.

Where supplementary protective equipotential bonding has been provided to satisfy the measured earth fault loop impedance requirements of BS 7671, the effectiveness of the bonding shall be verified.

The external fault loop impedance (Z_e) shall also be measured to verify there is an earth connection and to determine the external earth fault loop impedance (Z_e) which is part of the earth fault loop (Z_s).

The external fault loop impedance (Z_e) shall be measured at:-

- 1) The origin of the installation.

The measurement for Z_e in Ω (ohms) shall be recorded in the Supply Characteristics and Earthing Arrangements section of the certification / report.

- 2) At each item of switchgear within the installation (e.g. LV switch panels, MCCB panel boards, MCB distribution boards, consumer units etc. etc.)

The measurement for Z_s (sometimes known as Z_s , Z_{db} or similar) in Ω (ohms) shall be recorded on the Schedule of Test Results (top section) for the item of switchgear.

The measurements are to be made by using an earth fault loop impedance tester or by selecting the appropriate range on a multi-function tester.

PROSPECTIVE FAULT CURRENT

This is the measurement of prospective fault current (I_{pf}) under both short-circuit and earth fault conditions to verify that the rated short-circuit breaking capacities of protective devices are greater than the prospective fault current (I_{pf}).

The prospective short circuit current and prospective earth fault current shall be measured at every relevant point of the installation which includes: -

- 1) The origin of the installation.

The measurement for I_{pf} in kA shall be recorded in the Supply Characteristics and Earthing Arrangements section of the certification / report.

- 2) At each item of switchgear within the installation where a protective device is required to operate under fault conditions.

The measurement for I_{pf} in kA shall be recorded on the Schedule of Test Results (top section) for the item of switchgear.

The measurements are to be made by using the prospective fault current range of a suitable earth fault loop impedance tester or by selecting the appropriate range on a multi-function tester. Whichever is the greater measurement of prospective short circuit current (PSCC) and prospective earth fault current (PEFC) shall be recorded.

For three phase supplies where a 230V test instrument is used the prospective fault current line to line can be taken as twice that of the prospective fault current line to neutral.

e.g. line to neutral measurement of 4.6 kA \times 2 = 9.2 kA (I_{pf}).

The measurements shall be verified by comparing the measured prospective fault current (I_{pf}) at the terminals of protective devices with their rated short-circuit breaking capacities. The rated short-circuit breaking capacities of protective devices must be greater than the prospective fault current (I_{pf}).

CHECK OF PHASE SEQUENCE

Generally, this is verified by checking the polarity and connections at all relevant points throughout the installation. However, the phase sequence of all three-phase equipment such as rotating machines (e.g. motors) shall be verified to ensure correct rotation. This shall be verified by using a phase rotation tester or by selecting the appropriate range on a multi-function tester.

ADDITIONAL PROTECTION – OPERATION OF RESIDUAL CURRENT DEVICES

This is the measurement of RCD (RCCB or RCBO) operating times to verify the correct operation and required disconnection times are achieved. The measurements are to be made by using an RCD tester or by selecting the appropriate range on a multi-function tester. Loads shall be disconnected during testing. All residual current devices shall be tested at: -

- 1) 50% of the rated operating (tripping) current and shall not operate / open.
- 2) 100% of the rated operating (tripping) current ($I_{\Delta n}$) and shall operate / open.

The measured operating time in ms shall be recorded (where applicable) in the:

- a) Particulars of Installation at the Origin section of the certification / report. If the residual current device has a rated time delay this shall also be included.
- b) Schedule of Test Results (top section) for the item of switchgear.
- c) Schedule of Test Results for a circuit.

The residual current devices shall have an operating time not exceeding that required by their respective product standards at a residual current of $I_{\Delta n}$.

Regardless of RCD type, effectiveness is deemed to have been verified where an RCD disconnects within the time stated below with an alternating current test rated residual current ($I_{\Delta n}$): -

- 1) For general non-delay type, 300ms maximum.
- 2) For 'S' type RCD, between 130ms minimum and 500ms maximum.

RCDs used for additional protection shall have an operating time not exceeding 300ms at a residual current of $I_{\Delta n}$.

Measurements shall be taken on both positive and negative half cycles of the supply waveform and the longer operating time shall be recorded.

ADDITIONAL PROTECTION – SUPPLEMENTARY PROTECTIVE EQUIPOTENTIAL BONDING

Where supplementary protective equipotential bonding has been provided for additional protection the effectiveness of the bonding shall be verified.

FUNCTIONAL TESTING OF RESIDUAL CURRENT DEVICES

Functional testing shall be undertaken on all residual current devices. The integral test device shall be operated by pressing the button marked 'T' or 'Test', during testing the residual current devices must be energised.

Upon verification a '✓' shall be recorded on the Schedule of Test Results.

FUNCTIONAL TESTING OF ARC FAULT DETECTION DEVICES (AFDDs)

Functional testing shall be undertaken on arc fault detection devices (AFDDs) when they are provided with a manually operated test facility, in strict accordance with the manufacturers' recommendations.

Upon verification a '✓' shall be recorded on the Schedule of Test Results.

AFDDs that do not have a manually operated test facility cannot be tested for functionality.

OTHER FUNCTIONAL TESTING

All equipment that forms part of the electrical installation shall be subjected to functional testing to verify that it functions correctly and has been properly mounted, adjusted, and installed in accordance with BS 7671.

This shall include:

- 1) All electrical switchgear used for isolation e.g. main switches, isolators, protective devices etc.
- 2) All luminaires, switching and control devices, interlocks, adjustable relays, socket-outlets etc.
- 3) Motors, motor controls and starters, including correct rotation.

It shall be noted the above list is not exhaustive and functional testing must be undertaken on all equipment that forms part of the electrical installation.

2F-12 DEPARTURES FROM AND NON-COMPLIANCES WITH BS 7671

Any departures from or non-compliances with BS 7671 resulting from the inspection and testing of the electrical installation shall be brought to the attention of the Engineer immediately in writing.

2F-13 INSPECTION AND TESTING OF MEDICAL INSTALLATIONS

This section of the specification details the general inspection and testing requirements that shall also apply to medical installations. However, it shall be noted that medical installations will have additional inspection, testing and commissioning requirements, for example (but not limited to):

- 1) Inspection and functional tests of medical IT systems.
- 2) Measurement of the leakage current for the output circuit and the enclosure of medical IT system isolating transformers.
- 3) Measurement of the resistance of protective conductors between the earth terminals of any socket outlet (or fixed equipment) and any extraneous conductive parts (e.g. not exceeding 0.2 Ω for Group 1 and 2 locations etc.).

Medical IT systems are also known as medical isolated power supply systems.

Where required the inspection and testing requirements of medical installation shall be detailed within a subsequent section of this specification.

2F-14 CONTINUITY OF CABLE SUPPORT AND CONTAINMENT SYSTEMS

All metallic cable support and containment systems shall be equipotential bonded for protective earthing and to avoid / reduce electromagnetic disturbances as detailed within Section 2E of this specification.

The electrical continuity of cable support and containment systems shall be tested as follows: -

- 1) Cable ladder rack, cable tray and cable basket shall be tested in accordance with the relevant clauses of BS EN 61537.
- 2) Cable trunking shall be tested in accordance with the relevant clauses of BS EN 50085.
- 3) Cable conduit shall be tested in accordance with the relevant clauses BS EN 61386.

It shall also be verified that all connections between cable conduit (e.g. conduit take-off plates, conduit boxes) and cable tray / basket / tray have adequate electrical continuity.

The Contractor shall provide written clarification that the cable support and containment systems have electrical continuity characteristics as defined in the above standards.

2F-15 FIRE BARRIERS / STOPPING

On completion of the fire barriers / stopping works fully detailed completion / compliance certification shall be provided along with record drawings that detail all fire barrier / stopping locations.

2F-16 FACTORY BUILT ASSEMBLIES

The Engineer shall be afforded the opportunity to inspect and formally witness the testing of all bespoke factory built assemblies (e.g. LV switch panels, switchgear etc.) before they are dispatched to site. The required period of notice to attend shall normally be 10 days but shall be variable at the discretion of the Engineer.

The Engineer shall be provided with a copy of the appropriate inspection and testing certification for each factory built assembly which shall also be included within the Operation and Maintenance Manual.

2F-17 THERMOGRAPHIC SURVEYS

Any requirement for undertaking thermographic surveys shall be detailed within a subsequent section of this specification. The guidelines on thermographic equipment shall be followed within IET Guidance Note 3.

2F-18 FORMAL WITNESSING OF TESTING

The Qualified Supervisor and the person(s) undertaking the inspection / testing works shall give reasonable notice of all tests to permit them to be witnessed by the Engineer. The required period of notice shall normally be 10 days but shall be variable at the discretion of the Engineer.

Preliminary testing shall be undertaken prior to any formal witnessing by the Engineer. The preliminary test results shall be provided to the Engineer in draft certificates before inviting the Engineer to attend formal witnessing. The Engineer will then witness the formal tests in full or selectively as deemed necessary to verify the draft test results.

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The proportion of tests to be witnessed by the Engineer will be 20%, though this could be reduced to 10% at the discretion of the Engineer on very large systems. The Engineer has the right to ask for a higher proportion of witnessing should the verification or witnessing exercise be unsuccessful e.g. the test readings cannot be repeated within a reasonable degree of accuracy. In this instance the Electrical Contractor shall bear all costs associated with this additional work.

APPENDIX I – SCHEDULE OF INSPECTIONS (CHECKLIST)

SCHEDULE OF INSPECTIONS (FOR INITIAL INSPECTION AND TESTING)	
1.0 CONDITION OF ELECTRICAL INTAKE EQUIPMENT (The Distributor should be notified of any unsatisfactory equipment)	
1.1	Service cable
1.2	Service head
1.3	Earthing arrangement
1.4	Meter tails – Distributor / Consumer
1.5	Metering equipment
1.6	Isolator
2.0 PARALLEL OR SWITCHED ALTERNATIVE SOURCES OF SUPPLY	
2.1	Presence of adequate arrangements where generator to operate as a switched alternative
a)	Dedicated earthing arrangement independent of that of the public supply
2.2	Presence of adequate arrangements where generator to operate in parallel with public supply system
a)	Correct connection of generator in parallel
b)	Compatibility of characteristics of means of generation
c)	Means to provide automatic disconnection of generator in the event of loss of public supply system or voltage or frequency deviation beyond declared values
d)	Means to prevent connection of generator in the event of loss of public supply system or voltage or frequency deviation beyond declared values
e)	Means to isolate generator from the public supply system
2.3	Presence of alternative / additional supply warning notices at:
a)	The origin
b)	The meter position, if remote from the origin
c)	The consumer unit / distribution board to which the alternative / additional sources are connected
d)	All points of isolation of ALL sources of supply
3.0 AUTOMATIC DISCONNECTION OF SUPPLY	
3.1	Presence and adequacy of protective earthing / bonding arrangements as follows:
a)	Distributor's earthing arrangement
b)	Installation earth electrode (where applicable)
c)	Earthing conductor and connections
d)	Main protective bonding conductors and connections
e)	Earthing / bonding labels at all appropriate locations
f)	RCD(s) provided for fault protection

SCHEDULE OF INSPECTIONS (FOR INITIAL INSPECTION AND TESTING)		
3.2	Accessibility of:	
a)	Earthing conductor connections	
b)	All protective bonding conductors	
3.3	FELV – requirements satisfied	
3.4	Reduced low voltage – requirements satisfied	
4.0 BASIC PROTECTION		
4.1	Presence and adequacy of protective measures to provide basic protection	
a)	Insulation of live parts	
b)	Barriers or enclosures	
c)	Obstacles*	
d)	Placing out of reach*	
5.0 ADDITIONAL PROTECTION		
5.1	The presence and effectiveness of additional protection methods used, as follows:	
a)	RCDs not exceeding 30 mA operating current	
b)	Supplementary bonding	
6.0 OTHER METHODS OF PROTECTION (Insert location in box provided)		
The presence and effectiveness of other methods of protection against electric shock where used, as follows:		
6.1	Basic and fault protection	LOCATION
a)	SELV	
b)	PELV	
c)	Double insulation / Reinforced installation	
d)	Electrical separation for one item of equipment	
6.2	Fault protection	LOCATION
a)	Non-conducting location / Earth-free local equipotential bonding*	
b)	Electrical separation for more than one item of equipment*	
7.0 DISTRIBUTION EQUIPMENT		
7.1	Adequacy of working space / accessibility	
7.2	Security of fixing	
7.3	Insulation of live parts not damaged during erection	
7.4	Adequacy / security of barriers	
7.5	Suitability of enclosures for IP and fire ratings	

SCHEDULE OF INSPECTIONS (FOR INITIAL INSPECTION AND TESTING)	
7.6	Enclosures not damaged during installation
7.7	Presence and effectiveness of obstacles
7.8	Presence of main switch(es), linked where required
7.9	Operation of main switch(es) (functional check)
7.10	Operation of circuit-breakers and RCDs to prove functionality
7.11	RCD(s) provided for fault protection, where specified
7.12	RCD(s) provided for protection against fire
7.13	RCD(s) provided for additional protection, where specified
7.14	Confirmation overvoltage protection (SPDs) provided where specified
7.15	Confirmation of indication that SPD is functional
7.16	Presence of RCD six-monthly test notice where required
7.17	Presence of AFDD six-monthly test notice where required
7.18	Presence of diagrams, charts or schedules at or near each switchgear, where required
7.19	Presence of non-standard (mixed) cable colour warning notice at or near the appropriate distribution board, where required
7.20	Presence of next inspection recommendation label
7.21	Presence of other required labelling
7.22	Selection of protective device(s) and base(s); correct type and rating
7.23	Single-pole protective devices in line conductor only
7.24	Protection against mechanical damage where cables enter equipment
7.25	Protection against electromagnetic effects where cables enter ferromagnetic enclosures.
7.26	Confirmation that ALL conductor connections, including connections to busbars are correctly located in terminals and are tight and secure
8.0	CIRCUITS
8.1	Identification of conductors
8.2	Cables correctly supported throughout their length
8.3	Examination of cables for signs of mechanical damage during installation
8.4	Examination of insulation of live parts, not damaged during erection
8.5	Non-sheathed cables protected by enclosure in conduit, ducting or trunking
8.6	Suitability of containment systems (including flexible conduit)
8.7	Correct temperature rating of cable insulation
8.8	Adequacy of cables for current-carrying capacity with regard to the type and nature of installation
8.9	Adequacy of protective devices: type and rated current for fault protection

SCHEDULE OF INSPECTIONS (FOR INITIAL INSPECTION AND TESTING)	
8.10	Presence and adequacy of circuit protective conductors
8.11	Coordination between conductors and overload protective devices
8.12	Wiring systems and cable installation methods / practices appropriate to the type and nature of installation and external influences
8.13	Cables installed under floors, above ceilings, in walls / partitions, adequately protected against damage
a)	Installed in prescribed zones
b)	Incorporating earthed armour or sheath, or installed within earthed wiring system, or otherwise protected against mechanical damage by nails, screws and the like
8.14	Provision of additional protection by RCDs having a rated residual operating current (I _{Δn}) not exceeding 30mA:
a)	For mobile equipment with a current rating not exceeding 32 A for use outdoors
b)	For all socket-outlets of rating 32 A or less, unless exempt
c)	For cables installed walls / partitions at a depth of less than 50mm
d)	For cables installed in walls / partitions containing metal parts regardless of depth
e)	Final circuits supplying luminaires within (domestic) household premises
8.15	Provision of fire barriers, sealing arrangements so as to minimize the spread of fire
8.16	Band II cables segregated / separated from Band I circuits
8.17	Cables segregated / separated from non-electrical services
8.18	Termination of cables at enclosures
a)	Connection under no undue strain
b)	No basic insulation of a conductor visible outside enclosure
c)	Connections of live conductors adequately enclosed.
d)	Adequately connected at point of entry to enclosure (glands, bushes etc.)
8.19	Suitability of circuit accessories for external influences
8.20	Circuit accessories not damaged during erection
8.21	Single-pole devices for switching in the line conductor only
8.22	Adequacy of connections, including cpcs, within accessories and at fixed and stationary equipment
9.0 ISOLATION AND SWITCHING	
9.1	Isolators
a)	Presence and location of appropriate devices
b)	Capable of being secured in the OFF position
c)	Correct operation verified (functional check)

SCHEDULE OF INSPECTIONS (FOR INITIAL INSPECTION AND TESTING)	
d)	The installation, circuit or part thereof that will be isolated is clearly identified by location and / or durable marking
e)	Warning label posted in situations where live parts cannot be isolated be isolated by the operation of a single device.
9.2	Switching off for mechanical maintenance
a)	Presence of appropriate devices
b)	Acceptable location (state if local or remote)
c)	Capable of being secured in the OFF position
d)	Correct operation verified (functional check)
e)	The circuit or part thereof to be disconnected clearly identified by location and / or durable marking
9.3	Emergency switching / stopping
a)	Presence of appropriate devices
b)	Readily accessible for operation where danger might occur
c)	Correct operation verified (functional check)
d)	The installation, circuit or part thereof to be disconnected, clearly identified by location and / or marking
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10.5	Cable entry holes in ceilings above luminaires, sized or sealed so as to restrict the spread of fire
10.6	Recessed luminaires (downlighters)
a)	Correct type of lamps fitted.
b)	Installed to minimise build-up of heat.
10.7	Provision of under voltage protection, where specified
10.8	Provision of overload protection, where specified
10.9	Adequacy of working space / accessibility to equipment

SCHEDULE OF INSPECTIONS (FOR INITIAL INSPECTION AND TESTING)	
11.0 SPECIAL INSTALLATIONS OR LOCATIONS	
List below any Special Installations or Locations which are part of the installation to be verified and confirm that the additional requirements given in the respective section of Part 7 are fulfilled.	
12.0 OTHER	
List below any electrical installation works not covered in the above checklist that has been inspected and verified.	

* For use in controlled supervised / conditions only.

NOTES

- 1) All entry boxes on the schedules must be completed.
- 2) '✓' indicates that an inspection was undertaken, and the result was satisfactory.
- 3) 'N/A' indicates that an inspection was not applicable to the installation.

The above checklist need not be completed where all of the inspection items above are included on the 'Schedules of Items Inspected' schedules, which form part of the certification provided by Electrical Contracting Certification Schemes.

Section 2E

Electrical Installation Quality & Materials

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2E-1 GENERAL DESCRIPTION

This section details the general electrical installation quality and materials requirements and shall be read in conjunction with all other sections of this specification. All electrical installation works shall be undertaken in strict accordance with the clauses detailed herein and the latest version of all applicable standards and guidance.

This section also sets default requirements for methods and/or materials where several alternatives exist. These default requirements shall be followed unless there is explicit instruction to the contrary in a subsequent section dealing with the relevant system in more detail. Where such instruction is unclear or only inferred, written clarification via the Contract Administrator shall be obtained prior to submission of tender costs and in the absence of such the more onerous requirements shall be included.

Throughout this specification references are made to the requirements and recommendations detailed within several statutory and non-statutory standards / documents. It shall be noted the information presented herein is in no way intended to replace the detailed information provided within these documents which must be fully adhered to where applicable.

2E-2 DEFINITIONS

Please refer to the definitions, symbols and abbreviations as detailed within Part 2 of BS 7671 – IET Wiring Regulations – Requirements for Electrical Installations and the following: -

ABBREVIATION / MEANING			
ACB	Air circuit breaker	AFDD	Arc fault detection device
BBC	Backbone bonding conductor	BN	Bonding network
BRC	Bonding ring conductor	CBN	Common bonding network
CPC	Circuit protective conductor	DB	Distribution board
DCL	Device for connecting a luminaire	DNO	Distribution network operator
EBB / ERB	Equipotential bonding busbar / Earth reference bar	ELV	Extra-low voltage
EMC	Electromagnetic compatibility	EMI	Electromagnetic interference
EPO	Emergency power off	EVCS	Emergency voice communication system (Disabled refuge system)
FELV	Functional extra-level voltage	FFE	Furniture, fixtures and equipment
HV	High voltage	LSC	Luminaire supporting coupler
ICT	Information communication technology	IK	Impact protection code
IMD	Insulation monitoring device	IP	Ingress protection code
IPS	Medical isolated power supply system	IT	Information technology
LPZ	Lightning protection zone	LV	Low voltage
MCB	Miniature circuit breaker	MCCB	Moulded case circuit breaker
MSDB	Multi service distribution board	MET	Main earthing terminal
PBB	Primary bonding busbar	PE	Protective conductor
PELV	Protective extra-low voltage	PEN	Protective and neutral conductor (combined)
PME	Protective multiple earthing	PV	Photovoltaic

ABBREVIATION / MEANING			
RBB	Rack bonding busbar	RCBO	Residual current circuit-breaker with integral overcurrent protection
RCCB	Residual current circuit-breaker without integral overcurrent protection	RCD	Residual current device (RCCB or RCBO)
RCM	Residual current monitor	SBB	Secondary bonding busbar
SELV	Separated extra-low voltage	SMDB	Sub-Main Distribution Board
SPD	Surge protective device	TBB	Telecommunications bonding backbone
TBC	Telecommunications bonding conductor	UBC	Unit bonding conductor
UPS	Uninterruptible power supply system	VoIP	Voice over internet protocol

It shall be noted the above abbreviation list is not exhaustive and all other definitions, symbols and abbreviations used within this specification shall be defined upon occurrence.

2E-3 STANDARDS APPLICABLE

Works shall be completed in accordance with all applicable industry standards. Some of the most relevant standards associated with this section are scheduled below: -

STANDARDS & DOCUMENTS	
BS 7671	IET Wiring Regulations, including On-Site Guide, Guidance Notes 1-8 and all Codes of Practice
All Statutory Regulations (and Associated Memorandum) detailed within Appendix 2 of BS 7671 – IET Wiring Regulations	
All British Standards detailed within Appendix 1 of BS 7671 – IET Wiring Regulations	
All current and relevant British Standards, as referenced throughout this specification	
For healthcare projects all current and relevant Health Technical Memoranda (HTM's) and Health Building Notes (HBN's)	
All current and relevant Energy Networks Association / ESI publications e.g. Technical Specifications (ENATS), Engineering Recommendations (ER) and Engineering Technical Reports (ETR)	
For education projects, all current and relevant Building Bulletins by the DfES and other government agencies	
All current and relevant CIBSE (Chartered Institution of Building Service Engineers) guides and supporting documentation	
NJUG National Joint Utilities Group – NJUG Guidelines – Volumes 1 to 6	
The Construction Products Regulation	

Where the above standards refer to supporting documentation and standards these shall be fully complied with in all respects.

Any discrepancies between this specification and the relevant standards shall be referred to Engineer via the Contract Administrator for clarification prior to submission of the tender and in the absence of this clarification the Contractor shall include the most onerous requirements.

2E-4 STATUTORY REGULATIONS & BS 7671 IET WIRING REGULATIONS

All electrical installation quality and materials shall be selected, manufactured, installed, inspected and tested in accordance with the latest version of BS 7671 IET Wiring Regulations in addition to any statutory regulations.

2E-5 ELECTRICAL CONTRACTING CERTIFICATION SCHEMES

The Contractor shall undertake all works in accordance with industry best practice and must be registered with an appropriate certification scheme for the electrical installation works being undertaken which provides a six-year guarantee on completion of the works to rectify any non-compliance with the Building Regulations and BS 7671 IET Wiring Regulations.

This shall be the NICEIC / ELECSA – Platinum Promise registration scheme, or equivalent.

2E-6 THE CONSTRUCTION PRODUCTS REGULATION (CPR)

The Contractor shall ensure all electrical installation construction products are suitably certified for their intended use, UKCA marked in strict accordance with the latest requirements of The Construction Products Regulation and accompanied by a declaration of performance (DoP).

All cabling and equipment shall be covered by a British or Harmonized Standard.

All fixed wiring power, control and communication cables shall satisfy the requirements of the Construction Products Regulation in respect of their reaction to fire by being provided in strict accordance with their respective British and Harmonized Standards.

2E-7 ACCESSIBILITY & MAINTAINABILITY

Access and maintainability of electrical equipment shall be provided in accordance with the standards listed, and as follows: -

- 1) Adequate space shall be provided for the initial installation and for its potential replacement at a later date.
- 2) All equipment shall be installed such that it is accessible for operation, inspection, testing, maintenance and repair.
- 3) To prevent access by ordinary persons (as defined in BS 7671), equipment shall be located behind lockable doors / covers, or shall only be accessible by the use of a tool.
- 4) Equipment shall be suitably labelled, and adequate signage provided in accordance with BS 7671 and this specification.
- 5) Operating instructions shall be provided adjacent to all items of equipment where their function is not obvious.
- 6) Where items of equipment have removable lids, covers etc., it shall be possible to reinstate these to their original state without damaging cabling or equipment.
- 7) Access and adequate working space shall be provided to all wiring systems and items of equipment to facilitate maintenance or adaptation. This includes every electrical connection and joint, except for:
 - a) Joints designed to be buried in the ground.
 - b) Compound filled or encapsulated joints.
 - c) Connections between a cold tail and the heating system e.g. ceiling / floor heating or trace heating system.
 - d) Joints or connections made in equipment by a manufacturer where access is not required.
 - e) Equipment complying with BS 5733, suitably marked as a maintenance free accessory and installed in strict accordance with the manufacturer's recommendations.
- 8) Suitable access arrangements shall be made for all equipment concealed within roof spaces, ceiling / floor voids and other non-accessible locations e.g. openable or removable access hatches / traps etc.
- 9) All switchgear and distribution equipment shall be located so that it can be operated and maintained safely.

2E-8 PROTECTION AGAINST ELECTRIC SHOCK

Protective measures shall be provided by the following: -

- 1) Basic protection – Protection against electric shock under fault-free conditions.
- 2) Fault protection – Protection against electric shock under single fault conditions.

Suitable provisions shall be made in the installation where danger or damage is expected to arise due to an interruption of supply.

Additional protection (e.g. RCD's and supplementary protective equipotential bonding) shall be provided as detailed. Type AC RCD's shall only be used to serve fixed equipment, where it is known that the load current contains no DC components.

The following protective measures are permitted:

- 1) Automatic disconnection of supply e.g. protective earthing, protective equipotential bonding, protective devices etc.
- 2) Double or reinforced insulation e.g. Class II equipment.
- 3) Electrical separation e.g. safety isolating transformer used to supply equipment (shaver socket).
- 4) Extra-low voltage (SELV and PELV) e.g. ELV lighting in a special location.

Automatic disconnection of supply shall be the primary protective measure. The other forms of protective measure (items 2 to 4 above) shall be provided if required e.g. within special locations.

The following protective measures, for application only where the installation is controlled or under supervision of skilled or instructed persons, are not permitted by this specification: -

- 1) Obstacles.
- 2) Placing out of reach.
- 3) Non-conducting locations.
- 4) Protection by earth-free local equipotential bonding.
- 5) Electrical separation for the supply to more than one item of current-using equipment.

2E-8-1 AUTOMATIC DISCONNECTION OF SUPPLY

This protective measure shall provide both Basic and Fault protection: -

BASIC PROTECTION

This shall be provided by: -

- 1) Basic insulation of live parts.
- 2) Barriers and/or enclosures.

Insulation shall completely cover live parts, be suitable for its environment and shall only be removable by destruction. It shall be capable of withstanding the electrical, mechanical, chemical and thermal stresses that it may be subjected to during service.

The insulation to electrical equipment shall comply with the relevant standard(s) for that item of equipment. Basic insulation of live parts shall not be provided by paint, varnish, lacquer or similar products.

Barriers and/or enclosures shall: -

- 1) Be provided to prevent contact with live parts.
- 2) Provide at least the degree of protection IPXXB or IP2X.
- 3) Provide at least the degree of protection IPXXD or IP4X to horizontal or top surfaces which are readily accessible.
- 4) Be suitable for the environment in which they are installed.

The removal of barriers, opening of enclosures etc. shall only be possible by:

- 1) The use of a key or tool, or
- 2) After disconnection of the supply to all internal live parts.

Any item made accessible that may retain a dangerous electrical charge shall be suitably labelled.

FAULT PROTECTION

This shall be provided by: -

- 1) Protective earthing.
- 2) Protective equipotential bonding.
- 3) Automatic disconnection in case of a fault.

When an earth fault occurs the impedance of the fault path shall be low enough to cause sufficient current to operate the circuit protective device within the required disconnection times given in BS 7671 without reliance on the operation of RCDs.

ADDITIONAL PROTECTION

Additional protection shall be provided when there is an increased risk of electric shock and shall include: -

- 1) Residual current devices (RCD's, RCCB's and RCBO's).
- 2) Supplementary protective equipotential bonding.

Additional protection shall: -

- 1) Not be used as a sole means of protection against electric shock.
- 2) Be provided by RCDs with operating current $I_{\Delta n}$ not exceeding 30mA and for non-delay type RCDs an operating time not exceeding 300ms.

This additional protection shall be provided: -

- 1) For socket-outlets with a rated current not exceeding 32A.-
Note: A lighting distribution unit complying with BS 5733, shaver supply unit complying with BS EN 61558-2-5, luminaire track system, installation coupler, LSC or DCL is not regarded as a socket-outlet with regards to this requirement.
- 2) For mobile equipment with a current rating not exceeding 32A for use outdoors.
- 3) Within (household) premises, AC final circuits supplying luminaires.
- 4) For all LV final circuits: -
 - a) Serving a location containing a bath or shower.
 - b) Passing through zones 1 and/or 2 of a location containing a bath or shower.
- 5) For external lighting LV final circuits to bike stores, telephone kiosks, bus shelters, advertising panels and town plans.
- 6) Where additional protection is required within special locations as required by Part 7 of BS 7671.

Residual current device (RCD's, RCCB's and RCBO's) protection shall be provided to all socket-outlets.

Additional protection shall also be provided to special locations as required by Part 7 of BS 7671 using supplementary protective equipotential bonding conductors between simultaneous accessible exposed-conductive-parts and extraneous-conductive parts.

2E-9 PROTECTION AGAINST THERMAL EFFECTS

Arc fault detection devices (AFDD) conforming to BS EN 62606 shall be provided for single-phase AC final circuits supplying socket-outlets with a rated current not exceeding 32A in: -

- 1) Higher Risk Residential Buildings (HRRB).
- 2) Houses in Multiple Occupation (HMO).
- 3) Purpose-built student accommodation.
- 4) Care homes.

Note: HRRBs are assumed to be residential buildings over 18m in height or in excess of six storeys, whichever is met first. Building Control / Fire Advisor shall confirm the definition of the building(s).

For all other buildings, AFDDs conforming to BS EN 62606 shall be provided for single-phase AC final circuits supplying socket-outlets not exceeding 32A, unless there is explicit instruction to the contrary in a subsequent section of this specification.

AFDD's shall be installed: -

- 1) At the origin of the final circuits to be protected, and
- 2) In AC single-phase circuits not exceeding 230V.

Note: For busbar systems to BS EN 61439-6 and powertrack systems to BS EN 61534, AFDDs may be placed at the equipment location.

The use of AFDDs does not obviate the need for other protective measures. AFDD's shall be co-ordinated with overcurrent / residual current protective devices and installed in strict accordance with manufacturers' literature.

2E-10 PROTECTION AGAINST IMPACT – CONCEALED CABLING

LV final circuit cabling concealed within the building fabric / structure shall have the following protection against impact: -

CABLE TYPE AND CABLE SUPPORT / CONTAINMENT	CABLES UNDER FLOORS OF ABOVE CEILINGS	CABLES CONCEALED IN A WALL OR PARTITION AT A DEPTH OF LESS THAN 50mm	CABLES INSTALLED IN A WALL OR PARTITION THAT INCLUDES METALLIC PARTS (SEE NOTE 3)
Single core insulated non-sheathed cables in metallic cable trunking / metallic conduit	Cable trunking and conduit shall be equipotential bonded and satisfy the requirements for a protective conductor.		
Flat multicore insulated sheathed cables (T&E) in metallic cable basket / metallic conduit	Shall be run at least 50mm from the top or bottom as appropriate, of a joist or batten. or Where a 50mm depth cannot be achieved they shall be installed within metallic cable trunking (not cable basket) and metallic conduit that is equipotential bonded and satisfies the requirements for a protective conductor.	Conduit shall be equipotential bonded and satisfy the requirements for a protective conductor.	
Flat multicore insulated sheathed cables (T&E) clipped / fixed direct to the building fabric / metallic or plastic capping		Shall be installed within the prescribed zones detailed within BS 7671. and Additional protection shall be provided by RCD's (RCCB's or RCBO's).	Additional protection shall be provided by RCD's (RCCB's or RCBO's).
Notes:- 1) As advised by the IET Wiring Regulations Technical Support Group, unbonded metallic conduit, metallic plate (e.g. on the top of joists) or metallic capping (e.g. run within walls) do not provide adequate mechanical protection 2) RCDs shall have an operating current not exceeding 30mA I _{Δn} and for non-delay type RCDs an operating time not exceeding 300ms. 3) Other than just metallic fixings such as nails, screws or the like, e.g. metal stud partitions.			

	Default cabling / cable support and containment system, shall be included at Tender and used for installation.
	May only be used when detailed in a subsequent section of this specification and on the drawings.

2E-11 IDENTIFICATION, NOTICES & LABELLING

This shall be provided in accordance with site standards, BS 7671, all supporting IET documentation and the respective standards for different systems.

Diagrams, charts and information or instruction notices shall comply with BS EN 61082-1, BS EN IEC/IEEE 82079-1, and where appropriate BS EN 81346-1.

Where there is a discrepancy between existing site standards and the accompanying specification(s) / drawing(s), written confirmation via the Contract Administrator shall be obtained prior to submission of tender costs to clarify the requirements, and in the absence of such the more onerous requirements shall be included.

Where locations are to be defined on labelling, diagrams, schedules / charts the room numbers / names used shall be agreed with the client to ensure co-ordination with the final site room referencing system.

Regarding manufacturers proprietary labelling (e.g. periodic inspection and testing, RCD notices, earthing and bonding connections, alternative or additional supplies and presence of SPDs), the only requirement is compliance with Section 514 and Appendix 11 of BS 7671.

2E-11-1 SAFETY SIGNAGE

Safety signage shall be: -

- 1) Provided as required for the electrical installation.
- 2) In strict accordance with The Health and Safety (Safety Signs and Signals) Regulations – Guidance on Regulations – HSE L64, BS 5499, BS ISO 3864, BS EN ISO 7010 and BS EN IEC/IEEE 82079-1.
- 3) Clearly visible and adequately illuminated by both general lighting and emergency lighting as required
- 4) Provided in strict accordance with their respective standards e.g. BS 5266 for self-illuminated emergency exit signs.
- 5) Provided in the following geometric shapes, safety colours and contrast colours: -

SIGN / NOTICE / IDENTIFICATION MEANING	GEOMETRIC SHAPE	SAFETY COLOUR	CONTRAST COLOUR	GRAPHICAL SYMBOL COLOUR	INSTRUCTION AND INFORMATION
Prohibition sign	Circle with diagonal bar	Red	White	Black	A sign prohibiting behavior likely to increase or cause danger e.g. no access for unauthorised persons.
Mandatory sign	Circle	Blue	White	White	A sign prescribing specific behavior e.g. eye protection must be worn.
Warning sign	Equilateral triangle with curved corners	Yellow	Black	Black	A sign warning of a hazard e.g. danger: electricity, nominal voltage exceeding 230 V to earth.
Emergency escape or first-aid sign	Rectangle (square or oblong)	Green	White	White	A sign giving information on emergency exits, first aid, or rescue facilities.
Fire / fire-fighting equipment	Rectangle (square or oblong)	Red	White	White	A sign giving information on fire equipment e.g. fire alarm call point etc.

2E-11-2 IDENTIFICATION, NOTICES & LABELLING COLOURS / TEXT SIZE

All labelling used for the identification of electrical services shall be provided in the following colours: -

SIGN / NOTICE / IDENTIFICATION TYPE	BACKGROUND COLOUR	TEXT COLOUR	NOTES
General information	White	Black	Labelling of general switchgear, electrical equipment and wiring accessories
Fire / fire-fighting equipment	Red	White	Labelling of fire / fire-fighting equipment and the circuits that feed them, (including disable refuge panels etc.)
Fire alarm devices	White	Red	Labelling of fire alarm devices

Identification and labelling of electrical equipment shall be carried out using a mixture of Traffolyte or printed adhesive labels (e.g. Brother / DYMO adhesive tape or similar), depending on the application, as specified hereafter. Critchley / Tyco HLX LSZH cable markers or similar shall be used for cables.

Traffolyte labels shall be fixed by either screws or bolts (not adhesive). Labels higher than 25mm shall have fixings in each corner.

All text shall be in capital letters of the following height: -

- 1) 25mm for warning notices.
- 2) 12mm for primary identification labels.
- 3) 6mm for secondary identification labels and all printed adhesive labels.

2E-11-3 IDENTIFICATION & LABELLEING OF ELECTRICAL EQUIPMENT

GENERAL REQUIREMENTS

- 1) Each item of switchgear, controlgear and electrical equipment shall be provided with labelling that indicates its purpose.
- 2) Switchgear and controlgear terminals shall be marked in accordance with BS 5472 and BS 6272.
- 3) Protective devices shall be labelled so that the circuit protected is easily identifiable and in accordance with BS EN 61439.
- 4) Indicating equipment shall be provided in strict accordance with BS EN 60073, BS EN 60447 and BS EN ISO 9241-300, where the remote operation of switchgear is necessary.
- 5) All switchrooms (including rooms containing battery systems), cupboards and risers shall have suitable warning signs.
- 6) A laminated 'Electric shock: First aid procedures' (resuscitation) poster shall be provided adjacent to every low voltage switch panel, MCCB panel board and MSDB multi-service distribution board.
- 7) All labelling shall be fully coordinated and consistent throughout.
- 8) Traffolyte identification labels shall be provided to every termination or joint box indicating the type of service contained.
- 9) All spare ways shall be labelled.
- 10) Additional labelling shall be provided as required by BS 7671 e.g. nominal voltage exceeding 230 V to earth, alternative supplies from different sources or circuits etc.
- 11) Traffolyte shall be used for all external labelling and for internal (circuit) labelling to switchpanels and feeder pillars.
- 12) Handwritten notices and identification labels are not acceptable under any circumstances.

Labelling shall be provided as detailed in the headings below, including the following external labelling to all items:

- 1) Switchgear / equipment reference number.
- 2) General description and Manufacturer's details.
- 3) Origin / source of supply (e.g. FED FROM ...).
- 4) Date of installation

LOW VOLTAGE SWITCH BOARDS & FEEDER PILLARS

External labelling to indicate the following: -

- 1) Form and type.
- 2) IP rating.
- 3) Earthing arrangements e.g. TN-C, TN-S, TN-C-S (PME), TT, IT.
- 4) Nominal voltage.
- 5) Nominal frequency in Hz .
- 6) Rated fault current.
- 7) Busbar rated current, I in A.
- 8) Incoming device; BS (EN) number, type, rated current in A, settings where relevant.
- 9) Incoming supply cable(s); circuit reference / number, no. of cables, no. of cores, size and type.
- 10) Incoming protective conductor cable(s), no. of cores, size and type (if separate).
- 11) Weight in kg.

Traffolyte labelling shall also be provided externally to all outgoing ways of low voltage switch panels and internally to all outgoing ways of low voltage feeder pillars. For each outgoing way the labelling shall clearly indicate the following: -

- 1) Circuit description, phase(s) present, supplied switchgear / equipment reference number, (or "Spare")
- 2) Destination location of the outgoing circuit including the building, floor and room number.
- 3) Protective device type, BS (EN) number, rating in A and settings (including spare ways fitted with protective devices).
- 4) Outgoing cable(s) type, size, no. of cables, no. of cores.
- 5) Outgoing protective conductor cable(s) type, circuit reference, no. of cables, no. of cores, size (if separate).
- 6) Date of installation if different to main panel

MCCB PANEL BOARDS, CONTROL PANELS, MSDB/SMDB/MCB DISTRIBUTION BOARDS & CONSUMER UNITS

External labelling shall generally be as described above for switch boards apart from those that are inapplicable e.g. form and type does not apply to final distribution boards. Traffolyte shall be used.

Printed adhesive labelling fixed to the manufacturer's internal labelling boxes adjacent to each outgoing way / circuit shall be provided to indicate: -

- 1) Circuit description and/or the supplied equipment reference number
- 2) Circuit type e.g. DB1, DB2, ring circuit, radial circuit etc.
- 3) Destination location of the outgoing circuit including the building, floor and room number.

Further technical details shall be provided on the schedules / charts provided internally for each MCCB panel board, MCB distribution and consumer unit (see section below).

ISOLATORS, FUSE SWITCH / SWITCH FUSE DISCONNECTORS & OTHER INDUSTRIAL SWITCHGEAR

External labelling shall generally be as described above for switchpanels apart from those that are inapplicable e.g. form and type does not apply.

CONTACTORS

External labelling to include No. of poles, Coil control voltage in V, Contactor rating in kW / V / I.

POWER FACTOR CORRECTION UNITS

External labelling to include rating in kVAr and the number of stages.

SURGE PROTECTION DEVICES

External labelling to include the classification e.g. Type 1, kA etc. and be located at or near the relevant distribution board, MCCB panel board, LV switch panel or similar.

ENERGY METERING

Traffolyte labelling shall be provided externally to all metering enclosures and shall clearly indicate the following: -

- 1) Equipment reference number.
- 2) General description.
- 3) Date of installation.

FIRE-FIGHTING / LIFE SAFETY & SECURITY EQUIPMENT

External traffolyte labelling to include: -

- 1) Any necessary instructions for an emergency situation.
- 2) Battery autonomy and date when new.
- 3) For breakers/isolators feeding critical systems, appropriate warning notices e.g. FIRE ALARM – DO NOT SWITCH OFF or similar, dependent upon the system and the associated British Standard requirements.
- 4) On fire fighters' switches, clear "ON" and "OFF" labels in letters not less than 10mm high. (When installed the "OFF" switch position shall be up.).

All emergency voice communication outstations shall be labelled with simple pictogram instructions on how to initiate a call.

Evacuation alert system control panels shall be labelled 'EACIE: FOR FIRE AND RESCUE SERVICE USE ONLY' which shall be Sans Serif text on a red background, with lower-case letter height of at least 10mm. Signage shall: -

- 1) Incorporate the flames pictogram specified for firefighting in BS 5499, the text and flames pictogram shall be of a contrasting colour / finish to the red background).
- 2) Be of metal or traffolyte construction and fixed to the EACIE enclosure door by rivets or at least four security screws.

Controls for the testing of evacuation alert devices / sounders shall be labelled with the words 'CONTROLS FOR MAINTENANCE USE ONLY' or similar.

Evacuation alert system short circuit isolators, interfaces, addressable input/output devices, junction boxes or similar shall be labelled 'EVACUATION ALERT SYSTEM'.

Printed adhesive labelling shall be provided for the following: -

- 1) Fire alarm devices giving loop number, device number and device type.
- 2) Disabled persons call indicators giving source of call by floor/room number.
- 3) Fire suppressant release buttons e.g. "EXTINGUISHANT RELEASE".
- 4) Time delay facilities e.g. "EXTINGUISHANT HOLD-OFF".
- 5) All security devices giving ID reference.

2E-11-4 LABELLING TO WIRING ACCESSORIES & HIDDEN SERVICES

Labelling shall be provided as follows: -

WIRING ACCESSORIES

- 1) The face plates of all accessories such as socket outlets, fused connection units, isolators, light switches, etc. shall have printed adhesive labels that indicate the distribution board from which they are fed and their final circuit reference; this shall exclude dwellings.
- 2) All final circuit references shall be coordinated throughout and consistent on all accessories, schedules and drawings.
- 3) All fused connection units and isolators shall be labelled as to their purpose. Where available from the specified range, accessories shall have integral engraved labelling e.g. water heater, cooker, etc.
- 4) Socket outlets identified for cleaners' use shall have the integral engraved labelling 'CLEANER'S SOCKET'.
- 5) The buttons of scene setting panels shall be labelled showing all scene setting options / programmes to provide ease of use. Where this is not possible, a small laminated clearly legible pictogram shall be permanently fixed adjacent to the devices.
- 6) Small laminated pictograms shall also be permanently fixed adjacent to all devices where there is insufficient space for printed adhesive labelling e.g. lighting grid switches etc.

- 7) All data outlets shall have printed adhesive labels that indicate their unique agreed patch panel ID reference, as detailed within Section E5 Voice and Data Systems within this specification (where provided).

Traffolyte labelling shall be used for all externally located accessories and those within dedicated electrical switch rooms, plant rooms and service risers.

HIDDEN SERVICES

Where services are to be concealed above ceilings, colour coded identification markers shall be provided which shall be fixed to the underside of ceilings. These shall be fully co-ordinated with O&M manuals / as-installed information.

The following services shall be identified: -

- 1) Concealed power supply units.
- 2) Fire alarm detectors and interfaces.
- 3) Smoke / fire dampers.
- 4) Valves / commissioning sets etc.

Fire alarm remote indicators shall be clearly labelled to indicate their function. They shall be sited and/or labelled in such a way as to assist in determining the location of the detectors that they serve.

The appearance and use of colour coded markers must be agreed with the Engineer, Architect and Contract Administrator prior to installation.

2E-11-5 DIAGRAMS & DOCUMENTATION

DIAGRAMS

For each low voltage switch panel and MCCB/MSDB panel board a detailed low voltage distribution schematic(s) shall be provided, mounted within framed clear perspex and screw fixed to an adjacent wall.

The schematic shall be: -

- 1) Clearly legible.
- 2) Minimum size of A2.
- 3) Minimum text size of 4mm in height when printed.
- 4) Provided with a drawing legend that includes all the drawing symbols used on the schematic.

The low voltage distribution schematic(s) shall include all upstream switchgear and cabling together with the downstream distribution to the next level. All the panel labelling information as detailed earlier shall be repeated on the schematic.

The low voltage distribution schematics shall be provided in strict accordance with BS 5070 and BS EN 61082.

A drawing(s) shall be provided that details all electrical safety installations for firefighting and life safety services. The drawing(s) shall be located at the origin of the electrical installation and adjacent to any other electrical switchgear (e.g. MCCB panel board, MCB distribution board etc.) to which the firefighting / life safety systems relate.

The drawing(s) shall be mounted within framed clear perspex and screw fixed to an adjacent wall. The electrical safety installations drawing shall detail the exact location of the following: -

- 1) All electrical equipment and switchgear including switchgear / equipment reference numbers.
- 2) All firefighting and life safety equipment including final circuit designation and the particulars / purpose of the equipment.
- 3) Special switching and monitoring equipment for life safety power supplies.

Documentation shall be provided within or adjacent to all MCB distribution boards and consumer units that supply heating cables and embedded heating systems e.g. underfloor or ceiling heating systems, as required by BS 7671. This shall include: -

- 1) Manufacturer and type of heating units.
- 2) Number of heating units installed.
- 3) Length/area of heating units.

- 4) Rated power.
- 5) Surface power density.
- 6) Layout of the heating units in the form of a sketch, drawing, or picture.
- 7) Position/depth of heating units.
- 8) Position of junction boxes.
- 9) Cables, earthed conductive shields and the like.
- 10) Rated voltage.
- 11) Rated resistance (cold) of heating units.
- 12) Rated current of overcurrent protective device.
- 13) Rated residual operating current of RCD.
- 14) The insulation resistance of the heating installation and the test voltage used.
- 15) Product information containing provisions about approved materials in contact with the heating units, with necessary instructions for installation.

In addition to the above, the 'Information for the user of the installation' shall also be provided as detailed within BS 7671.

SCHEDULES / CHARTS

Schedules / charts shall be provided to all low voltage switch panels, MCCB panel boards, MCB distribution boards and consumer units, and shall include the following as a minimum: -

- 1) Switchgear reference number.
- 2) General description.
- 3) Date of installation
- 4) Circuit information including: -
 - a) Circuit reference and phase.
 - b) Circuit description and the supplied equipment reference number or final circuit type e.g. DB1. DB2, ring circuit, radial circuit etc. including the destination location of the outgoing circuit by building, floor and room number.
 - c) Type of wiring.
 - d) Reference method from Appendix 4 of BS 7671 – IET Wiring Regulations.
 - e) Number of points served.
 - f) Circuit conductor cross sectional area for both live and CPC.
 - g) Maximum disconnection time (s) permitted by BS 7671.
 - h) Maximum Zs permitted by BS 7671 (MCB not RCBO).
 - i) Overcurrent protective devices: -
 - i) BS (EN) number.
 - ii) Type number.
 - iii) Rating (A).
 - iv) Short circuit capacity (kA).
 - j) RCD operating current I_{Δn} (mA) and type.
 - k) Presence of AFDD(s).
- 5) Method used to provide protection against electric shock e.g. basic protection and fault protection.
- 6) Details of all final circuits having a high protective conductor current.
- 7) Details of any equipment or circuit vulnerable to 500V insulation resistance testing e.g. electronic devices.

It shall be noted the above schedules / charts shall be provided within or adjacent to the associated switchgear.

Where they are mounted adjacent to the item of switchgear they shall be mounted within framed clear perspex and screw fixed to the adjacent wall, however when they are mounted inside distribution boards (e.g. inside the front cover) they shall be laminated and suitably placed / attached.

Schedules / charts shall be provided that detail all current using equipment permanently connected to firefighting / life safety power supplies indicating: -

- 1) Nominal electric power.
- 2) Rated nominal voltage, current and starting current.
- 3) Duration.

The schedules /charts shall be located at the origin of the electrical installation and adjacent to any other electrical switchgear to which the firefighting / life safety systems relate. The schedules / charts shall be mounted within framed clear perspex and screw fixed to an adjacent wall. The schedules / charts shall include the nominal power, rated nominal voltage, current, starting current and duration.

All switchgear reference numbers / codes shall be coordinated throughout and the same on all identification labels, schedules and drawings.

All final circuit references shall be coordinated throughout and the same on all wiring accessories, schedules and drawings.

EXISTING DIAGRAMS, SCHEDULES & CHARTS

Where electrical installation works is undertaken that requires work to existing site LV distribution systems, firefighting / life safety systems and final circuit wiring, the diagrams, schedules and charts shall be updated in strict accordance with the above clauses and shall incorporate all existing installed information.

2E-11-6 IDENTIFICATION OF CABLES

All main and sub-main cabling shall be provided with identification labels / markers so that it can be identified for inspection, testing, maintenance, repair or alteration of the installation.

Printed identification labels / markers (e.g. Critchley / Tyco HLX LSZH cable markers or similar) shall be fixed as follows: -

- 1) Each end of the cable.
- 2) Locations where buried cabling enters / exits the ground.
- 3) Draw pit locations.
- 4) Building entry points.
- 5) Pass between floors.
- 6) Pass between 60-minute or greater fire compartments.

Each identification label shall include the following: -

- 1) Cable reference / circuit number.
- 2) Source and destination location(s).
- 3) Indication if the cable is run in parallel with other cables.
- 4) Date of installation in DD/MM/YYYY.

Cable route markers shall be provided to all underground cabling and shall include: -

- 1) Depth at which the cable is buried.
- 2) Cable operating voltage.

Cable markers / sleeves as a minimum shall be made from materials equivalent to that of the cabling being labelled e.g. LSZH, LSOH, OHLS etc. They shall also be selected to suit the environment in which they are installed.

Separate protective conductors that are not part of a multicore cable shall have identification labels as detailed above.

2E-11-7 IDENTIFICATION OF CONDUCTORS BY COLOUR & LETTERS / NUMBERS

Cores of cables shall be identified by both: -

- 1) Colour and,

- 2) Lettering and/or numbers.

At terminations and throughout the exposed length of every core shall be identifiable and where appropriate binding and sleeves for identification purposes shall comply with BS 3858.

Identification by colour or marking is not required for concentric conductors, bare conductors and the following when used as a protective conductor: -

- 1) Metal sheath or armour of cables.
- 2) Extraneous-conductive parts.
- 3) Exposed conductive parts.

Neutral or midpoint conductors shall be blue.

The colours green-and-yellow shall only be used for protective conductors and the colour combination shall not be less than 30% or more than 70% for each colour. The single colour green shall not be used except for copper strip earthing tape.

Green-and-yellow PEN conductors shall be labelled at the terminations by blue markings and blue PEN conductors shall be labelled at the terminations by green-and-yellow markings.

Lettering and numbering shall be provided to individual conductors or conductors in a group, in accordance with the following: -

- 1) Clearly legible and durable.
- 2) A strong contrast between characters and the insulation of the cable.
- 3) When used, the numbers 6 and 9 shall be underlined to avoid confusion.
- 4) Protective conductors shall not be numbered unless for circuit identification.
- 5) The number 0 shall be reserved for neutral and mid-point conductors.

Conductors shall be identified by colour and alphanumeric / marking as detailed in the table below: -

CONDUCTOR FUNCTION	COLOUR	ALPHANUMERIC / MARKING
Protective conductors	Green-and-yellow	CPC
Functional earthing conductor	Pink	-
AC power circuit¹⁾		
Line of single-phase circuit	Brown	L1 / L2 / L3 as appropriate
Neutral of single- or three-phase circuit	Blue	N
Line 1 of three-phase AC circuit	Brown	L1
Line 2 of three-phase AC circuit	Black	L2
Line 3 of three-phase AC circuit	Grey	L3
¹⁾ Power circuits include lighting circuits.		

At terminations marker sleeves with lettering / numbering shall be provided to each cable core as detailed in the table above e.g. for a three phase circuit, brown shall be L1, black shall be L2, grey shall be L3, blue shall be N.

Protective conductors shall not be lettered / numbered other than for the purpose of circuit identification.

Where terminations are made into switchgear such as switch panels, MCCB panel boards, MCB distribution boards, consumer units, main earth terminals / bars and similar, marker sleeves shall be provided to each cable core.

These marker sleeves shall be in accordance with the alphanumeric marking in the above table and shall also detail the way / circuit reference for which they are terminated into e.g. for final circuits terminated into a three phase distribution board: -

OUTGOING WAY	FINAL CIRCUIT TYPE	CIRCUIT NUMBER / LINE or NEUTRAL or CPC CONDUCTOR	CABLE COLOUR	ALPHANUMERIC / MARKING
Way 1 Line conductors (L1, L2, L3)	Three phase	1/L1	Brown	1/L1
		1/L2	Black	1/L2
		1/L3	Grey	1/L3
Way 1 Neutral conductor	Three phase	1/N	Blue	1/N
Way 1 Circuit protective conductor	Three phase	1/CPC	Green-and-yellow	1/CPC
Way 2 Line conductor (L1)	Single phase	2/L1	Brown	2/L1
Way 2 Neutral conductor (L1)	Single phase	2/N	Blue	2/L1/N
Way 2 Circuit protective conductor (L1)	Single phase	2/CPC	Green-and-yellow	2/L1/CPC
Way 2 Line conductor (L2)	Single phase	2/L2	Brown	2/L2
Way 2 Neutral conductor (L2)	Single phase	2/N	Blue	2/L2/N
Way 2 Circuit protective conductor (L2)	Single phase	2/CPC	Green-and-yellow	2/L2/CPC

Where two or three-core cables (6242* and 6243* flat twin / triple and earth cables) are used for switch wires, intermediate and two-way switch wires, they shall be marked / sleeved as follows: -

FUNCTION	COLOUR	ALPHANUMERIC / MARKING OR SLEEVING
Switch wires – two-core cabling		
Line conductor	Brown ¹⁾	-
Line conductor	Brown ¹⁾	-
Intermediate and two-way switch wires – three-core cabling		
Line conductor	Brown	-
Line conductor	Black	L or Brown
Line conductor	Grey	L or Brown
¹⁾ 6242* Twin and earth cabling shall have two brown cores when used for switching circuits, blue cores with brown sleeving or the cable marker 'L' may be used as an alternative.		

2E-11-8 IDENTIFICATION OF NEW CABLING (HARMONIZED COLOURS) INTERFACED WITH OLD CABLING (NON-HARMONIZED CABLE COLOURS)

Where there is an addition or alteration to an existing single phase installation and new cabling (to the harmonized colours) is interfaced with old cabling (non-harmonized colours), identification and marking is not required at the interface provided that: -

- 1) Old cable colours are red for line and black for neutral.
- 2) New cable colours are brown for line and blue for neutral.

However, where there is an addition or alteration to an existing two or three-phase installation or a DC installation, and new cabling (to the harmonized colours) is interfaced with old cabling (non-harmonized colours), the conductor markings in the table below are required at the interface location: -

CONDUCTOR FUNCTION	NEW CONDUCTOR		OLD CONDUCTOR	
	MARKING	COLOUR	MARKING	COLOUR
Protective conductors	–	Green-and-yellow	–	Green-and-yellow
AC power circuit ¹⁾				
Line 1 of three-phase AC circuit	L1	Brown ²⁾	L1	Red
Line 2 of three-phase AC circuit	L2	Black ²⁾	L2	Yellow
Line 3 of three-phase AC circuit	L3	Grey ²⁾	L3	Blue
Neutral of single- or three-phase circuit	N	Blue	N	Black
¹⁾ Power circuits include lighting circuits.				
²⁾ Three single-core cables with insulation of the same colour may be used if identified at the terminations.				

2E-11-9 TECHNICAL SUBMISSIONS

Prior to installation on-site the Contractor shall provide technical submissions for the following: -

- 1) A schedule of all identification, notices, labels (including safety signage) and cable identification labels / markers along with a physical sample of each label type.

The time allowed for comment shall be as detailed within section 1B of this specification.

2E-12 EXISTING SUPERVISORY / END-USER MANAGEMENT SOFTWARE

Where electrical installation works is undertaken that requires the integration of electrical systems into existing site supervisory / end-user management software (e.g. fire / voice alarm systems, emergency voice communication systems, disabled persons call systems, emergency lighting systems, security systems etc.) the Contractor shall employ the relevant specialist(s) to: -

- 1) Update the software so that electrical systems within refurbished, remodelled and new build areas / buildings are fully integrated into the existing software.
- 2) Incorporate room numbers / names co-ordinated with the architectural drawings and the site room referencing system.
- 3) Upload and integrate into the existing software the latest floor plans were used as part of an end-user GUI.

2E-13 SELECTION & ERECTION OF WIRING SYSTEMS TO MINIMISE THE SPREAD OF FIRE

To minimise the risk of spread of fire appropriate materials and erection methods shall be selected in strict accordance with The Building Regulations – Approved Document B, BS 9999, BS 7671 and all supporting IET documentation.

2E-13-1 PRECAUTIONS WITHIN A FIRE SEGREGATED COMPARTMENT

The general building structural performance / fire safety shall not be reduced by the installation of wiring systems.

All fixed wiring power, control and communication cables shall meet the flame propagation requirements of: -

- 1) BS EN 60332-1-2.
- 2) BS EN 60332-3-24 (where required by cable manufacturing standards – see below).

Note: IET Wiring Regulations requires cables to meet the flame propagation requirements of the BS EN 60332-3 series when installed within 'fire-segregated compartments that provide a means of escape in an emergency'.

However only XLPE/SWA/LSZH armoured, XLPE/LSZH softskin 'fire rated' and XLPE/SWA/LSZH armoured 'fire rated' cabling is tested to meet these requirements, and this is currently under review by the IET.

Therefore, cabling need only meet the requirements of BS EN 60332-1-2 where its manufacturing standard does not require testing to the BS EN 60332-3 series.

Where cables do not comply with the flame propagation requirements of BS EN 60332-1-2 and the BS EN 60332-3 series (where possible), they shall be limited to short lengths for connection of appliances to the permanent wiring system e.g. flexible connections. They shall not pass between fire segregated compartments.

Note: Protected escape routes have additional requirements to those detailed above, see below.

2E-13-2 FIREFIGHTING LOBBIES, SHAFTS OR STAIRCASES WITHIN PROTECTED ESCAPE ROUTES

Cabling and other electrical equipment shall not be installed in a firefighting lobby, shaft or staircase of a protected escape route unless they are for: -

- 1) An essential fire safety or related safety system e.g. fire alarm system.
- 2) Local lighting and emergency lighting.
- 3) Local socket-outlets provided for cleaning or maintenance.

Electric heaters and security systems shall not be installed in a firefighting lobby, shaft or staircase of a protected escape route, in accordance with BS 7671 and as advised by the IET and NICEIC (and electrical contracting certification schemes).

Other cabling such as primary distribution or final circuits feeding other areas (e.g. sub-mains distribution, voice and data cabling, other ELV signalling cabling etc.) must not be routed through or above a firefighting lobby, shaft or staircase of a protected escape route.

Protected escape routes and firefighting lobbies, shafts or staircases within protected escape routes must be defined by Building Control / Fire Advisor.

For residential and mixed-use buildings, protected escape routes that are assumed to be firefighting lobbies in accordance with BS 9991 must also be identified by Building Control / Fire Advisor. The restrictions and prohibitions above for firefighting lobbies shall apply to any such protected escape routes in residential / mixed-use buildings.

Cabling within all protected escape routes must be LSOH / LSZH / OHLS – Low smoke zero halogen (BS EN 61034-2 and BS EN 50267-2-1 respectively), and meet the flame propagation requirements of: -

- 1) BS EN 60332-3 series, or
- 2) BS EN 60332-2-1 when installed within metallic cable trunking / conduit to BS EN 50085 and BS EN 61386.

XLPE/SWA/LSZH armoured, XLPE softskin 'fire-rated' and XLPE/SWA/LSZH armoured 'fire rated cabling' are tested to meet the requirements of the BS EN 60332-3 series and must be installed upon metallic cable tray / cable ladder systems classified as non-flame propagating to BS EN 61537 within protected escape routes.

LSZH single core and XLPE/LSZH flat twin and earth cabling are tested to meet the requirements of BS EN 60332-2-1 and must be installed within metallic cable trunking / conduit systems classified as non-flame propagating to BS EN 50085 and BS EN 61386 respectively, within protected escape routes.

LSZH flat twin and earth (T&E) cabling must not be installed on metallic cable basket / conduit when installed within a protected escape route, as cable basket is not deemed to meet the flame propagation requirements of BS 7671.

PVC cabling shall not be installed within protected escape routes under any circumstances, as it does not meet the requirements for flame propagation or halogen / smoke emissions.

Switchgear and controlgear within protected escape routes shall be: -

- 1) Accessible only to authorized persons.
- 2) Enclosed in a cabinet or an enclosure constructed of non-combustible or not readily combustible material.
Note: This does not apply to items installed to facilitate evacuation e.g. fire alarm manual call points.

The above cabling and containment requirements shall also be applied to the following locations where a particular risk of fire exists: -

- 1) Locations with risks of fire due to the nature of processed or stored materials.
- 2) Combustible construction materials.

- 3) Fire propagating structures.
- 4) Selection and erection of installations in locations of national, commercial, industrial or public significance. Locations must be defined by Building Control / Fire Advisor and it shall be noted the above locations have other additional/different requirements to those for protected escape routes.

2E-13-3 PROTECTED ESCAPE ROUTES WITHIN HEALTHCARE FACILITIES

Within healthcare facilities, cabling and other electrical equipment may be installed in a protected escape route, where: -

- 1) The healthcare facility complies with Health Technical Memoranda (HTM) and healthcare fire safety guidance, and
- 2) The particulars of the electrical installation within the protected escape route are documented as part of a fire strategy.

Reference shall be made to the fire safety guidance within Health Technical Memoranda (HTM) or the equivalent guidance documents in other devolved administrations e.g. Scotland (SHTM) and Wales (WHTM).

Within healthcare facilities, protected escape routes and firefighting lobbies, shafts or staircases within protected escape routes must be defined by Building Control / Fire Advisor so the particulars of the electrical installation can be documented.

2E-13-4 SEALING OF WIRING SYSTEM PENETRATIONS

The sealing of wiring system penetrations shall be as follows: -

- 1) Where wiring systems pass through floors, walls, roofs, ceilings, partitions, cavity barriers and other elements of the building construction, the penetrations through the building fabric shall be suitably sealed (e.g. fire barriers / stopping) to provide the level of fire resistance and acoustic properties required by the building element that has been penetrated.
- 2) Manufacturers' proprietary cable transit systems and sleeves shall be utilised which have been tested in strict accordance with BS EN 1366-3. Other systems may be considered if based on sample construction details and written approval by Building Control and appropriate Fire Advisors.
- 3) Under no circumstances shall expandable foam be used.
- 4) Cable ducting, cable trunking, conduit and busbar systems etc. shall also be internally sealed to provide the level of fire resistance required by the building element that has been penetrated.
- 5) Where the wiring system / products are classified as non-flame propagating according to the relevant product standard, internal sealing is not required provided that: -
 - a) The wiring system has a maximum internal cross-sectional area of 710mm² e.g. 32mm diameter conduit or smaller, or 25 x 25mm trunking.
 - b) (However, they may require sealing for other reasons, such as to prevent condensation, in classified hazardous areas etc.).
 - c) The system has the degree of protection of IP33 to BS EN 60529.
 - d) Any termination of the system in one of the compartments, separated by the building construction being penetrated, has the degree of protection of IP33 to BS EN 60529.
- 6) Temporary fire stopping arrangements shall be provided if required during the installation works. Existing fire stopping that is disturbed during alteration works shall be reinstated as soon as practical.
- 7) The fire sealing must also resist external influences to the same degree as the wiring system e.g. resistance to combustion, ingress protection from water, be from compatible material, permit thermal movement and have adequate mechanical stability.
- 8) Cable cleats and supports for cable management systems shall be provided within 750mm of all fire barrier / stopping seals and shall be able to withstand the mechanical load induced by the collapse of wiring systems on the fire side of the seal, to prevent strain and damage to the fire seal. This is not required if the seal itself is able to provide adequate support under such conditions.

- 9) Intumescent gaskets and covers shall be provided where electrical equipment or accessories are installed within ceilings or walls whose fire integrity has been compromised by their installation e.g. recessed luminaires in ceilings to maintain the ceilings fire integrity, accessory boxes in thin skinned walls that form part of a fire compartment etc.
- 10) Gaskets and covers shall be provided where electrical equipment or accessories are installed within ceilings or walls whose acoustic properties have been compromised by their installation e.g. recessed luminaires, accessory boxes in thin skinned walls etc.
- 11) Labelling shall be provided at each penetration location and shall have a designated unique reference, include the installation date and details of the specialist installer.
- 12) On completion of the fire barriers / stopping works fully detailed completion / compliance certification shall be provided along with record drawings that detail all fire barrier / stopping locations.

Fire sealing shall be provided in strict accordance with Appendix 13 of BS 7671.

Technical specifications for all manufacturers' proprietary fire stopping systems and materials (e.g. cable transit systems and sleeves) shall be agreed with Building Control / Fire Advisor and the Architect.

2E-14 PROXIMITY OF WIRING SYSTEMS & ELECTROMAGNETIC DISTURBANCES

This section of the specification details the general requirements for the proximity of wiring systems and measures against electromagnetic disturbances.

2E-14-1 PROXIMITY & SEGREGATION OF WIRING SYSTEMS

GENERAL

Electrical services cabling shall be segregated in strict accordance with BS 5266, BS 5839, BS 6701, BS 8629, BS EN 50174, BS EN 62305, NJUG Guidelines, BS 8519, BS 7594, BS 7671 and all supporting IET documentation.

Voltage Band I and Voltage Band II circuits must not be contained in the same wiring system as a circuit of nominal voltage exceeding that of low voltage.

LIGHTNING PROTECTION SYSTEMS

Adequate separation shall be provided between conductors of a lightning protection system and other electrical wiring systems, including extra-low voltage systems. The minimum separation distances shall be calculated by the lightning protection specialist in accordance with BS EN 62305-3.

EMERGENCY LIGHTING SYSTEM WIRING

Emergency lighting system wiring from a central battery system shall be segregated from all other electrical circuits and wiring systems to avoid the risk of mechanical damage, in strict accordance with BS 5266-1.

FIRE ALARM SYSTEM, VOICE ALARM SYSTEM & EMERGENCY VOICE COMMUNICATION SYSTEM WIRING

Fire alarm system and emergency voice communication system (disabled refuge) wiring shall be segregated from all other electrical circuits and wiring systems in strict accordance with BS 5839-1, BS 5839-8 and BS 5839-9.

Fire alarm system, voice alarm system and emergency voice communication system (disabled refuge) wiring may be installed together within the same cable support / containment system, as permitted by BS 5839.

EVACUATION ALERT SYSTEM WIRING

Evacuation alert system wiring shall be segregated from all other electrical circuits and wiring systems including those of other life safety / firefighting systems (e.g. fire alarm systems, voice alarm systems, emergency voice communication systems etc.) to avoid the risk of mechanical damage, in strict accordance with BS 8629.

OTHER LIFE SAFETY / FIRE-FIGHTING WIRING

All other life safety / fire-fighting system wiring systems shall be segregated from each other and all other electrical circuits and wiring systems. Primary and secondary power supplies shall be adequately separated from each other so that a failure in a cable or equipment (e.g. mechanical breakdown, damage by fire etc.), in either supply does not affect the other supply.

Where more onerous requirements are detailed within standards, documents or manufacturers' literature relating to life safety / fire-fighting systems, these requirements must be adhered to (e.g. diverse routing of primary and secondary power supplies to fire-fighting lifts, evacuation lifts, smoke ventilation systems etc.).

AUDIO FREQUENCY INDUCTION LOOP SYSTEMS (AFILS)

Loop conductor(s), microphone and other signal cables shall be segregated from all other electrical circuits and wiring systems in strict accordance with BS 7594.

- 1) Loop cabling shall be installed at least 600mm from low voltage (general power wiring) and extra low voltage systems (fire alarm, security, telecommunications and data wiring etc.). However, the loop cabling shall be installed at least 1000mm from all other audio wiring systems. These requirements shall be verified with the AFILS equipment manufacturers.
- 2) Line and neutral conductors or switch feeds and switch wires (e.g. conventional two-way switching) must be grouped / run together in areas where AFILS have been installed.
- 3) Adjacent loops shall be adequately separated from each other dependent upon their classification / type e.g. A1, A2, A3, A4 etc. as required by BS 7594.

INFORMATION TECHNOLOGY & TELECOMMUNICATIONS WIRING

Information technology (e.g. data cabling) and telecommunications wiring systems shall be segregated from all other electrical circuits and wiring systems. This shall include any building services systems that may utilise the information technology / telecommunications wiring e.g. access control, CCTV, BMS etc.

External and internal telecommunication wiring systems by utility service providers e.g. BT, Virgin Media, Hyperoptic etc. shall be segregated from each other in strict accordance with the associated providers guidance e.g. developer guides, design guides etc.

Where underground telecommunications cables and underground power cables cross or are in close proximity a minimum clearance of 100mm shall be maintained unless one of the methods is adopted from BS 7671.

These methods are as follows: -

- 1) The provision of a fire retardant partition shall be provided between the underground telecommunication and power cables.
e.g. bricks, clay / concrete cable protection caps, concrete shaped blocks, protective cable conduit or troughs made of fire retardant materials.
Or,
- 2) Where underground telecommunication cables and power cables cross, mechanical protection between the cables shall be provided.
e.g. cable conduit, concrete cable protection caps or concrete shaped blocks.

OTHER WIRING

The following wiring systems shall be fully segregated from each other and all other electrical circuits and wiring systems: -

- 1) Security systems.
- 2) BMS.
- 3) ELV mechanical services controls.

GENERAL INSTALLATION REQUIREMENTS

The general installation requirements are as follows: -

- 1) Wiring systems that require segregation shall be installed in their own dedicated cable management systems or in common cable management systems that are provided with individual dedicated compartments.
Where dividers / partitions are installed on-site they must be from the same manufacturer as the cable management system and the manufacturer's proprietary fixings shall be used.
The compartment walls or dividers / partitions within the common cable management system shall be: -
 - a) Securely fixed and manufactured from the same material as the cable management system.
 - b) Mechanically strong and continuous throughout the cable management system.
 - c) The same height as the sides of the common cable management system and without perforations.

- d) Equipotential bonded to the cable management system.
- 2) Signalling and data cabling shall not be installed within a common cable management system that contains low voltage wiring unless the dividers / partitions are manufactured from steel with a minimum thickness of 1.5mm.
- 3) All wiring systems shall have its own cable conduits and shall not be installed in the same conduits as the cables of other wiring systems.
- 4) Under no circumstances shall any wiring be strapped or fixed to the outside of cable management systems.
- 5) Underground electrical wiring systems shall be separated as detailed by the NJUG National Joint Utilities Group or as shown on the drawings. All buried wiring systems shall be installed within their own dedicated cable ducting systems unless specifically shown otherwise.

2E-14-2 PROXIMITY OF WIRING SYSTEMS TO NON-ELECTRICAL SERVICES

Wiring systems shall not be located in close proximity to non-electrical services that produce heat (e.g. hot pipework), smoke or fumes, or below services that may cause condensation (e.g. water, steam, gas services), unless adequate precautions are taken to prevent harmful effects to the wiring.

Mechanical / thermal shielding or suitable spacing shall be provided between electrical and non-electrical services to prevent the operation of one service affecting another.

Under no circumstances shall wet services be installed within LV switch rooms and rooms containing standby battery systems.

Low pressure gas systems shall be separated from electrical equipment in accordance with BS 6891: -

- 1) Gas pipework shall be at least 150mm from low voltage equipment such as metering, DNO cut-outs / isolators, distribution boards and consumer units.
- 2) Gas pipework shall be at least 25mm from switches, sockets and low voltage cabling.

The guidance outlined in IGEM/GM/6 shall also be followed: -

- 1) Gas metering shall not be installed within rooms that are intended for electricity metering and electrical switchgear.
- 2) Gas metering shall be located away from electricity metering and electrical switchgear and under no circumstances within 150mm.

The only wiring systems that shall be installed within lift or hoist wells shall be those that form part of the lift installation as defined by the BS EN 81 series.

2E-14-3 MEASURES AGAINST ELECTROMAGNETIC DISTURBANCES

To avoid and reduce electromagnetic disturbances the electrical installation works shall also be undertaken in strict accordance with the following standards: -

REFERENCE STANDARDS / DOCUMENTS	
BS 6701	Telecommunications equipment and telecommunications cabling – Specification for installation, operation and maintenance
BS EN 50310	Telecommunications bonding networks for buildings and other structures
BS EN 50174	Information technology – Cabling installation
BS IEC 61000-5-2	Electromagnetic compatibility (EMC) – Part 5: Installation and mitigation guidelines – Section 2: Earthing and cabling

Where referenced within this section of the specification data and signalling cabling shall include the following non-exhaustive systems: -

- 1) Information and communication systems.
- 2) All life safety / fire-fighting systems.
- 3) Security systems.
- 4) AV/TV/integrated reception systems.

- 5) BMS systems.
- 6) ELV mechanical services controls.
- 7) Nurses call systems.
- 8) Any other systems that utilise ELV signalling wiring.

Reference shall be made to BS EN 50174-2 for the minimum separation distances from data / signalling cabling to sources of electromagnetic interference (e.g. fluorescent / neon / mercury vapour / high-intensity discharge lamps, arc welders, frequency induction heating, hospital equipment, radio / television transmitters and radars).

As a minimum the following measures must be adopted to avoid and reduce electromagnetic disturbances: -

- 1) Signalling cabling shall be adequately screened.
- 2) All circuit conductors of low voltage cabling shall be run together in close proximity utilising the same cable support / containment system (e.g. line, neutral and protective earth conductors).
- 3) Adequate separation and segregation of power (e.g. low voltage) and signalling cables shall be provided.
- 4) All cable support and containment systems shall be equipotential bonded as detailed within the Earthing and Bonding section within this section of the specification.

Where more onerous measures (e.g. surge protection and/or filters, EMC equipotential bonding networks etc.) are required these shall be detailed elsewhere within this specification.

It shall be assumed, unless unambiguously stated otherwise, that the minimum separation distances given in BS 7671 apply, as summarised below: -

INSTALLATION METHOD (ALL CABLE SUPPORT & CONTAINMENT SYSTEMS ARE STEEL)		SEPARATION DISTANCE
DATA / SIGNALLING CABLING	LOW VOLTAGE CABLING	
Dedicated cable basket or tray	Free air, cable tray or basket	200mm
Dedicated cable basket or tray	Cable trunking	150mm
Dedicated cable trunking	Cable tray or basket	150mm
Dedicated cable trunking	Dedicated cable trunking	0mm
Notes: - <ol style="list-style-type: none"> 1) The minimum separation distances shall apply in three dimensions. 2) Signalling and data cabling shall not be installed within a common cable management system that contains low voltage wiring unless the dividers / partitions are manufactured from steel with a minimum thickness of 1.5mm. 3) Where signalling / data cabling and power cabling are required to cross each other and the minimum separation distances cannot be maintained, they must cross each other at 90 degrees for at least the minimum separation distance either side of the crossing. 		

Electrical safety and measures to avoid / reduce electromagnetic disturbances may produce different segregation or separation requirements; the electrical installation shall meet both requirements.

2E-15 EARTHING & BONDING

This shall be provided in accordance with BS EN 50310, BS EN 50174, BS 7430, BS 7671 and all supporting IET documentation.

The following definitions apply: -

- 1) Supply system earthing – Where a connection is provided between the source of energy (e.g. generator winding) and the general mass of earth via a source electrode.
- 2) Electrical installation earthing – Where the exposed-conductive-parts of an installation are connected to an appropriate means of earthing at the origin of the installation e.g. MET.

For intakes at LV, the DNO is normally responsible for supply system earthing and the provision of a connection for the MET.

All earthing and bonding cabling shall be LSZH (LSOH, OHLS) with emissions of hydrogen chloride gas < 0.5%.

2E-15-1 EARTHING ARRANGEMENTS

Dependent on the installation earthing arrangements, METs shall be connected to earth by one of the following methods as required by BS 7671:

- 1) TN-S, to the earthed point of the source of energy, may partly be formed by the DNO's lines and equipment.
- 2) TN-C-S, where protective multiple earthing is provided, by the DNO to the neutral of the source of energy.
- 3) TT and IT, via an earthing conductor to an earth electrode.

Earth electrodes shall be provided in accordance with BS 7671 and shall be from the following types: -

- 1) Earth rods or pipes.
- 2) Earth tapes or wire.
- 3) Earth plates.
- 4) Underground structural metalwork embedded in foundations (e.g. piling) or other metalwork installed in the foundations.
- 5) Welded metal reinforcement of concrete (except pre-stressed concrete) embedded in the ground.
- 6) Lead sheaths and other metal coverings of cables (existing installations only).
- 7) Other suitable underground metalwork.

The following shall not be used as an earth electrode: -

- 1) Metallic pipework for gases or flammable liquids.
- 2) Metallic pipework of a water utility supply.

Metal objects immersed into water shall not be used as earth electrodes.

2E-15-2 PROTECTIVE CONDUCTORS

The term protective conductor applies to the following: -

- 1) Earthing conductors.
- 2) Protective equipotential bonding conductors.
- 3) Supplementary protective equipotential bonding conductors.
- 4) Circuit protective conductors.

The following shall not be used as protective conductors: -

- 1) Gas pipes.
- 2) Oil pipes.
- 3) Flexible or pliable conduits.
- 4) Support wires or other flexible metallic parts.
- 5) Constructional parts subject to mechanical stress in normal service.

Although permissible by BS 7671 the metal enclosures or frames of low voltage switch panels, control gear assemblies and busbar trunking systems shall not be used as protective conductors.

2E-15-3 EARTHING CONDUCTORS

Earthing conductors and connections shall be suitably protected against mechanical damage and corrosion and be suitably labelled.

2E-15-4 MAIN EARTH TERMINALS (MET)

An MET shall be provided to all electrical installations for connection of the following to the main earthing conductor: -

- 1) Circuit protective conductors.
- 2) Main protective bonding conductors.

- 3) Functional earthing conductors (if required).
- 4) Lightning protection system bonding conductors (if any).
- 5) Metallic sheath of incoming telecommunications cables (where agreed).
- 6) Telecommunications bonding conductors from telecommunications PBB (if required).

Main protective equipotential bonding conductors shall be provided from the following metallic extraneous-conductive-parts to the MET: -

- 1) Water installation pipes.
- 2) Gas installation pipes.
- 3) Fuel oil pipes.
- 4) District heating pipes.
- 5) Steam pipes.
- 6) Laboratory and medical gases.
- 7) Mechanical service installation pipework and ducting (e.g. ventilation, heating, chilled water etc.)
- 8) Central heating and air conditioning systems.
- 9) Exposed metallic structural parts of the building.

The above shall be applied to each building where the electrical installation serves more than one building.

Where agreed with the service provider / owner, the metallic sheath of incoming telecommunications cables shall also be equipotential bonded to the MET.

Where the service provider / owner will not give permission for equipotential bonding to be undertaken this must be recorded within the description section of the appropriate electrical installation certificates.

Lightning protection systems shall also be connected to the MET.

Disconnection of the main earthing conductor shall be provided to facilitate measurement of the earthing arrangements. This may be provided as part of the main earthing terminal (MET) in the form of a bolted disconnection test link. It shall only be possible to remove disconnection joints / links by means of a tool.

Where non-metallic pipes (e.g. plastic) enter the building and are then connected to metallic pipes within the building(s) the metallic pipes within the building will not normally require protective equipotential bonding as they are unlikely to be extraneous conductive parts, the Contractor shall confirm this requirement.

2E-15-5 TELECOMMUNICATION PRIMARY BONDING BUSBARS (PBB)

Each building / installation shall be provided with a PBB which shall be connected to the electrical installation main MET as part of a dedicated telecommunications bonding network.

2E-15-6 TELECOMMUNICATION SECONDARY BONDING BUSBARS (SBB)

Each telecommunications, server, equipment, communications room (e.g. main equipment rooms (MER's) and secondary equipment rooms (SER's) shall be provided with an SBB as part of the dedicated telecommunications bonding network.

2E-15-7 PROTECTIVE EQUIPOTENTIAL BONDING CONDUCTORS

Main protective equipotential bonding conductors shall be provided from extraneous-conductive-parts to the MET, as detailed above in the section Main Earthing Terminals.

Generally protective equipotential bonding conductors shall be installed on cable support and containment systems, however where they are fixed to the building structure / fabric they shall be supported at spacing's as detailed within IET Guidance Note 8 – Earthing and Bonding.

SIZING OF MAIN PROTECTIVE BONDING CONDUCTORS – WHERE PME CONDITIONS DO NOT APPLY

Where PME conditions do not apply the minimum cross sectional area of main protective bonding conductors shall be in relation to the size of the line and earthing conductors, as detailed in the table below: -

WHERE PME CONDITIONS DO NOT APPLY		
LINE CONDUCTOR CROSS SECTIONAL AREA	EARTHING CONDUCTOR CROSS SECTIONAL AREA	MAIN PROTECTIVE BONDING CONDUCTOR CROSS SECTIONAL AREA
4mm ² to 10mm ²	4mm ² to 10mm ²	6mm ²
16mm ² to 35mm ²	16mm ²	10mm ²
50mm ²	25mm ²	16mm ²
70mm ² to 400mm ²	35mm ² to 240mm ²	25mm ²
Notes: 1) Assumes all conductors are copper. 2) Where an installation serves more than one building, a main protective bonding conductor shall be selected in accordance with the characteristics of the distribution circuit protective conductor for that particular building.		

SIZING OF MAIN PROTECTIVE BONDING CONDUCTORS – WHERE PME CONDITIONS APPLY

Where PME conditions apply the minimum cross-sectional area of main protective bonding conductors shall be in relation to the size of the supply neutral conductor, as detailed in the table below: -

SUPPLY NEUTRAL CONDUCTOR CROSS SECTIONAL AREA	MAIN PROTECTIVE BONDING CONDUCTOR CROSS SECTIONAL AREA
35mm ² or less	10 mm ²
50mm ²	16 mm ²
70mm ² to 95mm ²	25 mm ²
120mm ² to 150mm ²	35 mm ²
Over 150mm ²	50 mm ²
Notes: - 1) Assumes all conductors are copper. 2) DNO conditions may require larger main protective bonding conductors and this should be verified with the DNO.	

METALLIC PIPEWORK

The main bonding connections to water, gas or other services shall be made as near as practicable to the point of entry of that service into the building.

Where there is a meter, isolation point or union the connection shall be made: -

- 1) To the hard metal pipework and before any branch pipework.
- 2) Where the meter is within the building – Where practicable within 600mm of the meter outlet union when the meter is installed within the building
- 3) Where the meter is outside of the building – where the service enters the building.

If an insulating section has been provided to prevent galvanic corrosion the bonding connection shall be to the building side only.

Bonding clamps that comply with BS 951 shall be used to make main bonding connections to metal pipework and shall be selected to suit the environment in which they are installed. Where bonding clamps cannot be used due to the size of the pipework other suitable means of connection shall be provided.

STRUCTURAL STEELWORK

The structural steelwork shall be equipotential bonded using proprietary clamps at regular intervals with final connection to the MET by means of a bolted lug type connection.

TELECOMMUNICATIONS PRIMARY BONDING BUSBARS (PBB)

Telecommunications PBB shall: -

- 1) Be connected to MET using suitably sized TBC. TBC shall be sized in strict accordance with BS EN 50310, shall have a minimum cross-sectional area of 16mm² and shall be pink in colour as required by BS 7671.
- 2) Provide a central connection point for the building / installation TBB.

SECONDARY BONDING BUSBARS (SBB)

SBBs and RBBs shall be provided as follows: -

- 1) Each SBB shall be connected to the building / installation telecommunications PBB using a suitably sized TBB / BBC. TBB / BBC shall be sized in strict accordance with BS EN 50310 and shall have a minimum cross-sectional area of 16mm².
- 2) Each server, equipment, communications rack or cabinet shall have an integral proprietary RBB (vertical and / or horizontal as required) and shall be equipotential bonded in strict accordance with BS EN 50310 and BS EN 50174.
- 3) Cabinet, frame or rack mounted equipment (passive or active) shall be equipotential bonded to the horizontal or vertical rack RBB within in each rack using suitably sized UBC. UBC shall be sized in strict accordance with BS EN 50310 and shall have a minimum cross-sectional area of 4mm².
- 4) All parts of racks including doors, blank panels, gland plates, and any equipment that is provided with earth studs, shall be equipotential bonded individually to the RBB within each rack.
- 5) Each RBB shall be connected to the SBB within the same room using suitably sized RBC. RBC shall be sized in strict accordance with BS EN 50310 and shall have a minimum cross-sectional area of 4mm² for a cabinet, frame or rack of ≤ 21U and 16mm² for a cabinet, frame of rack of > 21U.

PHOTOVOLTAIC SYSTEMS

Earthing and bonding (if required) for the DC side of the PV system shall be provided in strict accordance with BS IEC 62548, BS 7671 and the MCS & ECA – Guide to the Installation of Photovoltaic Systems.

Earthing and bonding to the AC side of the PV system installation shall be provided in strict accordance with BS 7671.

METALLIC CABLE LADDER RACK, CABLE TRAY & CABLE BASKET

All cable ladder rack, cable tray and cable basket / wire mesh systems shall have adequate electrical continuity characteristics as defined in BS EN 61537. A protective bonding conductor shall connect cable ladder rack or cable tray to the main earth terminal (MET) or the equipotential bonding network (for equipotential bonding networks).

The electrical continuity of the cable ladder rack, cable tray and/or basket shall be tested in accordance with BS EN 61537.

METALLIC CABLE TRUNKING

All cable trunking shall: -

- 1) Be equipotential bonded using the manufacturer's proprietary components and fixings in strict accordance with the manufacturer's recommendations and with due allowance made for thermal expansion / contraction.
- 2) Have adequate electrical continuity characteristics as defined in BS EN 50085. A protective bonding conductor shall connect the cable trunking systems to the MET or the equipotential bonding network (for equipotential bonding networks).

The electrical continuity of the cable trunking shall be tested in accordance with BS EN 50085.

METALLIC CONDUIT & FITTINGS

Metallic cable conduit and fittings shall have adequate electrical continuity as defined in BS EN 61386 when connected to cable tray, cable basket and cable trunking. The metallic cable conduit shall be connected to the main earth terminal (MET) via the primary containment systems.

The electrical continuity of the cable conduit shall be tested in accordance with BS EN 61386.

ELECTRICAL EQUIPMENT & WIRING ACCESSORIES

A separate protective conductor shall be run between the earthing terminal within an accessory / equipment and the earthing terminal in the associated back box / enclosure. Notwithstanding Guidance Note 8, a single fixed lug shall not be relied upon as the sole means of continuity.

EMC BONDING NETWORKS

Where EMC equipotential bonding networks are required to avoid / reduce electromagnetic disturbances they shall be detailed elsewhere within this specification.

2E-15-8 SUPPLEMENTARY PROTECTIVE EQUIPOTENTIAL BONDING CONDUCTORS

Supplementary protective equipotential bonding conductors shall be installed between simultaneous accessible exposed-conductive-parts and extraneous-conductive parts, including where practical, the main metallic reinforcement of constructional reinforced concrete.

The equipotential bonding system shall be connected to the protective conductors of all equipment within the area requiring supplementary protective equipotential bonding (including those of socket outlets).

Supplementary protective equipotential bonding shall be provided where additional protection is necessary within special locations as required by Part 7 of BS 7671.

The cross-sectional area of copper supplementary protective equipotential bonding conductors shall be determined from BS 7671, which can be summarised as follows: -

CABLE TYPE / INSTALLATION	SUPPLEMENTARY PROTECTIVE EQUIPOTENTIAL BONDING CONDUCTOR CONNECTION TYPE AND REQUIRED CABLE SIZE		
	TWO EXPOSED- CONDUCTIVE-PARTS	AN EXPOSED- CONDUCTIVE-PART AND AN EXTRANEOUS- CONDUCTIVE-PART	TWO EXTRANEOUS- CONDUCTIVE-PARTS
Sheathed or mechanically protected	Greater than or equal to the cross-sectional area of the circuit protective conductor	Greater than or equal to the cross-sectional area of the circuit protective conductor	Greater than or equal to 2.5mm ²
Non-sheathed single core cabling	Greater than or equal to 4.0mm ²	Greater than or equal to 4.0mm ²	Greater than or equal to 4.0mm ²

Generally metallic ceilings and ceiling grids shall not be supplementary protective equipotential bonded unless detailed elsewhere within this specification.

Where supplementary protective equipotential bonding conductors are fixed to the building structure / fabric they shall be supported at spacing's as detailed within IET Guidance Note 8 – Earthing and Bonding.

2E-15-9 CIRCUIT PROTECTIVE CONDUCTORS

Circuit protective conductors shall only be: -

- 1) Single core insulated cables (e.g. installed within cable trunking or separate CPC's for armoured cables).
- 2) Bare conductor within a multi-core cable (e.g. flat twin and earth).
- 3) Insulated conductor within a multi-core cable (e.g. armoured cable).
- 4) Metallic sheath, screen or armouring of a cable.

Under no circumstances shall cable support and containment systems be used as circuit protective conductors, however they shall be equipotential bonded, have adequate electrical continuity characteristics in accordance with their respective standards.

Where cable containment systems are required to satisfy the requirements for protection against impact, this shall be independent of other CPCs provided.



Circuit protective conductors provided as per items 1 to 3 above shall be suitably terminated into the electrical switchgear or equipment to which their corresponding final circuit relates.

Where the armouring of a cable is to be used as a circuit protective conductor the armouring shall be suitably connected to electrical switchgear, gland plates or trunking using a brass compression cable gland, gland earth tag washer / ring and gland lock nut. The gland earth tag washer / ring shall be fixed using a suitable stud and shall also be connected with a copper protective conductor and cable lug to the switchgear or equipment earth terminal.

2E-15-10 TELECOMMUNICATION BONDING CONDUCTORS (TBC)

Telecommunication bonding conductors (functional earthing conductors) shall be provided in strict accordance with BS EN 50310 and shall be pink in colour as required by BS 7671.

2E-15-11 HIGH INTEGRITY EARTHING

All sockets outlet final circuits shall be provided with high integrity protective conductor connections: -

- 1) Ring final circuits shall be provided with ring protective conductors.
- 2) Radial final circuits shall be provided with dual protective conductors effectively wired in a ring configuration.

All socket outlets (single and twin) shall be provided with dual earth terminals for the separate termination of these.

2E-16 DEFAULT CABLING & CABLE SUPPORT / CONTAINMENT SYSTEMS

The tables below detail the default cabling and support / containment systems that shall be used: -

INTERNAL / EXTERNAL POWER DISTRIBUTION SYSTEMS					
CABLE TYPE & CABLE SUPPORT / CONTAINMENT	HV 11kV	LV TAILS (SEE NOTE 3)	LV TAILS (SEE NOTE 4)	LV MAINS & SUB- MAINS	LV FINAL CIRCUIT
XLPE/SWA multicore armoured cables to BS 6622 / BS 7835 on cable ladder rack	✓	X	X	X	X
XLPE/SWA multicore armoured cables (Aluminium conductors) to BS 6622 / BS 7835 on cable ladder rack	O	X	X	X	X
XLPE/SWA multicore armoured cables to BS 6724 on cable ladder rack	X	O	X	O	X
XLPE/AWA single core armoured cables to BS 6724 on cable ladder rack	X	✓	X	O	X
XLPE/SWA multicore armoured cables to BS 6724 on cable tray	X	O	X	✓	O
XLPE/AWA single core armoured cables to BS 6724 on cable tray	X	O	X	O	X
XLPE split concentric cables to BS 7870-3 on cable tray	X	X	X	O	X
XLPE single core insulated and sheathed cables to BS 7211 on cable tray or in cable trunking	X	X	✓	X	X
6491* single core insulated non-sheathed cables to BS 7211 in metallic cable trunking / metallic conduit / dado with metallic dividers	X	X	X	O	✓
As above however with uPVC conduit replacing metallic conduit	X	X	X	O	O
6242* & 6243* XLPE flat multicore insulated sheathed cables (T&E) to BS 7211/BS 6004 in cable basket / metallic conduit / dado with metallic dividers (see Note 2 below)	X	X	X	X	O
As above however with uPVC conduit replacing metallic conduit	X	X	X	X	O
6242* & 6243* XLPE flat multicore insulated sheathed cables (T&E) to BS 7211/BS 6004 clipped / fixed direct to the building fabric / capping	X	X	X	X	O
Notes: 1) The specification of the Cable Support and Containment Systems is given in a later clause. 2) When installed within a protected escape route, LSZH flat twin and earth (T&E) cabling must be installed within metallic cable trunking / metallic conduit (and not within metallic cable basket / metallic conduit) to comply with the flame propagation requirements of BS 7671.					

INTERNAL / EXTERNAL POWER DISTRIBUTION SYSTEMS					
CABLE TYPE & CABLE SUPPORT / CONTAINMENT	HV 11kV	LV TAILS (SEE NOTE 3)	LV TAILS (SEE NOTE 4)	LV MAINS & SUB- MAINS	LV FINAL CIRCUIT
3) LV tails that connect a transformer to the main LV panel.					
4) LV tails that connect the DNO LV cut-out to the main LV panel.					

BELOW GROUND POWER DISTRIBUTION SYSTEMS					
CABLE TYPE & CABLE SUPPORT / CONTAINMENT	HV 11kV	LV TAILS (NOTE 3)	LV TAILS (NOTE 4)	LV MAINS OR SUB- MAINS	LV FINAL CIRCUIT
XLPE/SWA multicore armoured cables to BS 6622 / BS 7835 buried direct below soft dig/paving in uPVC ducts.	✓	X	X	X	X
XLPE/SWA multicore armoured cables (Aluminium conductors) to BS 6622 / BS 7835 buried direct below soft dig / paving in uPVC ducts.	O	X	X	X	X
XLPE/SWA multicore armoured cables to BS 6724 (suitably approved by the manufacturer for being buried direct in the ground or in ducts) for buried direct below soft dig / paving and in uPVC ducts.	X	O	X	✓	✓
XLPE/SWA multicore armoured cables to BS 5467 buried direct below soft dig / paving and in uPVC ducts.	X	O	X	O	O
XLPE/AWA single core armoured cables to BS 6724 buried direct below soft dig / paving and in uPVC ducts.	X	✓	X	O	X
As above but ducted throughout their length.	O	O	X	O	O

Notes:

- 1) The specification of the Cable Support and Containment Systems is given in a later clause
- 2) Earthenware ducts are required for contaminated ground conditions
- 3) LV tails that connect a transformer to the main LV panel.
- 4) LV tails that connect the DNO LV cut-out to the main LV panel.
- 5) XLPE/SWA/PVC multicore armoured cables must run within the ground for their entire length and terminate into switchgear / equipment at the point of entry into the building. Under no circumstances shall they be run within buildings.

LIFE SAFETY, FIRE-FIGHTING & COMMUNICATION SYSTEMS					
CABLE TYPE AND CABLE SUPPORT / CONTAINMENT	FIRE & SMOKE SYSTEMS	GENERAL ELV	VOICE / DATA	SECURITY SYSTEMS	BMS / CONTROLS
XLPE/LSZH enhanced fire-resistant multicore sheathed cables to BS 7629-1 (classification PH120) on cable tray / metallic conduit.	✓	X	X	X	X
LSZH single core cables to BS 7211 in metal trunking/conduit or dado with metal dividers.	X	✓	X	O	O
LSZH multicore cables on cable tray/metal conduit or in cable basket/metal conduit.	X	O	X	✓	✓
LSZH backbone fibre and copper (Cat 6 etc.) data cables in cable basket / metallic conduit / dado with metallic dividers.	X	X	✓	O	O
Mineral insulated (MICC) cables shall be manufactured to BS EN 60702.	O	X	X	X	X
Notes: <ol style="list-style-type: none"> 1) Voice alarm systems, central battery emergency lighting, evacuation alert systems and other life safety / firefighting cabling shall be as fire alarm systems & EVCS. 2) Disabled persons call system remote combined overdoor lamp / sounder units, remote control panels or when integrated into an EVCS system shall be as fire alarm systems & EVCS. 3) BMS cabling operating at LV shall be wired as LV final circuits. 4) When buried underground the above wiring systems shall be ducted throughout their entire length. 5) Standard fire-resistant cables with PH30 classification shall not be used for fire-fighting / life safety systems. 					

✓	Default cabling/cable support and containment system, shall be included at Tender and used for installation.
O	May only be used when detailed in a subsequent section of this specification and / or on the drawings.
X	Shall not be used.

2E-17 CABLE SUPPORT & CONTAINMENT SYSTEMS

This section of the specification details the general requirements for cable support and containment systems.

2E-17-1 SPARE CAPACITY WITHIN CABLE SUPPORT & CONTAINMENT SYSTEMS

Cable support and containment systems shall be provided with 30% spare capacity and also an additional 30% allowance shall be added to the calculated safe working load (SWL) for supports, for the provision of future cabling.

Prior to installation the Contractor must confirm to the Engineer that the required spare capacity will be achieved.

Where spare capacity is provided to cable ladder rack and cable tray, this shall be a dedicated section of the system and shall not be above or between installed cabling.

2E-17-2 GENERAL REQUIREMENTS FOR CABLE SUPPORT & CONTAINMENT SYSTEMS

All cable support and containment systems shall be provided as follows: -

- 1) They must be fully continuous throughout and utilise (where applicable) couplers, joint strips, connectors, brackets, bends, gussets, clips, clamps, risers, angles, tees, cross pieces, reducers, bell mouths, end caps, conduit boxes, adaptable boxes, conduit take-off plates and fixing components etc. from the same manufacturer.
- 2) Where visible, uPVC systems shall be from the same manufacturer so that variations in colour are avoided. uPVC systems shall not be used within environments that have extreme low or high temperatures.
- 3) Angles, bends, etc. shall be sized to accommodate the minimum bending radius of the largest cabling to be installed, based on the IET On-Site Guide, IET Guidance Note 1 and cabling manufacturer's recommendations.
- 4) Where possible cabling shall retain its position through all bends, tees, cross pieces etc. so that cross overs are minimised.
- 5) All fasteners, screws, bolts, washers, nuts, etc. clips shall be the proprietary type from the same material and manufacturer as the system. These shall not create snags that may cause damage to the cabling.
- 6) Where covers and partitions are specified, they must be from the same material and manufacturer as the system.
- 7) Covers / lids and dividers / partitions shall be fully continuous throughout the entire system. All covers / lids and dividers / partitions shall be fixed using the manufacturers proprietary screw fixings and self-tapping screws shall not be used.
- 8) Covers / lids shall be removable. However, where systems pass through the building fabric the covers / lids shall be cut to project 75mm on either side, remaining fixed when the structure is made good.
- 9) Printed labels shall be fixed at 10m intervals to denote the use of the system. These shall be external to single use systems and attached to partitions on multiple use systems.
- 10) Where galvanised steel systems, fittings or accessories are cut, all burrs must be removed and edges suitably painted with cold galvanise zinc-rich paint before erection. All cuts shall be straight and squared off. Any damage to the galvanised shall be similarly treated.
- 11) Where uPVC systems are cut all burrs must be removed and all cuts shall be straight and squared off where required.
- 12) Proprietary cutters / croppers shall be used in accordance with the manufacturer's recommendations.
- 13) Adequate allowance shall be made for thermal expansion and contraction. Expansion as opposed to rigid couplers shall also be used across expansion joints of the building structure. Connections that provide electrical continuity shall also allow for thermal expansion / contraction.
- 14) Calculations for flexible couplers shall be in accordance with the manufacturer's recommendations.
- 15) Where systems pass through the building(s) suitable measures shall be undertaken to prevent thermal bridging.
- 16) Non-metallic systems shall not be installed external to the building(s) e.g. uPVC conduit and fittings.
- 17) Under no circumstances shall slab fixed cable tie support systems be used.

For the purposes of these documents / specification, all cable support and containment systems indicated on the drawings are classed as 'primary containment' and all additional containment required in order to provide a complete and comprehensive containment installation is deemed to be secondary containment.

2E-17-3 METAL CHANNEL CABLE SUPPORT SYSTEMS & OTHER ASSOCIATED SUPPORTS

Metal channel (e.g. Unistrut) and/or manufacturer's proprietary systems shall be used to support all cable management systems. The former shall comply with BS 6946. The latter shall be provided in strict accordance with the manufacturer's recommendations.

These systems shall be provided as follows: -

- 1) All components shall be formed from steel compliant with BS 1449-1 and shall be hot dip galvanised after manufacture to the requirements of BS EN ISO 1461.
- 2) Supports shall be provided at intervals to prevent excessive deflection of the cable management systems in strict accordance with the manufacturer's recommendations, subject to a maximum interval of 2000mm.
- 3) Supports shall be provided within 300mm of couplers, brackets, bends, risers, tees, crosspieces, reducers and all other fittings. Vertical cable management systems shall be fixed to metal channel at 1500mm centres.
- 4) All cut ends of metal channel shall be painted with cold galvanise zinc-rich paint and be fitted with plastic protective caps.
- 5) Threaded drop rods (minimum 8mm diameter) shall be secured to brackets or supports by vibration proof lock-nuts. All drop rods shall be straight and vertical. Manufacturers' proprietary angle brackets shall be used where necessary. Any projections shall be shortened to within 10mm and fitted with plastic end caps.
- 6) Supports shall not be shared between services unless designed specifically with this in mind.
- 7) Wire suspension systems shall not be used to support primary cable support and containment systems without written authorisation from the Engineer.

2E-17-4 FIRE RESISTANCE OF CABLE SUPPORT & CONTAINMENT SYSTEMS

The fire resistance of cable support and containment systems shall be as follows: -

- 1) All wiring systems shall be adequately supported to prevent premature collapse under fire conditions in strict accordance with BS 7671. Steel cable support and containment systems are deemed to meet this requirement.
Under no circumstances shall: -
 - a) Non-metallic cable clips or cables ties be used as the sole means of support for cables.
 - b) Non-metallic cable trunking be used as the sole means of support of the cables therein.
 - c) Non-metallic cable trunking systems pass through walls, floors or fire compartments.
- 2) All fixing anchors supporting cables or containment systems shall provide equivalent fire resistance. This precludes the use of plastic plugs or similar – all metal fixing anchors shall be used.
- 3) Containment, supports and clips/cleats/ties shall have the same fire survival time as any fire-fighting / life safety cabling that is being supported, in strict accordance with BS 8519, BS 5839 and BS 8629.
- 4) For life safety / fire-fighting cabling they shall be fully continuous throughout from source to destination and shall be formed from steel that has been hot dip galvanised after manufacture to the requirements of BS EN ISO 1461.
- 5) All components shall be sized and selected with consideration for the reduced tensile strength of steel in a fire situation and shall be in accordance with manufacturers' literature.
- 6) The cross-sectional area of drops rods shall be calculated in accordance with BS 8519 and manufacturers' literature.
- 7) Cable cleats and supports for cable management systems shall be provided within 750mm of all fire barrier / stopping seals and shall be able to withstand the mechanical load induced by the collapse of wiring systems on the fire side of the seal, to prevent strain and damage to the seal, as required by BS 7671. This is not required if the seal itself is able to provide adequate support under such conditions.
- 8) Internal fire barriers shall be provided where metallic cable trunking systems pass through walls, floors or fire compartments, these fire barriers shall be rated in accordance with the fire compartmentation. Internal fire barriers shall also be installed within vertical cable trunking systems greater than 5m in height.
- 9) Fully continuous metallic systems that meet the necessary flame propagation requirements (as specified within their respective standards) shall be utilised as opposed to fire-rated clipping, unless agreed with the Engineer via the Contract Administrator.

2E-17-5 CABLE CLEATS & STRAPPING

Cable cleats and strapping shall comply with BS EN IEC 61914 and BS EN IEC 62275, be suitable for the environment in which they are installed, be adequately sized to suit the cable and installed at intervals recommended by the manufacturer. They shall be provided before and after all direction changes.

Where multiple cables share a route they shall run in an orderly manner and retain their positions through direction changes to minimise cross overs.

Cables up to 40mm diameter shall be supported at spacings detailed within the IET On-Site Guide and IET Guidance Note 1. Larger cables shall be supported at spacings as recommended by the manufacturer.

Cable cleats and strapping shall be provided as follows: -

CABLING TYPE / SIZE	CABLE CLEAT / STRAPPING TYPE	FIXING METHOD
Single Core Cables	Aluminium alloy or nylon (LSZH) trefoil cable cleats – suitable for clamping three cables together	Two bolt fixings shall be used for vertical cable runs
Multi-Core Cables up to and including 4 core 70mm ² XLPE/SWA/LSZH multicore armoured cables or equivalent overall diameter	Perforated / pre-drilled galvanised steel / aluminium cable strapping (all round banding), where coated (LSZH) (See notes 1 and 2)	Single bolt fixings to both sides of the cables
Multi-Core Cables greater than 4 core 70mm ² XLPE/SWA/LSZH multicore armoured cables or equivalent overall diameter	Aluminium alloy or nylon (LSZH) claw type cable cleats	Two bolt fixings shall be used for vertical cable runs
Notes: 1) LSZH cable ties may be used instead of metallic cable strapping (all round banding) when agreed with the Engineer via the Contract Administrator. 2) Non-metallic cables ties shall not be used as the sole means of support for cables, including vertical cable runs e.g. cleats must be used to fix cabling to vertical cable tray / building fabric, regardless of cable size.		

2E-17-6 CABLE LADDER RACK SYSTEMS

Cable ladder rack systems, including all fittings and components, shall: -

- 1) Comply with BS EN 61537 and be Extra Heavy-Duty type.
- 2) Be supported on heavy duty trapeze hangers where space allows.
- 3) Be formed from steel sheet compliant with BS 1449-1 and hot dip galvanised after manufacture to the requirements of BS EN ISO 1461. Deep galvanised, pre-galvanised, stainless steel, powder coated, and non-metallic systems shall not be used unless specified elsewhere within this specification.
- 4) Have a free base area to Classification Z as detailed within BS EN 61537.

Cabling shall be fixed to the rack using straps, saddles or cleats depending upon the diameter of the cabling to be installed.

2E-17-7 CABLE TRAY SYSTEMS

Cable tray systems, including all fittings and components shall: -

- 1) Comply with BS EN 61537 and by heavy duty, return flange type (medium duty for fire alarm, EVCS or similar.)
- 2) Be supported from heavy duty trapeze hangers where space allows
- 3) Be formed from steel sheet compliant with BS 1449-1 and be hot dip galvanised after manufacture to the requirements of BS EN ISO 1461. Deep galvanised, pre-galvanised, stainless steel, powder coated and non-metallic systems shall not be used unless specified elsewhere within this specification.
- 4) Be perforated to Classification D as detailed within BS EN 61537.

Cabling shall be fixed to the tray using straps, saddles or cleats depending upon the diameter of the cabling to be installed.

- 5) Conduit take-off plates, shall be utilised to connect conduit to the system.

The cable tray and conduit shall form a fully continuous system throughout from source to destination terminations.

2E-17-8 CABLE BASKET / WIRE MESH TRAY SYSTEMS

Cable basket / wire mesh tray systems shall comply with BS EN 61537 and shall be supported by metal channel and/or manufacturer's proprietary components e.g. cantilever arms, central hangers, suspension hangers, etc.

Where the term cable basket system is used within this specification it also refers to wire mesh cable tray systems.

Cable basket / wire mesh tray systems, including all fittings and components, shall: -

- 1) Comply with BS EN 61537
- 2) Be formed from steel wire welded into a mesh pattern and electro-galvanised after manufacture (electroplated with zinc) to the requirements of BS EN 12329 / BS EN ISO 2081. Deep galvanised, hot dip galvanised, stainless steel, powder coated and non-metallic systems shall not be used unless specified elsewhere within this specification.
- 3) Include bends, risers, tees, cross pieces etc. that are cut / formed on site using proprietary cutters / croppers in strict accordance with the manufacturer's recommendations.
- 4) Include conduit take-off plates to connect conduit to the system, the basket and conduit forming a fully continuous wiring channel from cable source to destination terminations.
Cabling shall be fixed to the basket using cable straps and ties as required.
- 5) Under no circumstances shall systems be used to support armoured cables or be installed external to the building(s).

2E-17-9 CABLE TRUNKING SYSTEMS

GENERAL REQUIREMENTS

Cable trunking systems shall: -

- 1) Be supported at spacings as detailed in the IET On-Site Guide, Guidance Note 1 and manufacturers' recommendations.
- 2) Be sized as detailed within the IET On-Site Guide and IET Guidance Note 1 – Selection & Erection.
- 3) Utilise proprietary multi-compartment bends, tees and cross overs to maintain full segregation throughout.
- 4) Include cable retainers at intervals of 600mm where lids are to the bottom or side of the system.
- 5) Include pin racks on vertical runs at 2m intervals.
- 6) Provide at least the degree of protection of IP4X or IPXXD to BS EN 60529 and require the use of a tool or deliberate action to secure or remove the trunking lid.
- 7) Not be installed external to the building(s).

METALLIC CABLE TRUNKING SYSTEMS

This section of the specification does not apply to metallic dado trunking systems.

Metallic cable trunking systems, including all fittings and accessories, shall: -

- 1) Comply with BS EN 50085.
- 2) Be formed from steel sheet and shall be pre-galvanised before manufacture to the requirements of BS EN 10346. Deep galvanised, hot dip galvanised, stainless steel, powder coated and non-metallic systems shall not be used unless specified elsewhere within this specification.
- 3) Include circular conduit boxes or couplings, brass male bushes and serrated washers to connect conduit to the system, the trunking and conduit forming a fully continuous containment system from cable source to destination terminations.
- 4) Not contain conduits passing through compartments to reach the destination compartment

- 5) Not be used as a circuit protective conductor (CPC) for final circuit wiring, (although shall satisfy the requirements of a protective conductor when used to provide protection against impact).

uPVC CABLE TRUNKING SYSTEMS

This section of the specification does not apply to non-metallic dado trunking systems.

Non-metallic cable trunking systems, including all fittings and components, shall: -

- 1) Comply with BS EN 50085 and BS 4678.
- 2) Be fixed and supported in accordance with manufacturers' recommendation
- 3) Be heavy gauge white uPVC with the following properties: -
 - a) Corrosion resistance.
 - b) High impact resistance.
 - c) Non-flame propagating.
 - d) Self-extinguishing.
- 4) Not be used unless specified elsewhere within this specification and never in conjunction with metal conduit.
- 5) Include manufacturer's proprietary couplers, bends, tees, cross overs, end caps etc. and NOT trunking lengths cut on site to form components.
- 6) Include conduit boxes or couplings / male bushes to connect conduit to the system, the trunking and conduit forming a fully continuous containment system to IP4X or IPXXD from cable source to destination terminations.

2E-17-10 DADO, SKIRTING & BENCH TRUNKING SYSTEMS

GENERAL REQUIREMENTS

- 1) Where applicable the general requirements for cable trunking systems shall also apply.
- 2) Systems shall comply with BS EN 50085 and BS 4678.
- 3) Systems shall be fixed and supported in accordance with manufacturer's recommendations.
- 4) Systems shall be suitable for all the types of cabling to be installed, including the category of data cabling (e.g. Cat 6A) and shall not impair the performance of the cabling.
- 5) Systems shall have a minimum of two compartments and it shall be possible to install manufacturer's proprietary 45mm deep back boxes. (35mm in bench trunking.).
- 6) Signalling and data cabling shall be installed within a separate compartment to LV wiring and steel screening dividers having a minimum thickness of 1.5mm shall be provided.
- 7) Dado and skirting trunking shall include cable retainers at intervals of 600mm.
- 8) Dado and skirting trunking systems shall generally include vertical sections linking to primary containment in the ceiling void. However, where conduit drops are used, these shall be concealed (flush) and connect to the trunking via recessed circular conduit boxes located immediately behind the destination compartment. The number of conduit drops shall be such that 100% spare capacity remains once the specified cables have been installed.

METALLIC DADO, SKIRTING & BENCH TRUNKING SYSTEMS

Metallic dado, skirting and bench trunking systems, including all fittings and components, shall: -

- 1) Be formed from steel sheet and shall be pre-galvanised before manufacture to the requirements of BS EN 10346 (unless Aluminium systems are specified elsewhere in this specification).
- 2) Have a white powder coat finish to RAL 9010 or RAL 9003.
- 3) Include proprietary components selected to suit either dado trunking, skirting or bench trunking systems.

uPVC DADO, SKIRTING & BENCH TRUNKING SYSTEMS

Non-metallic dado, skirting and bench trunking systems shall comply with the requirement given earlier for general uPVC trunking systems and shall include proprietary components selected to suit dado trunking, skirting trunking or bench trunking.

2E-17-11 CONDUIT & FITTINGS

GENERAL REQUIREMENTS

- 1) Conduit sizes and support spacings shall be as detailed within the IET On-Site Guide and IET Guidance Note 1.
- 2) Conduit systems shall include spare capacity so that 30% more cable/s of a similar size and type can be installed.
- 3) Conduits shall be dedicated to a single system/service.
- 4) The conduit system shall include sufficient accessible draw points to facilitate re-wiring or installation of additional cables in the future. Conduit behind inaccessible ceilings shall be configured as a loop-in system.
- 5) Conduits less than 20mm diameter shall not be used.
- 6) Surface conduits shall also be supported within 300mm of floors, ceilings, boxes and at each side of every bend.
- 7) Conduits shall be fixed using spacer bar and/or distance saddles, dependent upon the installation location and connections to conduit boxes / adaptable boxes. Conduits shall be fixed using crampets in wall chases.
- 8) Bends, elbows, tees or u-bends shall not be used. Bends for metallic conduit shall be formed on a proprietary bending machine. uPVC bends shall be formed using a suitably sized spring and by the application of heat.
- 9) Where conduits are installed for use by third parties, draw wires shall be provided to facilitate the installation of cabling.
- 10) All conduit boxes and adaptable boxes shall be filled with moisture repelling compound or have drains where there is a risk of condensation and within plantrooms / external locations all box lids shall be fitted with gaskets. In damp environments conduits shall enter wiring accessories from the bottom to prevent the build-up of moisture.
- 11) Chasing of walls must be carried out in accordance with the Structural Engineer's recommendations. Horizontal chases exceeding 500mm in length or Back to back chasing is not permitted.
- 12) Conduit shall not be installed within floor screeds or cast-in unless detailed elsewhere within this specification.

METALLIC CONDUIT & FITTINGS

Metallic cable conduit shall comply with BS EN 61386 with resistance to corrosion classification of 'Class 4' and shall: -

- 1) Comply with BS EN 61386 and have resistance to corrosion classification 'Class 4'.
- 2) Be formed from heavy gauge steel and hot dip galvanised after manufacture to the requirements of BS EN ISO 1461.
- 3) Connect to accessory boxes on a concealed installation with couplings, brass male bushes and serrated washers. For surfaces installation, flanged couplers with lead washers shall be used.
- 4) Be threaded to butt closely together in couplings and sockets.
- 5) Avoid exposed threads, except at running couplings, where they shall be cleaned, primed and painted with cold galvanise zinc-rich paint after installation.
- 6) NOT include pressed steel accessories and all conduit boxes, adaptor boxes and accessories shall be formed from malleable cast iron.
- 7) NOT be used as a circuit protective conductor (CPC) for final circuit wiring, although shall satisfy the requirements for a protective conductor when used to provide protection against impact.
- 8) Push-fit / quick-fit conduits shall not be used without written authorisation from the Engineer.
- 9) Where push-fit / quick-fit conduits are permitted by the Engineer, they shall utilise grub screws and satisfy the requirements for a protective conductor when used to provide protection against impact.

uPVC CONDUIT & FITTINGS

uPVC conduit and fittings shall be provided as follows: -

- 1) It shall comply with BS EN 61386 and shall be heavy gauge white or black uPVC and have the following properties: -
 - a) Corrosion resistance.
 - b) High impact resistance.
 - c) Non-flame propagating.
 - d) Self-extinguishing.
- 2) It shall not be used unless specified elsewhere within this specification.
- 3) Connections to accessory boxes shall be with couplings / male bushes and care must be taken to ensure that all joints are glued correctly.
- 4) In extremely cold weather the cable conduit shall be slightly warmed before use in accordance with the manufacturer's recommendations.
- 5) Proprietary steel or brass insert clips shall be fitted where luminaires are suspended from circular boxes to ensure that the weight of the luminaires is carried by the structure rather than the conduit box.

FLEXIBLE & PLIABLE CONDUIT

Flexible and pliable conduit shall comply with BS EN 61386 and be provided as follows: -

- 1) Metallic flexible conduit shall be formed from helical coiled steel with an overall waterproof sheath.
- 2) Non-metallic flexible conduit shall be heavy duty, corrosion resistant and non-flame propagating.
- 3) Non-metallic flexible conduit shall not be used unless specified elsewhere within this specification.
- 4) Generally it shall be used for the final connection to the following: -
 - a) Equipment that is required for ducting, pipework etc. such as control sensors, motorised valves etc.
 - b) Equipment subject to vibration e.g. motors, pumps etc.
 - c) Equipment where movement may be required for maintenance / access.
- 5) It shall be connected to conduit boxes and equipment termination boxes using compression glands.
- 6) The length of flexible conduit shall not exceed 1000mm.
- 7) Non-metallic flexible conduit shall not be used in environments where heat may be detrimental to its material properties or where additional mechanical protection may be required.

2E-17-12 BELOW GROUND CABLING

DEPTH REQUIREMENTS

Cabling and ducting shall be buried at the following depths unless detailed elsewhere within this specification and/or drawings. These depths are from final finished ground level and care shall be taken to ensure that this is checked prior to installation.

CABLING TYPE / SIZE	MINIMUM DEPTH OF LAYING
High Voltage – 11kV	800mm
Low Voltage	600mm
Communications	450mm
BT Openreach	450mm

All buried cabling and ducting shall also be provided in accordance with NJUG National Joint Utilities Group guidelines.

EXCAVATION

Excavation shall be provided as follows: -

- 1) All trenches for cables must be straight between points where there are no changes in direction. Trenches must not have step changes in level but be gradual where needed.
- 2) The bottom of trenches must be smooth and free from stones.

- 3) Where excavations reveal unsuitable ground containing rocks or ashes with a predominant or unusual chemical content, or any conditions liable to affect the life or performance of the cable, it must be brought to the attention of the Engineer.
- 4) Means are to be proposed and agreed via the Contract Administrator to minimise the effects on works traffic due to required excavations.
- 5) Where trench depths exceed 1.2m, trench boarding must be provided.
- 6) Where other services are encountered, during excavation, adequate support and protection must be provided particularly when digging, backfilling and cable pulling.
- 7) In conditions which may result in trenches flooding, the provision of pumping equipment must be allowed for. The method of disposing of pumped liquid must be approved.

CABLING IN TRENCHES

Cabling in trenches shall be provided as follows: -

- 1) Cables must be laid in the trenches using roller, or other approved devices, to prevent dragging, and consequent abrasion.
- 2) A minimum horizontal space of 300mm must exist between adjacent cables of differing service unless otherwise specified.
- 3) Cables must be laid on a bed of not less than 100mm of soft sand and covered with a further 150mm of hand compacted soft sand. Sifted soil may be used as an alternative, subject to approval via the Contract Administrator.
- 4) Earthenware or Stokbord, concrete/polypropylene interlocking cover tiles must be laid on the sand/earth directly above and 75mm from the cables, to provide covering at least 50mm wider than the space occupied by the installed cables. The cable tiles must be covered with 75mm of hand compacted, excavated material free from stones or other sharp objects.
- 5) Backfilling must be compacted in layers not deeper than 250mm and the final surface reinstated so that after settlement it must be consistent with the surrounding surface level. Surplus material must be disposed of.
- 6) The excavation must be inspected 12 weeks after the ground finish has been completed, and any hollows must be filled using approved materials and methods.
- 7) Plastic cable marking tape shall be laid at a depth of 200mm, using multiple runs as necessary to cover the width occupied by the cables. The tape must be yellow with black text "CAUTION ELECTRIC CABLE BELOW" printed along its length.
- 8) Where cables are laid along routes on which the ground will not immediately be made up to its final level, the routes must be marked by temporary notices indicating the danger present, over the total length of the route involved.
- 9) All temporary markers must be of a durable weatherproof nature and be approved.
- 10) The ground finish on completion must be similar to that in the immediate area.

CABLE DUCTS

Cable ducts shall be provided as follows: -

- 1) They must be of reputable manufacture, made from uPVC unless otherwise specified and of minimum 150mm diameter.
- 2) Earthenware cable ducts shall be used where there are contaminated ground conditions.
- 3) The ducts must be laid and bedded in such a way as to prevent damage from rocks etc.
- 4) Where cables pass under areas of hard standing or through foundations etc, they must be enclosed in pipe ducts or sleeves. Protection of ducts running under roads etc. shall be by concrete haunchings or other approved suitable means.
- 5) The provision of cable draw pits at points of route deviation, and the transition from open ground to ducts must be agreed via the Contract Administrator. Draw pits shall be suitably sized taking into account the

number, type and size of cables to be installed. Deep draw pits must be of a sufficient size to allow access to the lowest ducts.

- 6) High voltage cables must be run in separate ducts to any low voltage cables.
- 7) Where new ducts clusters are being installed, 25% of the total ways available must be spare, with a minimum of two, unless single way ducts are specified. All spare ducts must be sealed against ingress of water and or vermin, with proprietary products approved by both the duct and cable manufacturer.
- 8) Cable ducts shall be laid at a gradient away from building entries.
- 9) A nylon draw cord must be left in each spare duct for its entire length and in any used ducts with spare capacity.
- 10) Before cables are drawn into any ducts, new or existing, the ducts must be swabbed to ensure that it is free of debris.
- 11) Before cables are drawn into ducts the entry points must be protected by temporary bellmouths to ensure that there is no damage to the outer serving of the cable during the pulling operation.
- 12) Following the drawings in of the cable, the duct must be sealed using materials or devices authorised to provide protection against water, vermin, passage of gases, fire etc. These shall be a proprietary product from a specialist manufacturer such as CSD Sealing Systems Ltd.

2E-17-13 SURFACE / EXPOSED CABLE SUPPORT & CONTAINMENT SYSTEMS

Where surface/exposed primary (e.g. cable ladder, tray and trunking) and secondary (e.g. final conduit runs) containment is acceptable, the location and routing of these systems must be agreed with the Engineer/Contract Administrator prior to installation.

2E-17-14 DESIGN REQUIREMENTS

The Contractor shall assume design responsibility for those aspects of the Electrical installation detailed in Section 1B.

2E-18 CABLING & WIRING SYSTEMS

This section of the specification details the general requirements for cabling and wiring systems.

2E-18-1 DEFINITION OF TERMS

Key definitions applicable to this section of the specification:

ABBREVIATION / MEANING			
AWA	Aluminium wire armour	CSP	Chlorosulphonated polyethylene
CY	Multi-core insulated and sheathed PVC or LSOH cables with internal copper wire braiding	EPR	Ethylene propylene rubber
GSWB	Galvanised steel wire braid	HOFR	Heat oil resistant, flame retardant
LSF	Low smoke and fume	LSOH LSZH OHLS	Low smoke zero halogen – Emissions of hydrogen chloride gas < 0.5%
MI	Mineral insulated	PILC	Paper insulated lead covered cables
PVC	Polyvinyl chloride	SWA	Steel wire armour
SY	Multi-core insulated and sheathed PVC or LSOH cables with external steel wire braiding and outer transparent sheathing	TRS	Tough rubber sheath
XLPE	Cross-linked polyethylene	YY	Multi-core insulated and sheathed PVC or LSOH cables

2E-18-2 GENERAL REQUIREMENTS

All fixed wiring power, control and communication cables shall: -

- 1) Meet the flame propagation requirements of BS EN 60332-1-2 and the BS EN 60332-3 series (where possible).
- 2) Satisfy the requirements of the Construction Products Regulation in respect of their reaction to fire by being provided in strict accordance with their respective European and British.
- 3) Be LSZH (LSOH, OHLS) with emissions of hydrogen chloride gas < 0.5%. (Note: General 'LSF' cabling does not comply).

2E-18-3 MANUFACTURERS' IDENTIFICATION OF CABLES

All cables shall have manufacturers' identification, date of manufacture and a specification reference / standard number printed on the sheath to enable testing, if necessary, and traceability.

2E-18-4 GENERAL LV INSTALLATION CABLES

CABLE TYPE	CABLE SPECIFICATION
Single core armoured cables	694*B XLPE/AWA/LSZH single core armoured cables shall be manufactured to BS 6724.
Multicore armoured cables	694*B XLPE/SWA/LSZH multicore armoured cables shall be manufactured to BS 6724.
Split concentric cables	XLPE/LSZH split concentric cables shall be manufactured to BS 7870-3.
Single core insulated non-sheathed cables	6491B LSZH single core insulated non-sheathed cables shall be manufactured to BS 7211.
Single core insulated sheathed cables	6181B XLPE/LSZH single core insulated sheathed cables shall be manufactured to BS 7211.
Flat insulated sheathed cables – Flat twin and earth cables	6242B & 6243B XLPE/LSZH flat multicore insulated sheathed cables shall be manufactured to BS 7211.
Mineral insulated (MICC) cables	Mineral insulated (MICC) cables shall be manufactured to BS EN 60702.
Flexible plastic cables and cords	LSZH/LSZH flexible plastic cables shall be manufactured to BS EN 50525.
Flexible rubber cables and cords	EPR/HOFR flexible rubber cables and cords shall be manufactured to BS EN 50525. EPR or VIR/TRS flexible rubber cables and cords shall be manufactured to BS EN 50525.
* Denotes the number of cores in a multicore armoured cable and can be 2, 3, 4 or 5 cores.	

2E-18-5 INSTALLATION & USE OF 'NON-STANDARD' CABLES OR CABLES TO BS 8436

Cables for low voltage installation shall be selected from table above. Under no circumstances shall the following cables be used.

- 1) SY cables – LSZH/GSWB/LSZH or PVC/GSWB/PVC – Steel braided, translucent sheath, insulated flexible conductors.
- 2) YY cables – LSZH/LSZH or PVC/PVC – Usually grey sheath, insulated flexible conductors.
- 3) CY cables – LSZH/LSZH or PVC/PVC – Tinned copper wire braid, usually grey sheath, insulated flexible conductors.

Where, S = steel braid, Y = LSZH or PVC, C = copper braid.

SY, CY and YY cables that comply with relevant parts of BS EN 50525 and have LSZH sheaths may be used for ELV controls wiring. However, they must not pass from one fire segregated compartment to another unless they comply with the flame propagation requirements of BS EN 60332-1-2 and the BS EN 60332-3 series (where possible).

2E-18-6 FIRE RESISTANT CABLES FOR LIFE SAFETY & FIRE-FIGHTING APPLICATIONS

Cabling to life safety and fire-fighting equipment shall comply with BS 8519 and all supporting standards / documents, the relevant code of practice(s) appropriate to the application and shall be installed in such a manner that circuit integrity will not be impaired during a fire.

Where primary and secondary power supplies are required, they shall: -

- 1) Both have the same fire survival times
- 2) Each run back to their respective sources using appropriately fire rated cables at every intermediate level of distribution.
- 3) Be suitably separated from each other and have diverse cabling routes.

Cable support and containment systems shall have the same fire survival time as the cabling that is being supported.

All life safety and fire-fighting cabling shall be: -

CABLE TYPE	CABLE SPECIFICATION
Soft skin cables	XLPE/LSZH enhanced fire-resistant cables manufactured to BS 7629-1. Classification PH120 when tested in accordance with BS EN 50200. Resistance to integrated water spray and mechanical shock test to BS 8434-2 (60 mins – fire and mechanical impact, followed by 60 mins – fire, mechanical impact and water). e.g. Draka FT120, Prysmian FP Plus or similar.
Multicore armoured cables	XLPE/SWA/LSZH enhanced fire-resistant armoured power cables manufactured to BS 7846. Classified Category F120 – Resistance to fire with direct mechanical impact and water jet assessed in combination, when tested in accordance with BS 8491 for 120 mins. e.g. Draka FTP120, Prysmian FP600S or similar.
Notes: <ol style="list-style-type: none"> 1) Soft skin cabling for fire alarm, voice alarm, EVCS, evacuation alert systems or similar, shall be red, and conductors shall have a minimum cross-sectional area of 1mm². 2) All life safety / fire-fighting network cabling (e.g. fire alarm, voice alarm, EVCS, evacuation alert systems or similar) shall be soft skin cabling as above. 3) Standard fire-resistant cables with PH30 classification shall not be used. 	

The above cables shall be used for power and control cabling associated with all life safety and fire-fighting applications, including: -

- 1) Fire and smoke alarm systems,
- 2) Emergency evacuation systems, (including central battery emergency lighting),
- 3) Emergency communications systems (including disable refuge alarms).
- 4) Smoke extract or clearance systems (including associated ventilation opening e.g. sliding doors).
- 5) Smoke control systems (including pressurisation systems and zone controlled smoke dampers).
- 6) Automatic fire suppression systems (e.g. water spray, water mist, gas, powder etc.).
- 7) Non-automatic fire suppression systems (pumped wet riser).
- 8) Domestic sprinkler system (including booster sets serving both sprinklers and potable water).
- 9) Automatic fire or smoke barriers (unless these fail safe).

2E-18-7 FIRE PERFORMANCE OF TELECOMMUNICATIONS (VOICE / DATA) CABLING

Telecommunication cables shall satisfy CPR in terms of reaction to fire by being provided in accordance with BS 6701: -

- 1) All internal cabling shall meet the requirements of: -
 - a) EuroClass C_{ca} -s1b, d2, a2 in accordance with BS EN 13501-6.
 - b) BS EN 60332-1-2.
 - c) BS EN 60332-3-24 (where possible).

(This shall include cabling run externally where it enters and runs through buildings to equipment locations but does not apply to cabling run externally which terminates into equipment at the point of entry into a building).
- 2) All other telecommunications cabling shall meet the requirements of:
 - a) EuroClass E_{ca} in accordance with BS EN 13501-6; or
 - b) BS EN 60332-1-2.

2E-18-8 CABLE GLANDS

Cable glands shall be manufactured to BS 6121 and BS EN 62444, and shall be provided as detailed below: -

TECHNICAL DETAILS	CABLE TYPE		
	STEEL WIRE ARMOUR (SWA) CABLES	ALUMINIUM WIRE ARMOUR (AWA) CABLES	WIRE BRAID ARMOUR (GSWB) CY & SY CABLES
Gland type	CW Brass Gland	CW Aluminium Gland	RXT Brass Gland
Ingress protection	IP66 to BS EN 60529	IP66 to BS EN 60529	IP66 to BS EN 60529
Temperature	-20°C to 90°C	-20°C to 90°C	-20°C to 90°C
Gland material	Brass to BS 2874	Aluminium	Brass to BS 2874
Seal material	LSZH silicone	LSZH silicone	LSZH silicone
Shroud material	LSZH silicone	LSZH silicone	LSZH silicone
Shroud colour	Black	Black	Black
Notes: <ol style="list-style-type: none"> 1) To achieve the IP66 rating a sealing washer must be provided between the gland and the housing. 2) An earth tag washer / ring must be provided. 			

Glands for single core AWA cables shall be installed into non-ferromagnetic metal gland plates (e.g. aluminium / brass).

Cable glands for life safety / fire-fighting cabling shall have the same fire survival time as the life safety / fire-fighting cabling being installed. The cable gland shroud shall be the same colour as the life safety / fire-fighting cabling to be installed.

Cable glands for hazardous areas (ATEX and explosive atmospheres) shall be suitably certified for use in that environment.

In other instances, cable glands may be manufactured from durable nylon, however they must provide adequate mechanical protection and be suitably IP rated to suit the environment in which they are installed.

All non-metallic parts to cable glands shall be low smoke zero halogen (LSZH) and shall not be low smoke and fume (LSF).

2E-18-9 TECHNICAL SUBMISSIONS

Prior to installation on-site the Contractor shall provide technical submissions for all cabling and wiring systems to be installed.

The time allowed for comment shall be as detailed within section 1B of this specification.

2E-19 INSTALLATION OF FLAT INSULATED SHEATHED CABLES (FLAT TWIN & EARTH)

This section of the specification details the installation requirements for 6242B and 6243B XLPE/LSZH flat insulated sheathed cables (twin / triple and earth) manufactured to BS 7211 and for 6242Y and 6243Y XLPE/PVC to BS 6004. These clauses only apply if twin and earth is the specified wiring system.

GENERAL REQUIREMENTS

- 1) Twin and earth cabling shall be installed within cable basket and conduit throughout its length.
- 2) If specifically allowed elsewhere within this specification it may be clipped direct.
- 3) Regardless of the above installation methods:
 - a) Cables that are concealed within walls or partitions at a depth of less than 50mm shall be installed within the prescribed zones detailed within BS 7671 and additional protection shall be provided by RCD's
 - b) Cables installed in a wall or partition with an internal construction which includes metallic parts other than just metallic fixings (e.g. metal stud partitions) shall have additional protection provided by RCD's
- 4) Requirements to provide adequate supports to prevent premature collapse under fire conditions as detailed earlier in this section apply equally to twin and earth cabling.
- 5) The exposed circuit protective conductor core shall be provided with green and yellow sleeving to the point of termination which shall be secured in place by means of insulation tape or heat shrink.
- 6) Under no circumstances shall twin and earth cabling be laid on suspended ceilings.

Note: When installed within a protected escape route, LSZH flat twin and earth (T&E) cabling must be installed within metallic cable trunking / metallic conduit (and not within metallic cable basket / metallic conduit) to comply with the flame propagation requirements of BS 7671.

CABLE BASKET & CONDUIT INSTALLATION

The basket and conduit installation given earlier in this section fully applies when it is used for twin and earth cabling.

CLIPPED / FIXED DIRECT INSTALLATION

When twin and earth cabling is clipped / fixed directly to the building fabric the following shall apply: -

- 1) It shall be recessed within the building fabric and shall be adequately supported along its entire length.
- 2) Proprietary LSZH cable clips shall be used.
- 3) Clips shall be provided at no less than 250mm spacing's when horizontal and 400mm spacing's when vertical. Cable clips shall also be provided where the cable bends.
- 4) Under no circumstances shall joists be notched or sawn. Where there are concerns over structural integrity this shall be brought to the attention of the Engineer and Contract Administrator.
- 5) Where a minimum installation depth of 50mm cannot be achieved in joists / battens in ceilings and floors, twin and earth cables must be installed within metallic conduit and must be equipotential bonded.
- 6) All holes in boxes and accessories shall have suitably sized rubber grommets.
- 7) The outer sheath of twin and earth cabling must project at least 10mm into boxes and accessories.
- 8) Cables shall run in continuous lengths between wiring points i.e. without joints or junction boxes.
- 9) When installed within partition walls cables shall be drawn through suitably sized holes in noggins / vertical studs at the centre line of the partition construction.

2E-20 WIRING ACCESSORIES

Wiring accessories shall comply with BS 8300, The Building Regulations – Approved Document M and BS 7671. They shall be IP rated to suit their environment (or maintain IP rating of equipment) and installed in accordance with manufacturers' recommendations.

All flush accessories shall be from a common manufacturer and range to achieve a neat and homogenous appearance. This includes audio visual and voice/data system outlets.

Under no circumstances shall screw less, clip-on accessories be used.

A difference of 30 points in Light Reflectance Value (LRV) shall be provided between wiring accessories and their surroundings.

Unless otherwise specified in the system specific sections, wiring accessories shall be dark grey with white rockers on light coloured surrounds.

The appearance and colour shall be agreed in writing with the Engineer, Architect and Contract Administrator prior to installation.

2E-20-1 TECHNICAL SUBMISSIONS

Prior to installation on-site the Contractor shall provide technical submissions for the following: -

- 1) A schedule (including images) and technical specifications for all wiring accessories, along with a physical sample of each wiring accessory type.
- 2) A physical sample of coloured surrounds / side wings (where called upon elsewhere within this specification).

The time allowed for comment by the Engineer shall be as detailed within section 1B of this specification.

2E-21 POSITIONING & MOUNTING HEIGHTS OF ELECTRICAL SERVICES

Electrical services shall be positioned in accordance with relevant British Standards and in particular BS 8300, and The Building Regulations – Approved Documents M & P.

Compliance with these standards allows a range of mounting heights as shown in the table below, with the preferred height shown underlined. These shall be used as the default heights unless indicated otherwise in system specific sections of this document and the associated drawings, or on architect's room elevation drawings.

All outlet locations shall be marked up on site and agreed with the Engineer/Architect prior to installation.

EQUIPMENT / ACCESSORY	MOUNTING HEIGHT AFFL TO THE CENTRE	NOTES
Metering:		
Metering	<u>1200</u> -1400mm	Readings shall be visible to a person standing or sitting. Prepay meters shall be protected to prevent child tamper.
Lighting:		
Lighting switches and controls	1000 – <u>1200</u> mm	Horizontally aligned with door handles (TBC).
Lighting switches for public use	900 – <u>1100</u> mm	Horizontally aligned with door handles (TBC).
Lighting pull cords	<u>1000</u> – 1200mm	Bottom of the pull cord to be located within this range.
Outlets:		
13A socket or data/voice outlets	<u>450</u> – 1000mm	Or 150mm above desks/worktops (1050mm max)
Shaver socket outlets	800 – <u>1000</u> mm	Generally, to one side of a mirror.
Bathrooms for wheelchair uses:		
Switches, sockets, stopcocks and controls	700 – <u>1000</u> mm	Outlets switches and controls shall be a minimum of 300mm from the corners of the room.
General:		

EQUIPMENT / ACCESSORY	MOUNTING HEIGHT AFFL TO THE CENTRE	NOTES
Isolators, switches and controls	1200mm	Dependent on equipment being supplied.
Domestic consumer units	1350 – <u>1450</u> mm	To centre of isolator/lowest row of protective devices
Cooker control units	750 – <u>1200</u> mm	At least 100mm from the edge of the cooker hob.
Clocks	2500mm	Or 150mm from the top of the clock to the ceiling
Fire alarm:		
Fire alarm control panels	1200mm	At main entrance agreed central control point.
Manual call points	1200mm	
Visual alarm devices	Not less than 2100mm	Dependent on manufacturer to achieve compliance.
Optical beam detectors	Not less than 2700mm	
Evacuation alert system:		
Evacuation alert control panels	See Notes	Topmost manual control of the control panel shall be located at 2.2m AFFL with a minimum space of 100mm above the EACIE to accommodate its enclosure. Control panels shall be entirely enclosed within a cabinet with the bottom edge of the cabinet located at least 1.4m AFFL.
Evacuation alert devices / sounders	See Notes	Installed on walls at a height of not more than 150mm below ceiling level or on ceilings.
Door entry and access control:		
Proximity reader (card / fob) / release push button / activation pad	900 – <u>1100</u> mm	Preferably adjacent to the door handle and within 200mm of the door frame.
Swipe insertion-type reader	900 – <u>1000</u> mm	As above.
Green emergency break glass	1000 – 1200mm	To align with other door access devices.
Emergency assistance alarm systems:		
Emergency assistance pull cord	<u>800</u> – 1000mm & <u>100</u> mm	Two red bangles, one at each of the heights given.
Emergency assistance reset button	800 – <u>1000</u> mm	
Emergency voice communication systems (EVCS) – Disabled refuge systems:		
Main station / control panels	1200mm	Generally adjacent to the fire alarm panel
Outstations	1200mm	

EQUIPMENT / ACCESSORY	MOUNTING HEIGHT AFFL TO THE CENTRE	NOTES
Fire-fighting:		
Fire-fighters switches	1200mm when internal 2750mm when external	Adjacent to fire alarm panel (where internal)
Intruder alarm:		
Intruder alarm control panels and keypads	1200mm	
Electric vehicle charging systems:		
Socket outlets	750 – <u>1200</u> mm	
Equipment with visual displays, however no controls, switches or pushbuttons:		
Equipment with visual displays	1200 – <u>1400</u> mm	
Emergency lighting:		
Emergency lighting luminaires	Not less than 2000mm	
Mechanical services controls:		
Heating and ventilation controls	750 – <u>1000</u> mm	See also Controls section of this specification.
Notes:		
1) Outlets and controls shall be a minimum of 350mm from the corners of a room or area, unless otherwise stated. 2) Electrical equipment / accessories of the same type shall be mounted at the same height throughout the building. 3) The mounting heights for fire alarm and EVCS control panels may be increased based on agreement of the personnel responsible for their management if ratified by the local fire authority / building control.		

2E-22 ENGINEERS & ARCHITECTS DRAWINGS

All visible elements of the electrical installation shall be set out as detailed on agreed Architect's/Specialist's elevation drawings. In the absence of these the Contractor shall produce elevation drawings for approval.

Any discrepancies between the elevation drawings and this specification (e.g. mounting heights) this shall be brought to the attention of the Contract Administrator for further guidance/instruction.

The symbols used on the Engineer's drawings are not to scale so allowance shall be made for locating any item within a 1000mm radius of the indicated position at no further cost.

The above submissions and liaison shall take place in a timely manner to suit the construction programme.

2E-23 FIXINGS TO THE BUILDING STRUCTURE / FABRIC

These shall comply with BS 5080, BS 8000, BS 8539, BS 7671 and all supporting IET documentation.

Fixings shall not compromise the structural, acoustic or fire performance of the building. The following fixing methods are likely to be acceptable: -

FIXING APPLICATIONS / BASE MATERIALS	FIXING TYPE
Building structural steelwork	Clamp-on bracketry e.g. flange clamps
Heavy loads to concrete, blockwork and brickwork	Proprietary fixings such as metallic expansion anchors / bolts
Light loads to concrete, blockwork and brickwork	Proprietary fixings such as metallic expansion anchors/bolts, plugs/screws

FIXING APPLICATIONS / BASE MATERIALS	FIXING TYPE
Plasterboard	Wooden patresses, noggins and battens with wood screws Proprietary fixings such as expansion plugs / screws, self-drive fixings, plastic toggles, spring toggles, etc.
Wood	Screws

The following fixing methods are not acceptable: -

FIXING APPLICATIONS / BASE MATERIALS	FIXING TYPE
Building structural steelwork	Cutting and drilling of the buildings structural steelwork
Building structural steelwork	Welding to the buildings structural steelwork
Blockwork and brickwork	Fixings to blockwork and brickwork in the mortar joint.

All fixing anchors supporting cables shall provide fire resistance so as to prevent their premature collapse during a fire as detailed earlier.

2E-24 ROOM DATA SHEETS (WHERE PROVIDED)

Power supplies, electrical equipment, wiring accessories etc. shall be provided as detailed on the room data sheets.

Any discrepancies between the rooms data sheets and the Architect's / Engineer's drawings / specifications shall be brought to the attention of the Contract Administrator and written confirmation obtained prior to submission of tender costs to clarify the requirements, and in the absence of such the more onerous requirements shall be included.

2E-25 ELECTRICAL EQUIPMENT AND SPECIALISTS SCHEDULES

The appendices to subsequent sections of this specification include Electrical Equipment & Specialists Schedules which detail specialists, manufacturers, product ranges and materials (where applicable) that shall be included in the tender submission.

Where possible a number of suppliers have been provided for items of equipment to give a reasonable choice to the Contractor.

Where more than one specialist, manufacturer, product range or material is specified, this may be due to: -

- 1) Alternatives not being available which are equivalent.
- 2) To match existing site installations or site standards.
- 3) Specification by the Employer.

Reference shall be made to Section 1B with regards to the proposal of alternative equipment.

Section 4

Energy Metering



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4-1 GENERAL REQUIREMENTS

The energy metering systems required for this project shall be designed, installed and commissioned to allow the client to measure utility and energy use in the building.

It is essential to the successful operation that the meters and meter reading system be procured from the same single source.

The energy metering system shall be a standalone system that shall be totally independent of the building management system.

The energy metering system shall be fully compliant with all relevant Regulations and Standards as listed below in 'Standards Applicable'.

4-2 DEFINITIONS

Refer to Section 1B for general definitions plus:

DEFINITIONS			
BCO	Building Control Officer	HWSR	Hot Water Service Return
BCWS	Boosted Cold Water Service	LTHW	Low Temperature Hot Water
BMS	Building Management System	MCWS	Mains Cold Water Service
COW	Clerk Of Works	NDBSCG	Non Domestic Building Services Compliance Guide
CV	Check Valve	O&M	Operation and Maintenance Manual
DEC	Displayed Energy Certificate	RDS	Room Data Sheets
DRV	Double Regulating Valve	TMV	Thermostatic Mixing Valve
EPC	Energy Performance Certificate	VAV	Variable Air Volume
Engineer	Engineer representative from Couch Perry & Wilkes LLP	VFC	Volt Free Contacts
HWSF	Hot Water Service Flow	WRAS	Water Regulation Advisory Scheme

4-3 REFERENCE TO OTHER SECTIONS OF THIS SPECIFICATION

This section of the specification shall not be used in isolation and must be read in conjunction with the particular sections, commissioning and standard clauses, all of which define further the requirements for the installations.

The following text advises if the Contractor shall deviate from the preferred materials and standard or utilise one of the alternative materials and standards of construction listed in the 'General Installation Standards' sections detailed earlier in this specification. Agreed alternative materials for the installation from the preferred standard material and standard of construction are:

No deviation from the 'General Installation Standards' section preferred material and jointing method requirements.

'General Installation Standards' Sections provides all necessary details on pipework and valve materials and performance requirements that apply to this section.

4-4 STANDARDS APPLICABLE

Works shall be completed in accordance with all applicable industry standards. Some of the most relevant standards associated with this section are scheduled below:

STANDARDS	
BSRIA Commissioning Codes	Building Regulations, particularly Part L2
CIBSE Commissioning Codes	CIBSE CP1 – Heat Networks Code of Practice

STANDARDS	
CIBSE Guide H – Control Systems	CIBSE TM39 – Building Energy Metering
Heat Network (Metering and Billing) Regulations	Pressure Equipment Regulations & amendments

Where the above standards refer to supporting documentation and standards these shall be fully complied with in all respects.

Where discrepancy is found between this specification and the relevant standards, the Contractor shall obtain written clarification from the Engineer prior to submission of the tender. Where a discrepancy has not been clarified prior to tender submission, the Contractor shall include the most onerous requirements.

4-5 SCOPE OF WORKS

The following brief description lists the requirement for the energy metering system on this project. System requirements are detailed in this specification together with schematic and design drawings.

The energy metering installation shall include for all necessary tools, labour, materials and equipment to design, supply, install, commission and put into operation the energy metering system to meet the following requirements:

- 1) Fully comply with Part L2 of the Building Regulations.
- 2) Fully comply with recommendations detailed in CIBSE TM39.
- 3) Fully comply with the Heat Network (Metering and Billing) Regulations.
- 4) Be a fully independent system from the Building Management System
- 5) Water flow meters to the domestic cold water services.
- 6) Natural gas meters to all main equipment.
- 7) Liaison with other trades on site.
- 8) Copies of Operating and Maintenance instruction manuals including a 'brief description' of services and fault finding information list of spares, emergency telephone Nos. etc.
- 9) Full user instruction, both written and in the form of demonstrations.
- 10) Provide all necessary information for inclusion in the Building Log Book.
- 11) Complete electrical installation works associated with this Section of the Specification including all cabling, local isolation and protective devices.
- 12) Development of the Consultants drawings and detailing from the base tender information to full construction standards as detailed previously. This shall include responsibility for the following areas:-
 - a) Final co-ordination of the mechanical and electrical services including the preparation of completely dimensioned double line services fabrication drawings.
 - b) Development of the Consultants' details for equipment specified to achieve the criteria described within the tender documents.
 - c) Development of the controls specification for the hardware, software, power, controls wiring and all associated equipment.

4-6 PARTICULAR REQUIREMENTS

The energy metering systems shall be provided by:

- Gretton Ward Electrical Limited

The tender drawings and schematics show the main energy meters that are believed to be needed for the project however the energy metering specialist shall be responsible for assessing and providing all necessary meters for a fully compliant design based on the completed systems design. All costs associated with providing all necessary meters and associated works shall be included at tender.

4-7 INCOMING SERVICES METERING

Flow meters shall be provided where services enter the building, these shall be provided irrespective of whether separate meters are also being provided by the utility companies for their billing purposes. These client owned flow meters are required to provide overall water use by the project to allow the client to:

- 1) Review the accuracy of the utility company or other charged utility use.
- 2) Review the total energy used by all their sub-meters to quickly determine if the total of all sub-meters matches the main meters.

These meters shall be installed above ground at the entry point into the building.

4-8 SUB-METERING

The energy monitoring system shall be fully in accordance with the following specific requirements. The meters shall be linked back to the energy monitoring head end.

All new meters shall be monitored and logged at intervals agreed with the client. For tender allow for meter readings to be logged and collated every 10 minutes and sufficient system capacity to store meter readings.

The selection of the correct type of gas and water meter and ancillary equipment is important to ensure all gas and water use is monitored, inappropriate meter selections may result in some of the gas or water usage may not be monitored. The specific type of meter selected will depend on:

- Minimum and Maximum Flow. It is imperative the meter is capable of reading from minimum to maximum flow.
- Turndown Ratio.
- Type of gas equipment (Boiler Load, CHP load) / water demand.

All meters shall be certified as MID approved for commercial and industrial billing purposes.

All meters shall be provided by the Mechanical Contractor except for the meters within the main electrical LV panel and distribution board meters.

Energy meters shall be manufactured by the following and installed fully in accordance with the manufacturer's recommendations:

WATER METERS	
MANUFACTURER	MODEL
Siemens	MAG5100 series or similar and appropriate transmitter, especially where there is a risk of fouling
Itron	Woltex M MID Version with integral reading and output
Itron	Aquadis+ (residential type use)
Senus	accuMAG with integral metering

HEAT METERS	
MANUFACTURER	MODEL
Kamstrup	Multical 603 and 803 (The 803 particularly for environments that are or could be subject to dust, and humidity) with Ultraflow sensors and integral loggers
Itron	CF Echo II with integral calculator

ELECTRICAL METERS	
MANUFACTURER	MODEL
Provided by the Low Voltage (LV) panel manufacturer.	All electrical meters shall be fully compatible with the energy metering system.

4-9 SOFTWARE AND PROGRAMMING

The energy monitoring system shall be provided with all necessary software and software licences for a fully complete and operational system.

The Specialist Contractor shall allow for all necessary programming to calibrate all actual readings with the software and include for a logical easy to understand and interrogate graphical interface on the front end.

4-10 LANDLORD REMOTE READING

Not expected on current scheme, new meters to be provided for new incoming services. To be provided by facility

4-11 METERING COMMISSIONING AND HANDOVER

For all flow meter installed into pipe work to maintain meter accuracy, the meter manufacturer's minimum number of straight pipe diameters of unrestricted pipe lengths before, and after, the meter to provide LAMINAR flow through the meter must be adhered to.

To comply with Health and Safety along with CDM all meter reads outs are to be installed in easily accessible positions to enable the operator to read the meter face to minimise the risk of working at height or back strain etc. To eliminate the risk, a suitable, permanent access platform may be required in exceptional circumstances for maintenance.

The entire energy metering systems shall be fully commissioned fully in accordance with both CIBSE TM 39 and the energy metering system supplier.

Section 5

Enabling and Incoming Services Works

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Section 5 Enabling and Incoming Services Works

Job No. 230114



5-1 GENERAL

This section of the specification identifies the enabling work required for this project as below:-

- 1) Provision of new LV Electrical service to the building from the Client's existing switchpanel to the CTC Building
- 2) Isolate and Strip out of Electrical services installed within the scope areas in the existing building to allow for refurbishment.

5-2 DEFINITIONS

Refer to Preliminary Section for general definitions plus below:

DEFINITIONS	
MCWS	Mains Cold Water Service
HV	High Voltage
LV	Low voltage
LTHW	Low Temperature Hot Water
DNO	Distribution Network Operator

5-3 REFERENCE TO OTHER SECTIONS OF THIS SPECIFICATION

This section of the specification shall not be used in isolation and must be read in conjunction with particular sections, commissioning and standard clauses, all of which define further the requirements for this project.

5-4 STANDARDS APPLICABLE

Works shall be completed in accordance with all applicable industry standards. Some of the most relevant standards associated with this section are scheduled below:

STANDARDS	
Current Building Regulations	Water Regulation Advisor Scheme (WRAS)
CIBSE Guides	BS 1710 Pipework identification
All CIBSE & BSRIA Commissioning Codes	BS 7671 Wiring Regulations
National Joint Utilities Group Guidelines (NJUG)	BS EN 12201 PE 80 pipework (Water)
Water Industry Specifications including WIS 4-08-01 & WIS 4-08-02	BS EN 1555 PE 80 pipework (Gas)
Institute of Gas Engineers and Managers publications (IGEM)	BS EN 9990 – Non Automatic Fire Fighting Systems
Health and Safety Executive Approved Code of Practice L8 Control of Legionella Bacteria in Water Systems	BS EN 5041 – Hydrant Systems
BS 3251 Indicator plates for fire hydrants	BS EN 14384 Pillar Hydrants
BS EN 14339 Underground Fire Hydrants	

Where the above standards refer to supporting documentation and standards these shall be fully complied with in all respects.

Where discrepancy is found between this specification and the relevant standards, the Contractor shall obtain written clarification from the Engineer prior to submission of the tender. Where a discrepancy has not been clarified prior to tender submission, the Contractor shall include the most onerous requirements.

5-5 SCOPE OF WORKS

The following brief description describes the enabling works required for this project. Comprehensive system(s) requirements are detailed in subsequent clauses of this specification and on tender schematic and drawings. The Contractor shall employ Specialist Contractor(s) for each of the system(s) and shall include for all tools, labour, materials and equipment necessary to undertake all installation, modification and/or strip out works as below inclusive of:

- 1) Carry out a Subtronic survey to establish any below ground services
- 2) Carry out full BS7671 test on all services to be retained and re-used
- 3) Isolate and Strip out of all Electrical services installed within the scope of the existing building to allow for refurbishment as detailed on the tender drawings.
- 4) Carry out a survey of the services which are to be stripped out. (i.e. Electrical Systems) prior to any modification works taking place. The tender information is based on a visual inspection, final survey shall be required to assess the quality and condition of the existing infrastructure that is to be re-used.
- 5) Carry out commissioning checks on current installed services to ascertain duties.
- 6) Identify services to be removed and diverted and become conversant with the distribution and existing installation in order that isolation and removals may be undertaken with the minimum disruption to other connected services.
- 7) Allow for the removal from site and disposal of all equipment made redundant under this contract. Ensure that any existing equipment to be retained by the Client for future use is carefully isolated and protected for the duration of the works.
- 8) Allow for a phased stripping out to take place and coordinate with the project phasing instructions and other works taking place on site during this time.

5-6 DRAWING INFORMATION

- 1) Existing Record drawings are included within the tender package. The Contractor shall also allow to carry out survey of the area to verify the information contained.
- 9) The tender drawings indicate the findings from an initial visual inspection carried out during the Employers scheme evaluation process however these are not, nor intended to be, a full comprehensive record of the installed works. The Contractor is required to undertake their own evaluation of the extent of works via record drawings and a site visit and submit appropriate tender costs.
- 10) Record drawings provided for this scheme are dated and indicate some discrepancies between the drawings and current installed services, initial sub-sonic survey drawings are included within the tender package. The Contractor shall allow to undertake a full survey and include for any associated costs within the submitted tender.

5-7 NEW EXTERNAL SERVICES

The following new supplies shall be provided to serve the building:

5-7-1 MAINS COLD WATER SUPPLY

- 1) A new 35mm diameter MCWS for the project shall be extended from the existing site main to the building in the position detailed on the tender drawings.

System Capacity

2.7 m³/hr

35 mm diameter pipe

5-7-1-1 SOIL ANALYSIS

A soil analysis reports shall be carried out to determine if contaminants exist within the ground.

If ground contamination does exist, then Protecta-line pipework, in accordance with the Water Companies requirements shall be installed.

The Contractor shall also make reference to installation clauses of the specification.

5-7-1-2 MAINS COLD WATER PIPEWORK

External below ground pipework shall be:

MDPE – STANDARD PIPEWORK (Non-contaminated ground conditions) shall comply with the following standards:

- 1) Laid in Blue medium density polyethylene pipework, recommended for pressure pipe for cold potable water use.(for nominal sizes 63mm or below / 90-1000mm for underground installation)
- 2) Installed fully in accordance with the manufacturers recommendations and in accordance with Water Board requirements.
- 3) Complete with polyethylene socket and spigot fittings, saddles and drawn bonds for fusion jointing for use with cold potable water PE pressure pipes.
- 4) Polyethylene electrofusion couplers and fittings for cold potable water supply for nominal sizes up to and including 180. Shall be included.
- 5) All joints shall be butt-fusion or electrofusion welded.
- 6) Suitable for the system operating distribution/test pressures.
- 7) Include for all necessary portable welding/generator equipment and for a representative from the manufacturer to give on-site instruction prior to installation.
- 8) Stored on site with taped polythene protective end caps to prevent ingress of dirt and debris.

MDPE – STANDARD JOINTING

The system shall be:

- 1) Jointing system shall be by electro-fusion or butt-fusion methods.
- 9) All fittings to match the tube and to be Water Board approved standard.
- 10) The fusion welding of fittings to be installed by engineers with specialist fusion welding equipment and shall be manufactured approved Contractors.
- 11) Pipes should be cut square to axis and burrs removed and the surface of the pipe to be in contact with fitting shall be scraped to completely remove the surface layer prior to insertion into fitting.
- 12) On all straight pipes above 180mm diameter welding clamps must be used to minimise the risk of accidental movement. Clamps also to be used on all sizes of coiled pipe and where correct pipe alignment is difficult.
- 13) Each and every weld (butt or electro-fusion) shall be recorded using fusion automatic welding equipment bigger hard copies detailing each weld shall be included as part of the Operation and Maintenance Documentation.

Cold water pipework and fittings shall be by one of the following manufacturers:

- Fusion Ltd Tel No 0121 585 1079
- Durapipe Tel No 01543 279909
- Wavin Ltd. Tel No 028 9262 1577

PROTECTA-LINE POLYETHYLENE WATER MAINS (CONTAMINATED GROUND)

Should the soil analysis reports determine that contaminants do exist within the ground, the pipework installed within the service trench shall be:

- 1) A three layer composite pipe consisting of internal standard PE pipe for the conveyance of water, aluminum layer to prevent the ingress of contaminants and an external polyethylene protective layer.
- 14) All fittings, flanges and valves, necessary to complete the installation shall be suitable for this composite pipe installation and Electro-fuse fittings.
- 15) The installation shall be Electro fused utilising the manufacturers recommended procedures and fusion equipment. Underground joints and pipe exposed by peeling the protective layer shall be wrapped with Protecta-line tape in accordance with the manufacturer's instructions.
- 16) All pipework shall be installed in a neat, orderly manner and adequately restricted with suitable anchor points and backfill.

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- 17) At this stage in the project it shall be assumed that the ground is contaminated and therefore Protecta-Line pipework shall be utilised for the external services. The requirements of the installed systems shall be further developed during detailed design by the Contractor

Manufactured by:

- GPS PE Pipe Systems Tel No 01480-442600
- Or equal and approved

Trenching requirements:

- 1) The external trench is excavated having a level base so that the pipework can be laid flat. The trench depth shall provide a minimum cover of 1000 mm to the crown of the water pipework.
- 18) A 150mm deep bedding of sand or pea gravel shall be laid under the barrel of the pipe. The bedding should be properly compacted to provide uniformity of support to the pipe.
- 19) After the pipes have been laid, further bedding material shall be placed around the pipe and compacted in 75mm layers up to a level of 150mm above the top of the pipe.
- 20) To assist the future location/tracing of plastic pipe an approved metallic marker tape shall be laid along the line of main and connected at each end to a hydrant. The marker tape shall be 150mm above pipe.
- 21) The entry positions to the building are correctly positioned.
- 22) All underground valves are housed within proprietary valve chambers.
- 23) Liaison with the local Water Company, Fire Advisor and Drainage Contractors.

5-7-2 ELECTRICAL SERVICES

5-7-2-1 INCOMING ELECTRICAL SUPPLY

New intake services shall be provided with the following characteristics:

- 1) 230 Volts 50 Hz 3 phase 4 wire

Cables entering the building shall be via ducts cast into the slab (min 150mm diameter). For smaller cables these shall rise with slow bends located to allow the cable to rise vertically immediately below the equipment to be served. For larger cables short sections of horizontal ducts shall facilitate a route into cast floor trenches within the electrical plant space, allowing cables to be routed to suit the layout of the space.

Ensure all cable entry points are vermin proof and sealed to prevent water ingress.

5-8 EXISTING SERVICES

5-8-1 STRIPPING OUT/REDUNDANT MATERIALS

Due allowance within this tender for the careful removal, protection and storage of services and equipment to be retained by the Employer for future use shall be included. The Contractor shall be held liable for any damage incurred to equipment to be retained during the removal works associated with this contract.

All redundant plant shall be offered to the Employer / Contract Administrator in the first instance for spares / replacement purposes. Any items not required by the Employer shall be disposed of and removed from site in an appropriate manner.

The removal from site and disposal of all services and equipment made redundant under this contract shall be included within the tender costs

It should be noted that the Contractor shall not place sole reliance for accuracy of existing service installation on the available record drawings and it will be the Contractor's responsibility to 'trace' and identify all services within the refurbishment areas as part of their remit prior to undertaking any isolation of service.

Should, during the stripping out process, inadvertent disruption to adjacent areas take place the Contractor shall, as a priority provide all necessary labour, materials, temporary / permanent connections to restore service. All costs associated with these works shall be provided by the Contractor.

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Where services are removed / stripped out this shall be undertaken in such a manner as to minimise the consequential damage to other services, structures and building fabric. The Contractor shall make all necessary provision for the repair of fixing holes, building etc.

In instances where sinks and basins are required to be removed from the areas encompassed by these works, the Contractor shall make all necessary provision for the stripping out of dead legs, provision of suitable valves, and the flushing and chlorination of the system either partially or fully to suit the system architecture.

Electrical circuits shall generally be removed completely back to the associated final distribution board. In exceptional circumstances, and with explicit agreement with the Engineer, services that are likely to cause damage to existing fabric or major disruption to surrounding accommodation may be partially retained. Any such shall be isolated, made safe in a permanent and proprietary manner, clearly labelled and highlighted on the "as fitted" drawings.

5-8-2 IMPLICATIONS TO ADJACENCIES

It should be noted that certain Mechanical and Electrical systems within adjacent occupied areas may be served from infrastructure emanating from the area designated for these contract works. As a consequence, these systems within adjacent occupied areas required to be retained and re-fed shall be identified, isolated, stripped out (partially or fully) and re-supplied from the new / revised infrastructure locations identified on the accompanying tender drawings.

The Contractor shall, prior to re-energising the services, fully test and commission each complete service to ensure compliance to current statute, British Standards. Should systems fail to meet the requirements of the above the Contractor shall notify the Contract Administrator at the earliest opportunity for guidance and instruction as to how to proceed. All works associated with the re-feeding of services associated with the above shall be fully planned and co-ordinated with the client via the Contract Administrator in a mutually convenient timely manner.

The Contractor shall identify via the Contract Administrator the periods of access to undertake survey works, isolations, diversions, re-testing and final re-energising of the services. It should be noted that these may / will be at the behest of the occupant and may not necessarily be at the optimum time to suit the Contractor. The accompanying outline project programme identifies initial prospective dates although these are subject to future verification.

In carrying out these works, the Contractor shall be responsible for the provision of all materials, access equipment, and careful removal and re-installing of ceilings / wall panelling's etc. Prior to carrying out these works the Contractor shall, in conjunction with the Contract Administrator undertake a condition inspection of the affected areas recording and agreeing any inherent damage, faults etc. The Contract Administrator shall, in the case of system faults instruct the Contractor as to how to proceed.

Failure to carry out the inspections indicated above may render the Contractor liable for any damage identified during the post works inspection by the Contract Administrator.

5-8-3 ISOLATION OF EXISTING SERVICES

The following procedures shall be carried out prior to service isolation.

- 1) Examination of the local site conditions to fully assess the extent and nature of the works. No additional claim from lack of knowledge in these aspects shall be accepted. Following the examination of local site conditions provide detailed method statements of how the intended work is to be undertaken together with all relevant risk assessments.
- 2) Prior to any isolation/ interruption of any existing service notified in writing as to the extent of the isolation. A minimum of 48 hours' notice shall be provided or as dictated by the Employers retained FM systems provider whichever is the greater. No works shall be undertaken until the client has given written approval and a permit to work has been issued.
- 3) The route of services and extent of interruptions shall be established together with the location of isolation valves, if available.
- 4) All isolations and modifications shall be pre-planned, labour resourced, and materials obtained to ensure interruptions are kept to a minimum in certain instances more than one work team may be required.
- 5) General work shall take place during normal working hours and to suit the Contractor's programme.

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- 6) Upon completion of works the existing circuits and supplies shall be reinstated. All services and outlet points connected to the modified services shall be tested to ensure all systems are fully reinstated, re-commissioned and balanced.
- 7) Prior to making any new connections to existing drainage stacks, the contractor shall carryout a high-water pressure jet and CCTV survey all of the existing soil and waste drain points.

5-8-4 SITE SURVEY

The Contractor shall visit the site prior to submitting a tender in order that the total extent of the works involved may be assessed. Due allowance is to be made for any site restrictions, abnormal working heights, problems in dismantling and distributing both items to be re-used and redundant services, and any special bracketing requirements.

It is the Contractor's responsibility to view the site and the existing services in order that any accurate removal costs may be ascertained and no additional monies shall be considered due to non-compliance with this recommendation.

5-9 TESTING AND COMMISSIONING

Testing and commissioning shall be carried out fully in accordance with Standard installation Section of this Specification.

In addition the Contractor shall take water samples from the existing LTHW system and domestic water systems for laboratory analysis to determine the condition of the existing systems and ensure they are not contaminated in anyway.

5-10 MAINTAINING SAFE ACCESS TO OPERATIONAL AREAS

Access to operational areas shall be maintained at all times including all general and emergency access/exit routes. No materials or waste/debris shall be allowed to obstruct these routes.

5-11 ASBESTOS

The Contractor shall note the building may contain asbestos particularly pipe joints/ flanges, service risers (This is not an exhaustive list).

The Contractor shall refer to the Employer's asbestos register and shall obtain all necessary certificates prior to the commencement of the services strip out works to fully understand the extent of any asbestos present on site.

Should the Contractor come in to contact with materials during the refurbishment process that they suspect is asbestos they shall immediately cease works and bring it to the Contractor Administrators attention to arrange analysis.

5-12 IDENTIFICATION OF EXISTING AND NEW SERVICES

The existing services may not be suitably identified; the Contractor shall trace all services to ensure of its identity prior to undertaking any works out on that service/system.

All new and modified services shall be installed with adequate identification to BS 1710 to colour code, label (description of service) and identify direction of flow on all plant and services

5-13 STERILISATION OF PIPEWORK

Sterilisation work on all new and modified cold water services, fittings, valves etc., all fully in accordance with Standard Installation Station of this Specification.

Certificates of sterilisation shall be submitted to the Contract Administrator prior to practical completion. It shall be noted that practical completion will not occur in the absence of said certificates.

All mains prior to use shall be chlorinated and flushed out.

The potable water main shall be pressure tested as stated in the standard specification sections but not chlorinated until the building becomes live.

5-14 BUILDERS WORK

All builders work associated with the services strip out, including making good of any existing penetrations through walls and floors shall be included within the tender submission.

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5-15 TECHNICAL SUBMISSIONS

Refer to contract preliminaries for the Technical Submissions requirements.

Section E1A

Low Voltage Distribution

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E1A-1 GENERAL REQUIREMENTS

This section details the requirements for the Low Voltage (LV) distribution systems and gives the minimum standards of materials and quality that are required.

E1A-2 DEFINITIONS

Refer to Section 2E / Section 1B of this specification and Part 2 of BS 7671 – IET Wiring Regulations – Requirements for Electrical Installations for further details regarding definitions, symbols and abbreviations.

E1A-3 REFERENCES TO OTHER SECTIONS OF THIS SPECIFICATION

This section shall not be read in isolation and must be read in conjunction with all other sections of this specification which define further requirements for the electrical installation.

Section 2E details the default requirements for electrical installation quality standards and materials which shall apply to this section of the specification with deviations to the following:-

- 1) Identification, notices and labelling.
- 2) Cable types and containment.

Further details for these deviations from Section 2E can be found within this section of the specification.

E1A-4 STANDARDS APPLICABLE

Works shall be completed in accordance with all applicable industry standards. Some of the most relevant standards associated with this section are scheduled below:

STANDARDS AND DOCUMENTS	
BS 7671	IET Wiring Regulations – Requirements for Electrical Installations, including all IET Guidance Notes and the IET On Site guide
BEAMA Guide to forms of separation of LV Switchgear and Assemblies to BS EN 61439-2	
All standards, guidance and statutory regulations detailed within Section 2E	
BS EN IEC 61439-1	Low Voltage Switchgear and Control Gear Assemblies – General Rules
BS EN IEC 61439-2	Low Voltage Switchgear and Control Gear Assemblies – Power switchgear and controlgear assemblies
BS EN 61439-3	Low Voltage Switchgear and Control Gear Assemblies – Distribution Boards intended to be operated by ordinary persons
BS EN 61439-6	Low Voltage Switchgear and Control Gear Assemblies – Bus bar trunking systems
BS EN 60898-1	Circuit breakers for overcurrent protection for household and similar installations AC operation
BS EN IEC 60947-1	Low Voltage switchgear and controlgear – General rules
BS EN 60947-2	Circuit breakers for industrial applications
BS EN IEC 60947-3	Switches, disconnectors, switch-disconnectors and fuse combination units
BS EN 60947-6-1	Transfer switching equipment
BS EN 61009	Residual current operated circuit breakers
BS EN 60831	Power Capacitors
BS EN 61111	Electrical Insulated Matting
BS EN 61558	Safety of Power Transformers
BS EN 60529	Degrees of protection provided by enclosures
BS EN 62040	Uninterruptable Power Supplies

STANDARDS AND DOCUMENTS	
BS EN 62053	Electricity Metering Equipment (a.c.)
BS EN 62305	Protection against Lightning
BS IEC 61000	Electromagnetic Compatibility Limits
BS 8519	Selection and installation of fire-resistant power and control cable systems for life safety, fire-fighting and other critical applications. Code of practice.
IEEE-519	Harmonic Limits
HTM 06-01	Electrical Services Supply and Distribution (Healthcare only)

Where the above standards refer to supporting documentation and standards these shall be fully complied with in all respects.

Where discrepancy is found between this specification and the relevant standards, the Contractor shall obtain written clarification from the Engineer prior to submission of the tender. Where a discrepancy has not been clarified prior to tender submission, the Contractor shall include the most onerous requirements.

E1A-5 DESIGN REQUIREMENTS

The Contractor shall undertake the design elements detailed in Section 1B Appendix 1.

E1A-6 PERFORMANCE PARAMETERS AND TECHNICAL REQUIREMENTS

The following fundamental performance parameters shall apply:

- All equipment associated with the LV distribution shall be suitable for the system voltage which is 400V 3 phase, 4 wire 50Hz.
- The neutral conductor/bus bar in all cables/distribution equipment shall be fully rated.

E1A-7 SCOPE OF WORKS

The LV systems installation shall include the provision of the following (where required), as indicated on the LV schematic drawings:-

- 1) Low Voltage Panel board
- 2) Meters
- 3) Surge Protection Devices
- 4) Main and sub-main cabling
- 5) Cable support and containment systems
- 6) Final Distribution boards/Consumer Units
- 7) Main Earthing Terminal
- 8) Main equipotential bonds
- 9) Inspection, testing and commissioning.
- 10) All necessary identification, notices and labelling.
- 11) All necessary O&M information.

It shall be noted the above lists are not exhaustive and reference must be made to all sections of this specification and the associated drawings.

The systems shall be complete and fully operational at the point of handover, including all items detailed in this specification and the associated standards together with any additional items necessary for completion. The systems shall be fully commissioned with protection settings of all devices checked against the agreed Protection Study.

E1A-8 LV PANEL BOARD

Provide LV panelboard(s) as indicated on the schematic drawings and in accordance with this specification. The specific parameters for each switchboard are given in the schedules forming Appendix 1 to this section, and required manufacturers of the boards and relevant components are given in Appendix 2

In all cases LV panelboards shall:

- 1) Be designed and constructed to achieve >25 year life under the anticipated operating conditions
- 2) Provide separation between bus bar chambers, functional units and associated cable terminations to Form 3b Type 2 classification under BS EN 61439-2.
- 3) Be suitable for wall mounting with bottom cable entry/exit.
- 4) Use pan assemblies that are be type tested and ASTA certified.
- 5) Use totally enclosed, fully rated bus bars
- 6) Utilise moulded case breakers for all switching and protective devices
- 7) Utilise 4 pole devices for all intakes or bus couplers
- 8) Be provided with 20% spare outgoing ways, fitting with devices of appropriately mixed ratings
- 9) Be located in plant areas

All MCCB panel boards and MCCB's shall be of the same component manufacturer as the main low voltage switchgear (if present) and shall fully conform to the requirements of BS EN 60439-1 (panel board) and BS EN 60947-2 (MCCB's).

The Contractor shall ensure that all protective devices have an appropriate short circuit withstand capacity for their intended use.

The Contractor shall check that the load is evenly distributed across all phases with a maximum allowable 10% differential following connection of all final equipment.

ENCLOSURES

All MCCB switchboards shall be constructed from sheet steel casings painted to the manufacturers standard colour finish. They shall be surface fixed, including all support brackets etc., required to ensure such.

All MCCB panel boards shall have hinged lockable front covers to prevent unauthorised access complete with 2 No. spare keys for each lock. All locks shall be suited where possible.

Extension boxes shall be fitted to the MCCB panel as required to accommodate the cable sizes specified, and these shall be included in the tender.

In instances where MCCB switchboards or associated distribution equipment is located within areas subject to damp or dusty ambient conditions or in external locations they shall be enclosed within a suitable weather resistant enclosure rated at least IP54. In addition, the enclosure shall incorporate suitable thermostatically controlled ventilation and anti-condensation heating facilities as well as lockable access doors.

TERMINALS

All MCCB boards shall be equipped with sufficient neutral and earth bar terminals to accommodate each circuit outgoing way (including spares) within the distribution board. A protective cover to the neutral bar and terminal shrouds to outgoing ways shall be provided.

METERING

The Contractor shall ensure that all MCCB distribution boards incorporate appropriate multi-function metering in accordance with the details given elsewhere in this specification.

E1A-9 MOULDED CASE CIRCUIT BREAKERS

GENERAL

The moulded case circuit breakers shall:

- Comply with BS EN 60947-2.
- Comply with BS EN 60947-3 where used as switch disconnectors
- Have a rated service breaking capacity (Ics) equal to or greater than 50 kA.

- Have a rated operational voltage of 690V AC (50/60Hz).
- Have a rated insulation voltage of 800V AC (50/60Hz).
- Have rated impulse withstand voltage of 8kV
- Be suitable for isolation, with positive contact indication and lockable in the on and off position
- Be available in fixed or plug-in /withdrawable versions as well as in 3-pole and 4-pole versions.
- Be designed for both vertical and horizontal mounting, without any adverse effect on electrical performance. It shall be possible to supply power either from the upstream or downstream side.
- Provide Class II insulation (according to IEC 60664 standard) between the front and internal power circuits.

CONSTRUCTION, OPERATION, ENVIRONMENT

For maximum safety, the power contacts shall be insulated in an enclosure made of a thermosetting material from other functions such as the operating mechanism, the case, the trip unit and auxiliaries.

The operating mechanism of the moulded case circuit breakers shall be of the quick make, quick break type with fault tripping overriding manual operation. All poles shall operate simultaneously for circuit breaker opening, closing and tripping.

The moulded case circuit breakers shall be actuated by a toggle or handle that clearly indicates the three positions: ON, OFF and TRIPPED.

The moulded case circuit breakers shall be equipped with a "push to trip" button in front to test operation and the opening of the poles.

The circuit breaker rating, the "push to trip" button, outgoing circuit identification and the contact position indication must be clearly visible and accessible from the front, through the front panel or the door of the switchboard.

The moulded case circuit breakers, the current ratings of which are identical with the ratings of their trip units shall ensure discrimination for any fault current up to at least 50kA RMS, with any downstream circuit breaker having a current rating less or equal to 0.4 times that of the upstream circuit breaker.

Following tripping due to electrical faults (overload, short circuit) remote reset shall be inhibited. It shall however, be possible if opening was initiated by a voltage release.

The operating mechanism shall be of the stored energy type only.

The addition of the motor mechanism or a rotary handle shall in no way affect circuit breaker characteristics and shall not mask or block device settings. Only three stable tripping mechanism positions (ON, OFF and TRIPPED) shall be possible with the motor mechanism.

The moulded case circuit breakers shall be designed to enable safe on-site installation of auxiliaries such as voltage releases (shunt and under-voltage releases) and indication switches as follows:-

They shall be separated from power circuits.

- 1) All electrical auxiliaries shall be of the snap-in type and fitted with terminal blocks.
- 10) All auxiliaries shall be common for the entire range.
- 11) Auxiliary function and terminals shall be permanently engraved on the case of the circuit breaker and the auxiliary itself.
- 12) The addition of auxiliaries shall not increase the volume of the circuit breaker.
- 13) The moulded case breakers shall be suitable for operation in an environment that is between -20°C and 40°C without de-rating.

PROTECTION FUNCTIONS

Moulded case circuit breakers of all ratings, apart from those feeding final circuits, shall be equipped with trip units of the electronic type.

The trip units shall not augment overall circuit breaker volume.

Electronic trip units shall be adjustable and it shall be possible to fit seals to prevent unauthorised access to the settings.

Protection settings shall apply to all circuit breaker poles.

It shall be possible to ensure neutral protection. The tripping threshold shall be equal to that of the phases, or to a reduced value (generally half of that of the phases).

Electronic trip units shall possess the following characteristics as a minimum:

- 1) Long time protection (LT) selectable I_r threshold.
- 14) Short time protection (ST) I_m threshold fixed.
- 15) Instantaneous protection with the threshold fixed
- 16) Remotely change status of breaker. Transmit measurements, signal cause of alarms and tripping.

Thermal-magnetic trip units shall be adjustable and it shall be possible to fit lead seals to prevent unauthorised access to the settings.

Protection settings shall apply to all circuit breaker poles.

- 1) Thermal-magnetic units shall have the following minimum characteristics:-
- 17) Adjustable thermal protection.
- 18) Fixed magnetic protection for current ratings up to 100A.
- 19) Adjustable (from 5 to 10 times the current rating) for current ratings greater than 100A.

E1A-10 METERS

Metering shall be provided as indicated on the LV schematic(s) and in accordance with this specification.

Metering shall be:

- 1) Integrated into the main LV switchboard/panel board
- 20) Integrated into the sub distribution boards

Information from the metering shall be

- 1) Read manually by the client
- 21) Connected to the existing site monitoring system

Electricity energy meters shall be of the digital type capable of displaying, logging and outputting the following:

- 1) Phase and line voltages
- 22) Phase and neutral currents
- 23) Frequency per phase
- 24) Instantaneous kVA, kW and kVAr
- 25) Import kVA, kW and kVAr
- 26) Export kVA, kW and kVAr
- 27) Power factor
- 28) Consumption in kWh
- 29) kW maximum demand peak
- 30) kVA maximum demand peak
- 31) kVAr maximum demand peak

All meters shall comply with BS EN 62053 and be suitable for billing purposes with accuracy class 0.5s for active energy metering. All meters shall be provided with Modbus output.

Where the meters are to be located within the low voltage switch panel, the Contractor shall ensure that the panel manufacturer and all stakeholders have carried out all necessary liaison to ensure a fully integrated and co-ordinated installation.

Where the meters are located at distribution boards these shall be enclosed within a proprietary meter housing as part of the distribution board forming one unit. Meter housing to be supplied by the distribution board manufacturer as part of a complete, factory constructed unit.

Meters shall be as follows:

- 1) LV switchgear – Schneider PowerLogic PM5000 range (5110 for general use, 5111 for billing purposes)
- 32) Distribution boards – Schneider Acti 9 iEM3000 range (3255 model if used for billing purposes.)

In addition, each individual lighting circuit shall be metered in accordance with Part L of the Building Regulations. This shall be achieved using Schneider Power Tag energy sensors, or equivalent to suit the distribution board manufacturer. This shall only be omitted if equivalent information is obtainable from the Lighting control system on all circuits.

E1A-11 SURGE PROTECTION

Devices to protect against transient over-voltage shall be provided as indicated on the LV schematics and as detailed in this specification. These shall fully comply with BS 7671 and the recommendations of BS EN 62305.

As a minimum, transient over-voltage protectors shall be provided on all main switchboards and the intake sub-distribution boards in all separate buildings or external locations.

These Surge Protection Devices shall be classed as enhanced SPDs to BS EN 62305, providing:

- 1) Combined equipotential bonding and transient overvoltage protection (Type 1+2 & Type 1+2+3)
- 33) Full mode (common and differential mode) protection, essential to safe guard sensitive electronic equipment from all types of transient overvoltage - lightning & switching
- 34) Effective SPD coordination within a single unit versus installation of multiple standard Type SPDs to protect terminal equipment

Transient over-voltage protectors must not interfere with, or restrict the system's normal operation. They shall not:-

- 1) Corrupt the normal mains power supply during operation.
- 35) Break or shut down the power supply during operation.
- 36) Have an excessive earth leakage current.

The final selection of surge suppression devices shall be confirmed with the Lightning Protection Specialist.

E1A-12 SUB-MAINS CABLING

A complete system of mains and sub-mains distribution cabling shall be provided in accordance with this specification and the associated drawings.

The required standards for sub-mains cabling are given in Section 2E

Cable lengths shall be as short as possible based on the containment routes shown on the drawings.

Sub-main cable sizes, where provided, are based on assumed lengths. Prior to procurement, the Contractor shall provide a schedule of maximum lengths, based on site measurement, in sufficient time to allow a final check on cable sizing to be carried out.

Where these assumed cable lengths are given on the drawings, the above schedule need only cover those that exceed the figures given.

It shall be noted that the submains calculations have been carried out based on the grouping factor assumptions detailed below and care shall be taken to ensure that the installation maintains these spacings:

- Detail installation method e.g. flat touching on tray

Where particular manufacturers are specified for breakers, the cable calculations will have been carried out based on the operating characteristics of these devices and not generic operating characteristics. Alternative devices shall not be used without agreement with the Engineer and costs associated with any such alternative shall include the recalculation exercise and any necessary adjustments to cable sizes.

E1A-13 FINAL DISTRIBUTION BOARDS

Provide final distribution boards for final circuits as detailed on the drawings and this specification, in particular the requirements of Section 2E and of BS EN 61439 Parts 1 & 3.. They shall be from a single manufacturer, with MCB/RCBOs from the same manufacturer.

All boards shall be provided with a main isolator/switch disconnecting all phases present AND the neutral.

Where three phase boards are provided these shall be of a type and pattern to allow three phase outgoing breakers to be fitted.

Miniature circuit breakers shall be of the same manufacturer the ACB/MCCB's and shall comply with BS EN 60898. They shall have a minimum short circuit withstand rating of 10kA.

Residual current circuit breakers with overcurrent (RCBO) shall comply with BS EN 61009 and shall be interchangeable with MCBs, thus taking up a single outgoing single pole way on the board. For tendering purposes it shall be assumed that all outgoing ways may need to be fitted with RCBOs.

A selection of both standard and split load distribution boards shall be provided to enable separate metering of lighting and power loads in accordance with the metering strategy.

All boards shall be fitted with sufficient neutral bar terminals to allow separate connection of the neutral conductor from each outgoing way, including spare ways. All boards shall be fitted with duplicate earth terminal bars to allow separate connection of two circuit protective conductors from each outgoing way, including spare ways.

All boards shall be provided with 25% spare ways which shall be fitted with MCBs of mixed ratings.

In addition, the following shall be provided:

- Lockable covers using suited locks based on site standard

All distribution boards shall preferably be mounted at a height to allow access to all devices without operatives needing to stoop or use stepladders. Any situations where this is not possible shall be brought to the attention of the Engineer.

Where necessary to accommodate the cable sizes detailed, extension chambers and/or additional terminal capacity shall be provided.

E1A-14 EARTHING AND BONDING

Supply, install and test an earthing installation as detailed in this specification as the associated drawings.

A main earth bar shall be provided adjacent to the main LV panel. This shall be interlinked to the panel earth bar using cables sized as indicated on the drawings. The earth bar shall be 50mm x 6mm flat tinned copper appropriately labelled, including labelling of all bonds. The earth bar shall be provided with test links to allow external earth fault loop impedance testing.

Provide main equipotential bonds from the main earth bar to each of the main services detailed in section 2E.

APPENDIX I – LOW VOLTAGE DISTRIBUTION MATERIALS

ITEMS	MANUFACTURER
Panelboards	Schneider Ltd, Eaton Ltd
Moulded Case Circuit Breakers	Schneider – Compact NSX F (36kA) N(50kA) & H (70kA) Frame to suit required breaking capacity
LV Cables, Glands & Lugs	BICC, AEI, Pirelli
Cable Markers	Critchley
Distribution Boards	Schneider Ltd, Eaton Ltd



APPENDIX II – DISTRIBUTION BOARD SCHEDULE

Appendix

[II]

Distribution Board Schedule

Distribution Board Schedules

Job No. 230114



Distribution Board Information											
Board Reference:		DB/GF/01									
Location:		Secondary Intake Room									
Rating, Size and Type:		22-way (14/8) TP&N (Type B) + Split Load Metering									
Incomer:		125A 4-pole Isolating Switch									
Supplied from:		PB/00/01 – Main Panel Board									
Circuit Information											
Way No.	MCB/RCBO Rating (A)	Trip Curve	RCD/RCBO Rating (mA)	RCD/RCBO Type	Number of Poles	Arc Fault Detection	Cable Type	Phase & Neutral (mm²)	CPC (mm²/SWA)	Circuit Configuration	Duty
P/1L1											Spare / Existing
P/1L2	-	-	-	-	-	-	-	-	-	-	Spare / Existing
P/1L3	-	-	-	-	-	-	-	-	-	-	Spare / Existing
P/2L1	-	-	-	-	-	-	-	-	-	-	Spare / Existing
P/2L2	-	-	-	-	-	-	-	-	-	-	Spare / Existing
P/2L3	-	-	-	-	-	-	-	-	-	-	Spare / Existing
P/3L1	-	-	-	-	-	-	-	-	-	-	Spare / Existing
P/3L2	-	-	-	-	-	-	-	-	-	-	Spare / Existing
P/3L3	-	-	-	-	-	-	-	-	-	-	Spare / Existing

Codes:

1 – Cu LS0H Single; 2 – Cu LS0H Multi Flat; 3 – Cu XLPE/SWA/LS0H Armoured; 4 – Cu XLPE/LS0H Soft Skin Fire Rated PH120; 5 – Cu XLPE/SWA/LS0H Armoured Fire Rated F120;
6 – Cu LS0H Flexible; 7 – Cu XLPE/SWA/PVC; R – Radial Final Circuit; RFC – Ring Final Circuit

Distribution Board Schedules

Job No. 230114



Distribution Board Information											
Board Reference:		DB/GF/01									
Location:		Secondary Intake Room									
Rating, Size and Type:		22-way (14/8) TP&N (Type B) + Split Load Metering									
Incomer:		125A 4-pole Isolating Switch									
Supplied from:		PB/00/01 – Main Panel Board									
Circuit Information											
Way No.	MCB/RCBO Rating (A)	Trip Curve	RCD/RCBO Rating (mA)	RCD/RCBO Type	Number of Poles	Arc Fault Detection	Cable Type	Phase & Neutral (mm²)	CPC (mm²/SWA)	Circuit Configuration	Duty
P/4L1	-	-	-	-	-	-	-	-	-	-	Spare / Existing
P/4L2	-	-	-	-	-	-	-	-	-	-	Spare / Existing
P/4L3	-	-	-	-	-	-	-	-	-	-	Spare / Existing
P/5L1	-	-	-	-	-	-	-	-	-	-	Spare / Existing
P/5L2	-	-	-	-	-	-	-	-	-	-	Spare / Existing
P/5L3	-	-	-	-	-	-	-	-	-	-	Spare / Existing
P/6L1	-	-	-	-	-	-	-	-	-	-	Spare / Existing
P/6L2	-	-	-	-	-	-	-	-	-	-	Spare / Existing
P/6L3	-	-	-	-	-	-	-	-	-	-	Spare / Existing

Codes:

1 – Cu LS0H Single; 2 – Cu LS0H Multi Flat; 3 – Cu XLPE/SWA/LS0H Armoured; 4 – Cu XLPE/LS0H Soft Skin Fire Rated PH120; 5 – Cu XLPE/SWA/LS0H Armoured Fire Rated F120; 6 – Cu LS0H Flexible; 7 – Cu XLPE/SWA/PVC; R – Radial Final Circuit; RFC – Ring Final Circuit

Distribution Board Schedules

Job No. 230114



Distribution Board Information											
Board Reference:		DB/GF/01									
Location:		Secondary Intake Room									
Rating, Size and Type:		22-way (14/8) TP&N (Type B) + Split Load Metering									
Incomer:		125A 4-pole Isolating Switch									
Supplied from:		PB/00/01 – Main Panel Board									
Circuit Information											
Way No.	MCB/RCBO Rating (A)	Trip Curve	RCD/RCBO Rating (mA)	RCD/RCBO Type	Number of Poles	Arc Fault Detection	Cable Type	Phase & Neutral (mm²)	CPC (mm²/SWA)	Circuit Configuration	Duty
P/7L1	-	-	-	-	-	-	-	-	-	-	Spare / Existing
P/7L2	-	-	-	-	-	-	-	-	-	-	Spare / Existing
P/7L3	-	-	-	-	-	-	-	-	-	-	Spare / Existing
P/8L1	-	-	-	-	-	-	-	-	-	-	Spare / Existing
P/8L2	-	-	-	-	-	-	-	-	-	-	Spare / Existing
P/8L3	-	-	-	-	-	-	-	-	-	-	Spare / Existing
P/9L1	-	-	-	-	-	-	-	-	-	-	Spare / Existing
P/9L2	-	-	-	-	-	-	-	-	-	-	Spare / Existing
P/9L3	-	-	-	-	-	-	-	-	-	-	Spare / Existing

Codes:

1 – Cu LS0H Single; **2** – Cu LS0H Multi Flat; **3** – Cu XLPE/SWA/LS0H Armoured; **4** – Cu XLPE/LS0H Soft Skin Fire Rated PH120; **5** – Cu XLPE/SWA/LS0H Armoured Fire Rated F120; **6** – Cu LS0H Flexible; **7** – Cu XLPE/SWA/PVC; **R** – Radial Final Circuit; **RFC** – Ring Final Circuit

Distribution Board Schedules

Job No. 230114



Distribution Board Information											
Board Reference:		DB/GF/01									
Location:		Secondary Intake Room									
Rating, Size and Type:		22-way (14/8) TP&N (Type B) + Split Load Metering									
Incomer:		125A 4-pole Isolating Switch									
Supplied from:		PB/00/01 – Main Panel Board									
Circuit Information											
Way No.	MCB/RCBO Rating (A)	Trip Curve	RCD/RCBO Rating (mA)	RCD/RCBO Type	Number of Poles	Arc Fault Detection	Cable Type	Phase & Neutral (mm²)	CPC (mm²/SWA)	Circuit Configuration	Duty
P/10L1	-	-	-	-	-	-	-	-	-	-	Spare / Existing
P/10L2	-	-	-	-	-	-	-	-	-	-	Spare / Existing
P/10L3	-	-	-	-	-	-	-	-	-	-	Spare / Existing
P/11L1	-	-	-	-	-	-	-	-	-	-	Spare / Existing
P/11L2	-	-	-	-	-	-	-	-	-	-	Spare / Existing
P/11L3	-	-	-	-	-	-	-	-	-	-	Spare / Existing
P/12L1	-	-	-	-	-	-	-	-	-	-	Spare / Existing
P/12L2	-	-	-	-	-	-	-	-	-	-	Spare / Existing
P/12L3	-	-	-	-	-	-	-	-	-	-	Spare / Existing

Codes:

1 – Cu LS0H Single; **2** – Cu LS0H Multi Flat; **3** – Cu XLPE/SWA/LS0H Armoured; **4** – Cu XLPE/LS0H Soft Skin Fire Rated PH120; **5** – Cu XLPE/SWA/LS0H Armoured Fire Rated F120;
6 – Cu LS0H Flexible; **7** – Cu XLPE/SWA/PVC; **R** – Radial Final Circuit; **RFC** – Ring Final Circuit

Distribution Board Schedules

Job No. 230114



DISTRIBUTION BOARD INFORMATION											
Board Reference:		DB/GF/01									
Location:		Secondary Intake Room									
Rating, Size and Type:		22-way (14/8) TP&N (Type B) + Split Load Metering									
Incomer:		125A 4-pole Isolating Switch									
Supplied from:		PB/00/01 – Main Panel Board									
CIRCUIT INFORMATION											
Way No.	MCB/RCBO Rating (A)	Trip Curve	RCD/RCBO Rating (mA)	RCD/RCBO Type	Number of Poles	Arc Fault Detection	Cable Type	Phase & Neutral (mm ²)	CPC (mm ² /SWA)	Circuit Configuration	Duty
P/13L1	-	-	-	-	-	-	-	-	-	-	Spare / Existing
P/13L2	-	-	-	-	-	-	-	-	-	-	Spare / Existing
P/13L3	-	-	-	-	-	-	-	-	-	-	Spare / Existing
P/14L123	To be confirmed by manufacturer.										
----- BUSBAR SPLIT -----											
L/1L1	-	-	-	-	-	-	-	-	-	-	Spare / Existing
L/1L2	-	-	-	-	-	-	-	-	-	-	Spare / Existing
L/1L3	-	-	-	-	-	-	-	-	-	-	Spare / Existing
L/2L1	-	-	-	-	-	-	-	-	-	-	Spare / Existing

Codes:

1 – Cu LS0H Single; 2 – Cu LS0H Multi Flat; 3 – Cu XLPE/SWA/LS0H Armoured; 4 – Cu XLPE/LS0H Soft Skin Fire Rated PH120; 5 – Cu XLPE/SWA/LS0H Armoured Fire Rated F120;
6 – Cu LS0H Flexible; 7 – Cu XLPE/SWA/PVC; R – Radial Final Circuit; RFC – Ring Final Circuit

Distribution Board Schedules

Job No. 230114



Distribution Board Information											
Board Reference:		DB/GF/01									
Location:		Secondary Intake Room									
Rating, Size and Type:		22-way (14/8) TP&N (Type B) + Split Load Metering									
Incomer:		125A 4-pole Isolating Switch									
Supplied from:		PB/00/01 – Main Panel Board									
Circuit Information											
Way No.	MCB/RCBO Rating (A)	Trip Curve	RCD/RCBO Rating (mA)	RCD/RCBO Type	Number of Poles	Arc Fault Detection	Cable Type	Phase & Neutral (mm²)	CPC (mm²/SWA)	Circuit Configuration	Duty
L/2L2	-	-	-	-	-	-	-	-	-	-	Spare / Existing
L/2L3	-	-	-	-	-	-	-	-	-	-	Spare / Existing
L/3L1	-	-	-	-	-	-	-	-	-	-	Spare / Existing
L/3L2	-	-	-	-	-	-	-	-	-	-	Spare / Existing
L/3L3	-	-	-	-	-	-	-	-	-	-	Spare / Existing
L/4L1	-	-	-	-	-	-	-	-	-	-	Spare / Existing
L/4L2	-	-	-	-	-	-	-	-	-	-	Spare / Existing
L/4L3	-	-	-	-	-	-	-	-	-	-	Spare / Existing
L/5L1	-	-	-	-	-	-	-	-	-	-	Spare / Existing

Codes:

1 – Cu LS0H Single; **2** – Cu LS0H Multi Flat; **3** – Cu XLPE/SWA/LS0H Armoured; **4** – Cu XLPE/LS0H Soft Skin Fire Rated PH120; **5** – Cu XLPE/SWA/LS0H Armoured Fire Rated F120; **6** – Cu LS0H Flexible; **7** – Cu XLPE/SWA/PVC; **R** – Radial Final Circuit; **RFC** – Ring Final Circuit

Distribution Board Schedules

Job No. 230114



Distribution Board Information											
Board Reference:		DB/GF/01									
Location:		Secondary Intake Room									
Rating, Size and Type:		22-way (14/8) TP&N (Type B) + Split Load Metering									
Incomer:		125A 4-pole Isolating Switch									
Supplied from:		PB/00/01 – Main Panel Board									
Circuit Information											
Way No.	MCB/RCBO Rating (A)	Trip Curve	RCD/RCBO Rating (mA)	RCD/RCBO Type	Number of Poles	Arc Fault Detection	Cable Type	Phase & Neutral (mm ²)	CPC (mm ² /SWA)	Circuit Configuration	Duty
L/5L2	-	-	-	-	-	-	-	-	-	-	Spare / Existing
L/5L3	-	-	-	-	-	-	-	-	-	-	Spare / Existing
L/6L1	-	-	-	-	-	-	-	-	-	-	Spare / Existing
L/6L2	-	-	-	-	-	-	-	-	-	-	Spare / Existing
L/6L3	-	-	-	-	-	-	-	-	-	-	Spare / Existing
L/7L1	-	-	-	-	-	-	-	-	-	-	Spare / Existing
L/7L2	-	-	-	-	-	-	-	-	-	-	Spare / Existing
L/7L3	-	-	-	-	-	-	-	-	-	-	Spare / Existing
L/8L1	-	-	-	-	-	-	-	-	-	-	Spare / Existing

Codes:

1 – Cu LS0H Single; 2 – Cu LS0H Multi Flat; 3 – Cu XLPE/SWA/LS0H Armoured; 4 – Cu XLPE/LS0H Soft Skin Fire Rated PH120; 5 – Cu XLPE/SWA/LS0H Armoured Fire Rated F120; 6 – Cu LS0H Flexible; 7 – Cu XLPE/SWA/PVC; R – Radial Final Circuit; RFC – Ring Final Circuit

Distribution Board Schedules

Job No. 230114



Distribution Board Information											
Board Reference:		DB/GF/01									
Location:		Secondary Intake Room									
Rating, Size and Type:		22-way (14/8) TP&N (Type B) + Split Load Metering									
Incomer:		125A 4-pole Isolating Switch									
Supplied from:		PB/00/01 – Main Panel Board									
Circuit Information											
Way No.	MCB/RCBO Rating (A)	Trip Curve	RCD/RCBO Rating (mA)	RCD/RCBO Type	Number of Poles	Arc Fault Detection	Cable Type	Phase & Neutral (mm²)	CPC (mm²/SWA)	Circuit Configuration	Duty
L/8L2	-	-	-	-	-	-	-	-	-	-	Spare / Existing
L/8L3	-	-	-	-	-	-	-	-	-	-	Spare / Existing

Codes:

1 – Cu LS0H Single; 2 – Cu LS0H Multi Flat; 3 – Cu XLPE/SWA/LS0H Armoured; 4 – Cu XLPE/LS0H Soft Skin Fire Rated PH120; 5 – Cu XLPE/SWA/LS0H Armoured Fire Rated F120; 6 – Cu LS0H Flexible; 7 – Cu XLPE/SWA/PVC; R – Radial Final Circuit; RFC – Ring Final Circuit

Distribution Board Schedules

Job No. 230114



Distribution Board Information											
Board Reference:		DB/GF/02									
Location:		Joinery Store									
Rating, Size and Type:		24-way (14/10) TP&N (Type B) + Split Load Metering									
Incomer:		200A 4-pole Isolating Switch									
Supplied from:		PB/00/01 – Main Panel Board									
Circuit Information											
Way No.	MCB/RCBO Rating (A)	Trip Curve	RCD/RCBO Rating (mA)	RCD/RCBO Type	Number of Poles	Arc Fault Detection	Cable Type	Phase & Neutral (mm ²)	CPC (mm ² /SWA)	Circuit Configuration	Duty
P/1L1	32	B	30	A	2	Yes	1	2.5	2.5	RFC	Socket Room Mechanical Workshop and Store + AFDD space Allowances
P/1L2	32	B	30	A	2	Yes	1	2.5	2.5	RFC	Socket Room Mechanical Workshop + AFDD space Allowances
P/1L3	32	B	30	A	2	Yes	1	2.5	2.5	RFC	Socket Room Mechanical Workshop and Lock Smith + AFDD space Allowances
P/2L1	32	B	30	A	2	Yes	1	2.5	2.5	RFC	Socket Room Electrical Workshop + AFDD space Allowances
P/2L2	32	B	30	A	2	Yes	1	2.5	2.5	RFC	Socket Room AP Office and Paint Store + AFDD space Allowances
P/2L3	32	B	30	A	2	Yes	1	2.5	2.5	RFC	Cleaner's Socket Outlet + AFDD space Allowances
P/3L1	32	B	30	A	2	Yes	1	2.5	2.5	RFC	Cleaner's Socket Outlet + AFDD space Allowances
P/3L2	-	-	-	-	-	-	-	-	-	-	Spare
P/3L3	32	B	30	A	2	Yes	1	2.5	2.5	RFC	Socket Room Joinery Workshop + AFDD space Allowances

Codes:

1 – Cu LS0H Single; 2 – Cu LS0H Multi Flat; 3 – Cu XLPE/SWA/LS0H Armoured; 4 – Cu XLPE/LS0H Soft Skin Fire Rated PH120; 5 – Cu XLPE/SWA/LS0H Armoured Fire Rated F120;
6 – Cu LS0H Flexible; 7 – Cu XLPE/SWA/PVC; R – Radial Final Circuit; RFC – Ring Final Circuit

Distribution Board Schedules

Job No. 230114



Distribution Board Information											
Board Reference:		DB/GF/02									
Location:		Joinery Store									
Rating, Size and Type:		24-way (14/10) TP&N (Type B) + Split Load Metering									
Incomer:		200A 4-pole Isolating Switch									
Supplied from:		PB/00/01 – Main Panel Board									
Circuit Information											
Way No.	MCB/RCBO Rating (A)	Trip Curve	RCD/RCBO Rating (mA)	RCD/RCBO Type	Number of Poles	Arc Fault Detection	Cable Type	Phase & Neutral (mm ²)	CPC (mm ² /SWA)	Circuit Configuration	Duty
P/4L1	20	B	-	-	1	-	1	4	4	R	Access Control Fused Spurs
P/4L2	20	B	-	-	1	-	1	4	4	R	Extract Fan
P/4L3	20	B	-	-	1	-	1	4	4	R	Hand Driers
P/5L1	-	-	-	-	-	-	-	-	-	-	Spare
P/5L2	-	-	-	-	-	-	-	-	-	-	Spare
P/5L3	-	-	-	-	-	-	-	-	-	-	Spare
P/6L1	-	-	-	-	-	-	-	-	-	-	Spare
P/6L2	-	-	-	-	-	-	-	-	-	-	Spare
P/6L3	-	-	-	-	-	-	-	-	-	-	Spare

Codes:

1 – Cu LS0H Single; 2 – Cu LS0H Multi Flat; 3 – Cu XLPE/SWA/LS0H Armoured; 4 – Cu XLPE/LS0H Soft Skin Fire Rated PH120; 5 – Cu XLPE/SWA/LS0H Armoured Fire Rated F120; 6 – Cu LS0H Flexible; 7 – Cu XLPE/SWA/PVC; R – Radial Final Circuit; RFC – Ring Final Circuit

Distribution Board Schedules

Job No. 230114



Distribution Board Information											
Board Reference:		DB/GF/02									
Location:		Joinery Store									
Rating, Size and Type:		24-way (14/10) TP&N (Type B) + Split Load Metering									
Incomer:		200A 4-pole Isolating Switch									
Supplied from:		PB/00/01 – Main Panel Board									
Circuit Information											
Way No.	MCB/RCBO Rating (A)	Trip Curve	RCD/RCBO Rating (mA)	RCD/RCBO Type	Number of Poles	Arc Fault Detection	Cable Type	Phase & Neutral (mm²)	CPC (mm²/SWA)	Circuit Configuration	Duty
P/7L1	40	B	-	-	3	N/A	3	10	10	R	External Dust Extract Unit
P/7L2											
P/7L3											
P/8L1	20	B	-	-	3	N/A	3	4	4	R	Machine Isolator No. 1
P/8L2											
P/8L3											
P/9L1	20	B	-	-	3	N/A	3	4	4	R	Machine Isolator No. 2
P/9L2											
P/9L3											

Codes:

1 – Cu LS0H Single; 2 – Cu LS0H Multi Flat; 3 – Cu XLPE/SWA/LS0H Armoured; 4 – Cu XLPE/LS0H Soft Skin Fire Rated PH120; 5 – Cu XLPE/SWA/LS0H Armoured Fire Rated F120;
6 – Cu LS0H Flexible; 7 – Cu XLPE/SWA/PVC; R – Radial Final Circuit; RFC – Ring Final Circuit

Distribution Board Schedules

Job No. 230114



Distribution Board Information											
Board Reference:		DB/GF/02									
Location:		Joinery Store									
Rating, Size and Type:		24-way (14/10) TP&N (Type B) + Split Load Metering									
Incomer:		200A 4-pole Isolating Switch									
Supplied from:		PB/00/01 – Main Panel Board									
Circuit Information											
Way No.	MCB/RCBO Rating (A)	Trip Curve	RCD/RCBO Rating (mA)	RCD/RCBO Type	Number of Poles	Arc Fault Detection	Cable Type	Phase & Neutral (mm ²)	CPC (mm ² /SWA)	Circuit Configuration	Duty
P/10L1	20	B	-	-	3	N/A	3	4	4	R	Machine Isolator No. 3
P/10L2											
P/10L3											
P/11L1	-	-	-	-	-	-	-	-	-	-	Spare
P/11L2	-	-	-	-	-	-	-	-	-	-	Spare
P/11L3	-	-	-	-	-	-	-	-	-	-	Spare
P/12L1	-	-	-	-	-	-	-	-	-	-	Spare
P/12L2	-	-	-	-	-	-	-	-	-	-	Spare
P/12L3	-	-	-	-	-	-	-	-	-	-	Spare

Codes:

1 – Cu LS0H Single; 2 – Cu LS0H Multi Flat; 3 – Cu XLPE/SWA/LS0H Armoured; 4 – Cu XLPE/LS0H Soft Skin Fire Rated PH120; 5 – Cu XLPE/SWA/LS0H Armoured Fire Rated F120;
6 – Cu LS0H Flexible; 7 – Cu XLPE/SWA/PVC; R – Radial Final Circuit; RFC – Ring Final Circuit

Distribution Board Schedules

Job No. 230114



Distribution Board Information											
Board Reference:		DB/GF/02									
Location:		Joinery Store									
Rating, Size and Type:		24-way (14/10) TP&N (Type B) + Split Load Metering									
Incomer:		200A 4-pole Isolating Switch									
Supplied from:		PB/00/01 – Main Panel Board									
Circuit Information											
Way No.	MCB/RCBO Rating (A)	Trip Curve	RCD/RCBO Rating (mA)	RCD/RCBO Type	Number of Poles	Arc Fault Detection	Cable Type	Phase & Neutral (mm ²)	CPC (mm ² /SWA)	Circuit Configuration	Duty
P/13L1	-	-	-	-	-	-	-	-	-	-	Spare
P/13L2	-	-	-	-	-	-	-	-	-	-	Spare
P/13L3	-	-	-	-	-	-	-	-	-	-	Spare
P/14L123	To be confirmed by manufacturer.									SPD (Type 2)	
----- BUSBAR SPLIT -----											
L/1L1	10	C	-	-	1	-	1	2.5	2.5	R	Lighting Circuit rooms
L/1L2	10	C	-	-	1	-	1	2.5	2.5	R	Lighting Circuit rooms
L/1L3	10	C	-	-	1	-	1	2.5	2.5	R	Lighting Circuit rooms
L/2L1	10	C	-	-	1	-	1	2.5	2.5	R	Lighting Circuit rooms

Codes:

1 – Cu LS0H Single; **2** – Cu LS0H Multi Flat; **3** – Cu XLPE/SWA/LS0H Armoured; **4** – Cu XLPE/LS0H Soft Skin Fire Rated PH120; **5** – Cu XLPE/SWA/LS0H Armoured Fire Rated F120;
6 – Cu LS0H Flexible; **7** – Cu XLPE/SWA/PVC; **R** – Radial Final Circuit; **RFC** – Ring Final Circuit

Distribution Board Schedules

Job No. 230114



Distribution Board Information											
Board Reference:		DB/GF/02									
Location:		Joinery Store									
Rating, Size and Type:		24-way (14/10) TP&N (Type B) + Split Load Metering									
Incomer:		200A 4-pole Isolating Switch									
Supplied from:		PB/00/01 – Main Panel Board									
Circuit Information											
Way No.	MCB/RCBO Rating (A)	Trip Curve	RCD/RCBO Rating (mA)	RCD/RCBO Type	Number of Poles	Arc Fault Detection	Cable Type	Phase & Neutral (mm ²)	CPC (mm ² /SWA)	Circuit Configuration	Duty
L/2L2	10	C	-	-	1	-	1	2.5	2.5	R	Lighting Circuit rooms
L/2L3	10	C	-	-	1	-	1	2.5	2.5	R	Lighting Circuit rooms
L/3L1	10	C	-	-	1	-	1	2.5	2.5	R	Lighting Circuit rooms
L/3L2	10	C	-	-	1	-	1	2.5	2.5	R	Directional Emergency Lighting
L/3L3	10	C	-	-	1	-	1	2.5	2.5	R	External Lighting
L/4L1	10	C	-	-	1	-	1	2.5	2.5	R	External Lighting
L/4L2	10	C	-	-	1	-	1	2.5	2.5	R	Lighting Circuit rooms
L/4L3	10	C	-	-	1	-	1	2.5	2.5	R	Thorlux Lighting Gateway Controller
L/5L1	10	C	-	-	1	-	1	2.5	2.5	R	Contactor Control Circuit

Codes:

1 – Cu LS0H Single; 2 – Cu LS0H Multi Flat; 3 – Cu XLPE/SWA/LS0H Armoured; 4 – Cu XLPE/LS0H Soft Skin Fire Rated PH120; 5 – Cu XLPE/SWA/LS0H Armoured Fire Rated F120; 6 – Cu LS0H Flexible; 7 – Cu XLPE/SWA/PVC; R – Radial Final Circuit; RFC – Ring Final Circuit

Distribution Board Schedules

Job No. 230114



Distribution Board Information											
Board Reference:		DB/GF/02									
Location:		Joinery Store									
Rating, Size and Type:		24-way (14/10) TP&N (Type B) + Split Load Metering									
Incomer:		200A 4-pole Isolating Switch									
Supplied from:		PB/00/01 – Main Panel Board									
Circuit Information											
Way No.	MCB/RCBO Rating (A)	Trip Curve	RCD/RCBO Rating (mA)	RCD/RCBO Type	Number of Poles	Arc Fault Detection	Cable Type	Phase & Neutral (mm²)	CPC (mm²/SWA)	Circuit Configuration	Duty
L/5L2	-	-	-	-	-	-	-	-	-	-	Spare
L/5L3	-	-	-	-	-	-	-	-	-	-	Spare
L/6L1	-	-	-	-	-	-	-	-	-	-	Spare
L/6L2	-	-	-	-	-	-	-	-	-	-	Spare
L/6L3	-	-	-	-	-	-	-	-	-	-	Spare
L/7L1	-	-	-	-	-	-	-	-	-	-	Spare
L/7L2	-	-	-	-	-	-	-	-	-	-	Spare
L/7L3	-	-	-	-	-	-	-	-	-	-	Spare
L/8L1	-	-	-	-	-	-	-	-	-	-	Spare

Codes:

1 – Cu LS0H Single; **2** – Cu LS0H Multi Flat; **3** – Cu XLPE/SWA/LS0H Armoured; **4** – Cu XLPE/LS0H Soft Skin Fire Rated PH120; **5** – Cu XLPE/SWA/LS0H Armoured Fire Rated F120;
6 – Cu LS0H Flexible; **7** – Cu XLPE/SWA/PVC; **R** – Radial Final Circuit; **RFC** – Ring Final Circuit

Distribution Board Schedules

Job No. 230114



Distribution Board Information											
Board Reference:		DB/GF/02									
Location:		Joinery Store									
Rating, Size and Type:		24-way (14/10) TP&N (Type B) + Split Load Metering									
Incomer:		200A 4-pole Isolating Switch									
Supplied from:		PB/00/01 – Main Panel Board									
Circuit Information											
Way No.	MCB/RCBO Rating (A)	Trip Curve	RCD/RCBO Rating (mA)	RCD/RCBO Type	Number of Poles	Arc Fault Detection	Cable Type	Phase & Neutral (mm²)	CPC (mm²/SWA)	Circuit Configuration	Duty
L/8L2	-	-	-	-	-	-	-	-	-	-	Spare
L/8L3	-	-	-	-	-	-	-	-	-	-	Spare
L/9L1	-	-	-	-	-	-	-	-	-	-	Spare
L/9L2	-	-	-	-	-	-	-	-	-	-	Spare
L/9L3	-	-	-	-	-	-	-	-	-	-	Spare
L/10L1	-	-	-	-	-	-	-	-	-	-	Spare
L/10L2	-	-	-	-	-	-	-	-	-	-	Spare
L/10L3	-	-	-	-	-	-	-	-	-	-	Spare

Codes:

1 – Cu LS0H Single; **2** – Cu LS0H Multi Flat; **3** – Cu XLPE/SWA/LS0H Armoured; **4** – Cu XLPE/LS0H Soft Skin Fire Rated PH120; **5** – Cu XLPE/SWA/LS0H Armoured Fire Rated F120; **6** – Cu LS0H Flexible; **7** – Cu XLPE/SWA/PVC; **R** – Radial Final Circuit; **RFC** – Ring Final Circuit

Distribution Board Schedules

Job No. 230114



Distribution Board Information											
Board Reference:		DB/GF/03									
Location:		Plant Room									
Rating, Size and Type:		6-way SP&N (Type A)									
Incomer:		63A 4-pole Isolating Switch									
Supplied from:		PB/00/01 – Main Panel Board									
Circuit Information											
Way No.	MCB/RCBO Rating (A)	Trip Curve	RCD/RCBO Rating (mA)	RCD/RCBO Type	Number of Poles	Arc Fault Detection	Cable Type	Phase & Neutral (mm ²)	CPC (mm ² /SWA)	Circuit Configuration	Duty
1	20	B	-	-	1	-	1	4	4	R	Boiler 01
2	20	B	-	-	1	-	1	4	4	R	Boiler 02
3											Spare
4											Spare
5											Spare
6											Spare

Codes:

1 – Cu LS0H Single; 2 – Cu LS0H Multi Flat; 3 – Cu XLPE/SWA/LS0H Armoured; 4 – Cu XLPE/LS0H Soft Skin Fire Rated PH120; 5 – Cu XLPE/SWA/LS0H Armoured Fire Rated F120; 6 – Cu LS0H Flexible; 7 – Cu XLPE/SWA/PVC; R – Radial Final Circuit; RFC – Ring Final Circuit

Distribution Board Schedules

Job No. 230114



Distribution Board Information											
Board Reference:		DB/FF/01									
Location:		Secondary Intake Room – First Floor									
Rating, Size and Type:		22-way (14/8) TP&N (Type B) + Split Load Metering									
Incomer:		125A 4-pole Isolating Switch									
Supplied from:		PB/00/01 – Main Panel Board									
Circuit Information											
Way No.	MCB/RCBO Rating (A)	Trip Curve	RCD/RCBO Rating (mA)	RCD/RCBO Type	Number of Poles	Arc Fault Detection	Cable Type	Phase & Neutral (mm ²)	CPC (mm ² /SWA)	Circuit Configuration	Duty
P/1L1	-	-	-	-	-	-	-	-	-	-	Spare / Existing
P/1L2	-	-	-	-	-	-	-	-	-	-	Spare / Existing
P/1L3	-	-	-	-	-	-	-	-	-	-	Spare / Existing
P/2L1	-	-	-	-	-	-	-	-	-	-	Spare / Existing
P/2L2	-	-	-	-	-	-	-	-	-	-	Spare / Existing
P/2L3	-	-	-	-	-	-	-	-	-	-	Spare / Existing
P/3L1	-	-	-	-	-	-	-	-	-	-	Spare / Existing
P/3L2	-	-	-	-	-	-	-	-	-	-	Spare / Existing
P/3L3	-	-	-	-	-	-	-	-	-	-	Spare / Existing

Codes:

1 – Cu LS0H Single; 2 – Cu LS0H Multi Flat; 3 – Cu XLPE/SWA/LS0H Armoured; 4 – Cu XLPE/LS0H Soft Skin Fire Rated PH120; 5 – Cu XLPE/SWA/LS0H Armoured Fire Rated F120;
6 – Cu LS0H Flexible; 7 – Cu XLPE/SWA/PVC; R – Radial Final Circuit; RFC – Ring Final Circuit

Distribution Board Schedules

Job No. 230114



Distribution Board Information											
Board Reference:		DB/FF/01									
Location:		Secondary Intake Room – First Floor									
Rating, Size and Type:		22-way (14/8) TP&N (Type B) + Split Load Metering									
Incomer:		125A 4-pole Isolating Switch									
Supplied from:		PB/00/01 – Main Panel Board									
Circuit Information											
Way No.	MCB/RCBO Rating (A)	Trip Curve	RCD/RCBO Rating (mA)	RCD/RCBO Type	Number of Poles	Arc Fault Detection	Cable Type	Phase & Neutral (mm²)	CPC (mm²/SWA)	Circuit Configuration	Duty
P/4L1	-	-	-	-	-	-	-	-	-	-	Spare / Existing
P/4L2	-	-	-	-	-	-	-	-	-	-	Spare / Existing
P/4L3	-	-	-	-	-	-	-	-	-	-	Spare / Existing
P/5L1	-	-	-	-	-	-	-	-	-	-	Spare / Existing
P/5L2	-	-	-	-	-	-	-	-	-	-	Spare / Existing
P/5L3	-	-	-	-	-	-	-	-	-	-	Spare / Existing
P/6L1	-	-	-	-	-	-	-	-	-	-	Spare / Existing
P/6L2	-	-	-	-	-	-	-	-	-	-	Spare / Existing
P/6L3	-	-	-	-	-	-	-	-	-	-	Spare / Existing

Codes:

1 – Cu LS0H Single; 2 – Cu LS0H Multi Flat; 3 – Cu XLPE/SWA/LS0H Armoured; 4 – Cu XLPE/LS0H Soft Skin Fire Rated PH120; 5 – Cu XLPE/SWA/LS0H Armoured Fire Rated F120; 6 – Cu LS0H Flexible; 7 – Cu XLPE/SWA/PVC; R – Radial Final Circuit; RFC – Ring Final Circuit

Distribution Board Schedules

Job No. 230114



Distribution Board Information											
Board Reference:		DB/FF/01									
Location:		Secondary Intake Room – First Floor									
Rating, Size and Type:		22-way (14/8) TP&N (Type B) + Split Load Metering									
Incomer:		125A 4-pole Isolating Switch									
Supplied from:		PB/00/01 – Main Panel Board									
Circuit Information											
Way No.	MCB/RCBO Rating (A)	Trip Curve	RCD/RCBO Rating (mA)	RCD/RCBO Type	Number of Poles	Arc Fault Detection	Cable Type	Phase & Neutral (mm²)	CPC (mm²/SWA)	Circuit Configuration	Duty
P/7L1	-	-	-	-	-	-	-	-	-	-	Spare / Existing
P/7L2	-	-	-	-	-	-	-	-	-	-	Spare / Existing
P/7L3	-	-	-	-	-	-	-	-	-	-	Spare / Existing
P/8L1	-	-	-	-	-	-	-	-	-	-	Spare / Existing
P/8L2	-	-	-	-	-	-	-	-	-	-	Spare / Existing
P/8L3	-	-	-	-	-	-	-	-	-	-	Spare / Existing
P/9L1	-	-	-	-	-	-	-	-	-	-	Spare / Existing
P/9L2	-	-	-	-	-	-	-	-	-	-	Spare / Existing
P/9L3	-	-	-	-	-	-	-	-	-	-	Spare / Existing

Codes:

1 – Cu LS0H Single; **2** – Cu LS0H Multi Flat; **3** – Cu XLPE/SWA/LS0H Armoured; **4** – Cu XLPE/LS0H Soft Skin Fire Rated PH120; **5** – Cu XLPE/SWA/LS0H Armoured Fire Rated F120;
6 – Cu LS0H Flexible; **7** – Cu XLPE/SWA/PVC; **R** – Radial Final Circuit; **RFC** – Ring Final Circuit

Distribution Board Schedules

Job No. 230114



Distribution Board Information											
Board Reference:		DB/FF/01									
Location:		Secondary Intake Room – First Floor									
Rating, Size and Type:		22-way (14/8) TP&N (Type B) + Split Load Metering									
Incomer:		125A 4-pole Isolating Switch									
Supplied from:		PB/00/01 – Main Panel Board									
Circuit Information											
Way No.	MCB/RCBO Rating (A)	Trip Curve	RCD/RCBO Rating (mA)	RCD/RCBO Type	Number of Poles	Arc Fault Detection	Cable Type	Phase & Neutral (mm²)	CPC (mm²/SWA)	Circuit Configuration	Duty
P/10L1	-	-	-	-	-	-	-	-	-	-	Spare / Existing
P/10L2	-	-	-	-	-	-	-	-	-	-	Spare / Existing
P/10L3	-	-	-	-	-	-	-	-	-	-	Spare / Existing
P/11L1	-	-	-	-	-	-	-	-	-	-	Spare / Existing
P/11L2	-	-	-	-	-	-	-	-	-	-	Spare / Existing
P/11L3	-	-	-	-	-	-	-	-	-	-	Spare / Existing
P/12L1	-	-	-	-	-	-	-	-	-	-	Spare / Existing
P/12L2	-	-	-	-	-	-	-	-	-	-	Spare / Existing
P/12L3	-	-	-	-	-	-	-	-	-	-	Spare / Existing

Codes:

1 – Cu LS0H Single; 2 – Cu LS0H Multi Flat; 3 – Cu XLPE/SWA/LS0H Armoured; 4 – Cu XLPE/LS0H Soft Skin Fire Rated PH120; 5 – Cu XLPE/SWA/LS0H Armoured Fire Rated F120; 6 – Cu LS0H Flexible; 7 – Cu XLPE/SWA/PVC; R – Radial Final Circuit; RFC – Ring Final Circuit

Distribution Board Schedules

Job No. 230114



Distribution Board Information											
Board Reference:		DB/FF/01									
Location:		Secondary Intake Room – First Floor									
Rating, Size and Type:		22-way (14/8) TP&N (Type B) + Split Load Metering									
Incomer:		125A 4-pole Isolating Switch									
Supplied from:		PB/00/01 – Main Panel Board									
Circuit Information											
Way No.	MCB/RCBO Rating (A)	Trip Curve	RCD/RCBO Rating (mA)	RCD/RCBO Type	Number of Poles	Arc Fault Detection	Cable Type	Phase & Neutral (mm ²)	CPC (mm ² /SWA)	Circuit Configuration	Duty
P/13L1	-	-	-	-	-	-	-	-	-	-	Spare / Existing
P/13L2	-	-	-	-	-	-	-	-	-	-	Spare / Existing
P/13L3	-	-	-	-	-	-	-	-	-	-	Spare / Existing
P/14L123	To be confirmed by manufacturer.										
----- BUSBAR SPLIT -----											
L/1L1	-	-	-	-	-	-	-	-	-	-	Spare / Existing
L/1L2	-	-	-	-	-	-	-	-	-	-	Spare / Existing
L/1L3	-	-	-	-	-	-	-	-	-	-	Spare / Existing
L/2L1	-	-	-	-	-	-	-	-	-	-	Spare / Existing

Codes:

1 – Cu LS0H Single; **2** – Cu LS0H Multi Flat; **3** – Cu XLPE/SWA/LS0H Armoured; **4** – Cu XLPE/LS0H Soft Skin Fire Rated PH120; **5** – Cu XLPE/SWA/LS0H Armoured Fire Rated F120;
6 – Cu LS0H Flexible; **7** – Cu XLPE/SWA/PVC; **R** – Radial Final Circuit; **RFC** – Ring Final Circuit

Distribution Board Schedules

Job No. 230114



Distribution Board Information											
Board Reference:		DB/FF/01									
Location:		Secondary Intake Room – First Floor									
Rating, Size and Type:		22-way (14/8) TP&N (Type B) + Split Load Metering									
Incomer:		125A 4-pole Isolating Switch									
Supplied from:		PB/00/01 – Main Panel Board									
Circuit Information											
Way No.	MCB/RCBO Rating (A)	Trip Curve	RCD/RCBO Rating (mA)	RCD/RCBO Type	Number of Poles	Arc Fault Detection	Cable Type	Phase & Neutral (mm²)	CPC (mm²/SWA)	Circuit Configuration	Duty
L/2L2	-	-	-	-	-	-	-	-	-	-	Spare / Existing
L/2L3	-	-	-	-	-	-	-	-	-	-	Spare / Existing
L/3L1	-	-	-	-	-	-	-	-	-	-	Spare / Existing
L/3L2	-	-	-	-	-	-	-	-	-	-	Spare / Existing
L/3L3	-	-	-	-	-	-	-	-	-	-	Spare / Existing
L/4L1	-	-	-	-	-	-	-	-	-	-	Spare / Existing
L/4L2	-	-	-	-	-	-	-	-	-	-	Spare / Existing
L/4L3	-	-	-	-	-	-	-	-	-	-	Spare / Existing
L/5L1	-	-	-	-	-	-	-	-	-	-	Spare / Existing

Codes:

1 – Cu LS0H Single; **2** – Cu LS0H Multi Flat; **3** – Cu XLPE/SWA/LS0H Armoured; **4** – Cu XLPE/LS0H Soft Skin Fire Rated PH120; **5** – Cu XLPE/SWA/LS0H Armoured Fire Rated F120;
6 – Cu LS0H Flexible; **7** – Cu XLPE/SWA/PVC; **R** – Radial Final Circuit; **RFC** – Ring Final Circuit

Distribution Board Schedules

Job No. 230114



Distribution Board Information											
Board Reference:		DB/FF/01									
Location:		Secondary Intake Room – First Floor									
Rating, Size and Type:		22-way (14/8) TP&N (Type B) + Split Load Metering									
Incomer:		125A 4-pole Isolating Switch									
Supplied from:		PB/00/01 – Main Panel Board									
Circuit Information											
Way No.	MCB/RCBO Rating (A)	Trip Curve	RCD/RCBO Rating (mA)	RCD/RCBO Type	Number of Poles	Arc Fault Detection	Cable Type	Phase & Neutral (mm ²)	CPC (mm ² /SWA)	Circuit Configuration	Duty
L/5L2	-	-	-	-	-	-	-	-	-	-	Spare / Existing
L/5L3	-	-	-	-	-	-	-	-	-	-	Spare / Existing
L/6L1	-	-	-	-	-	-	-	-	-	-	Spare / Existing
L/6L2	-	-	-	-	-	-	-	-	-	-	Spare / Existing
L/6L3	-	-	-	-	-	-	-	-	-	-	Spare / Existing
L/7L1	-	-	-	-	-	-	-	-	-	-	Spare / Existing
L/7L2	-	-	-	-	-	-	-	-	-	-	Spare / Existing
L/7L3	-	-	-	-	-	-	-	-	-	-	Spare / Existing
L/8L1	-	-	-	-	-	-	-	-	-	-	Spare / Existing

Codes:

1 – Cu LS0H Single; **2** – Cu LS0H Multi Flat; **3** – Cu XLPE/SWA/LS0H Armoured; **4** – Cu XLPE/LS0H Soft Skin Fire Rated PH120; **5** – Cu XLPE/SWA/LS0H Armoured Fire Rated F120; **6** – Cu LS0H Flexible; **7** – Cu XLPE/SWA/PVC; **R** – Radial Final Circuit; **RFC** – Ring Final Circuit

Distribution Board Schedules

Job No. 230114



Distribution Board Information											
Board Reference:		DB/FF/01									
Location:		Secondary Intake Room – First Floor									
Rating, Size and Type:		22-way (14/8) TP&N (Type B) + Split Load Metering									
Incomer:		125A 4-pole Isolating Switch									
Supplied from:		PB/00/01 – Main Panel Board									
Circuit Information											
Way No.	MCB/RCBO Rating (A)	Trip Curve	RCD/RCBO Rating (mA)	RCD/RCBO Type	Number of Poles	Arc Fault Detection	Cable Type	Phase & Neutral (mm²)	CPC (mm²/SWA)	Circuit Configuration	Duty
L/8L2	-	-	-	-	-	-	-	-	-	-	Spare / Existing
L/8L3	-	-	-	-	-	-	-	-	-	-	Spare / Existing

Codes:

1 – Cu LS0H Single; 2 – Cu LS0H Multi Flat; 3 – Cu XLPE/SWA/LS0H Armoured; 4 – Cu XLPE/LS0H Soft Skin Fire Rated PH120; 5 – Cu XLPE/SWA/LS0H Armoured Fire Rated F120; 6 – Cu LS0H Flexible; 7 – Cu XLPE/SWA/PVC; R – Radial Final Circuit; RFC – Ring Final Circuit

Section E2

Utility Power



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E2-1 GENERAL REQUIREMENTS

This section details the requirements for utility power installations and shall be read in conjunction with all other sections of this specification and the associated drawings.

Utility power installations shall be provided to the CTC Workshop at Maudsley Hospital

E2-2 DEFINITIONS

Refer to Section 2E / Section 1B of this specification and Part 2 of BS 7671 – IET Wiring Regulations – Requirements for Electrical Installations for further details regarding definitions, symbols and abbreviations.

E2-3 REFERENCES TO OTHER SECTIONS OF THIS SPECIFICATION

This section shall not be read in isolation and must be read in conjunction with all other sections of this specification which define further requirements for the electrical installation.

Section 2E details the default requirements for electrical installation quality and materials which shall apply to this section of the specification with deviations to the following:-

- 1) Cable support and containment systems / Cabling and wiring systems.
- 2) Wiring accessories.

Further details for these deviations from Section 2E can be found within this section of the specification.

E2-4 STANDARDS APPLICABLE

Works shall be completed in accordance with all applicable industry standards. Some of the most relevant standards associated with this section are scheduled below:

STANDARDS AND DOCUMENTS	
BS 7671	IET Wiring Regulations – Requirements for Electrical Installations – Part 6 Inspection and Testing
IET On-Site Guide – BS 7671 – IET Wiring Regulations – Requirements for Electrical Installations	
All IET Guidance Notes – BS 7671 – IET Wiring Regulations – Requirements for Electrical Installations, in particular:-	
IET Guidance Note 1 – Selection & Erection	
BS 1363	13A plugs, socket-outlets, adaptors and connection units
BS 4177	Specification for Cooker control units
BS 4573	Specification for 2-pin reversible plugs and shaver socket-outlets
BS 5733	General requirements for electrical accessories – Specification
BS 7288	Specification for Socket-outlets incorporating residual current devices (s.r.c.d's)
BS 8300	Design of buildings and their approaches to meet the needs of disabled people – Code of practice
BS EN 60309	Plugs, socket-outlets and couplers for industrial purposes
BS EN 60669	Switches for household and similar fixed electrical installations
BS EN 60947	Low voltage switchgear and controlgear
BS EN 61558-2-5	Safety of transformers, reactors, power supply units and combinations thereof – Part 2-5: Particular requirements and tests for transformer for shavers, power supply units for shavers and shaver supply units
BS EN IEC 62368	Audio/video, information and communication technology equipment – Safety requirements

STANDARDS AND DOCUMENTS	
IEC 60950-1	Information technology equipment – Safety – Part 1: General requirements
IEC 61000-6-1/3	Electromagnetic compatibility (EMC) – Generic standards
IEC 61558-2-16	Safety of transformers, reactors, power supply units and similar products for supply voltages up to 1 100 V – Part 2-16: Particular requirements and tests for switch mode power supply units and transformers for switch mode power supply units
The Building Regulations – Approved Document M	
The Building Regulations – Approved Document P	
All standards, guidance and statutory regulations detailed within Section 2E-3	

Where the above standards refer to supporting documentation and standards these shall be fully complied with in all respects.

Where discrepancy is found between this specification and the relevant standards, the Contractor shall obtain written clarification from the Engineer prior to submission of the tender. Where a discrepancy has not been clarified prior to tender submission, the Contractor shall include the most onerous requirements.

E2-5 SCOPE OF WORKS

The utility power installation shall include the provision of the following:-

- 1) Socket outlets to BS 1363-2.
- 2) Fused connection units to BS 1363-4.
- 3) Three pole fan isolators with switch lock to BS EN 60947-3.

Socket outlets shall be located as follows:-

- 1) Wall mounted (recessed / surface).
- 2) On dado trunking.
- 3) On desk management systems / bench trunking.
- 4) On power poles / posts.

Utility power shall be wired from the following sources:-

- 1) LV switchgear fed from the normal mains supply.

Where referenced above LV switchgear shall refer to LV switch panels, MCCB panel boards, MSDB multi-service distribution boards, MCB distribution boards and consumer units.

In principle, the Electrical Contractor shall provide main supplies to all mechanical control panels (MCPs) in plant rooms and the Mechanical Contractor shall undertake all wiring from these panels to the equipment they control. However some equipment provided by the Mechanical Contractor shall be wired directly from the utility power system by the Electrical Contractor and this shall include:-

- 1) External extract
- 2) Local extract fans.

Where standalone local extract fans are provided the Electrical Contractor shall be responsible for all power and control wiring e.g. standalone extract fans controlled from local lighting circuits / fan speed controllers.

Generally wiring accessories, final connections, cabling and containment systems shall be recessed within the building fabric to provide a flush finish with the exception of surface mounted equipment (e.g. surface dado trunking / bench trunking). However wiring accessories, final connections, cabling and containment systems shall be surface mounted within electrical switch rooms, ceiling voids, service risers, plant rooms and external plant areas.

It shall be noted the above lists are not exhaustive and reference must be made to all sections of this specification and the associated drawings.

All due allowances shall be made within the tender submission to ensure all necessary power supplies, wiring accessories, final connections and associated equipment is provided for the electrical installation, with particular attention paid to electrical systems where the Contractor has design responsibility (where it shall be the Contractor's responsibility to provide all necessary power supplies e.g. additional power supplies for security systems / fire-fighting and life safety systems).

Where discrepancy is found between the utility power requirements detailed within this specification / drawings and Specialist specifications / drawings (e.g. Kitchen / Laboratory Specialists), written clarification shall be obtained from the Engineer prior to submission of tender. Where a discrepancy has not been clarified prior to tender submission the most onerous requirements shall be included within the tender price.

E2-6 CABLE SUPPORT AND CONTAINMENT SYSTEMS / CABLING AND WIRING SYSTEMS

Refer to Section 2E of this specification.

Final circuiting for the utility power installations shall be provided in strict accordance with the low voltage distribution schematic(s) and distribution board schedules provided within this specification. The information provided on the low voltage distribution schematic(s) and distribution schedules shall take precedence over the information provided within this specification e.g. where XLPE/SWA/LSZH armoured cables are to be used for final circuits etc.

E2-7 WIRING ACCESSORIES

Utility power wiring accessories shall exactly match the appearance of those associated with voice / data, light switches and the like. Thus, a common manufacturer and range shall be used for all such, and the Contractor shall inform the Engineer of any anomalies in this respect prior to installation.

The tables below detail the wiring accessories that shall be included at tender and used for installation: -

WIRING ACCESSORY	MANUFACTURER / PRODUCT RANGE	FINISH
General areas, all flush mounted unless otherwise indicated: -		
13A socket outlets to BS 1363-2	MK Logic Plus Eaton PREMERA Schneider Electric Ultimate	Plastic white, switched, with white outboard rockers (when doubles) and dual earth terminals
Fused connection units to BS 1363-4		Plastic white with white rockers (when switched)
Double pole lockable fire alarm isolator switches to BS EN 60669-2-4		Plastic white
Voice and data outlets		Plastic white with white inserts
Light switches (including grid switches) to BS EN 60669-1		Plastic white with white rockers
Three pole fan isolators with switch lock to BS EN 60947-3		Plastic white with white switch and red switch lock
Switch rooms, plant rooms, ceiling voids and workshop areas:		
13A socket outlets to BS 1363-2	MK Metalclad Plus Eaton XTRA Surface Metalclad	Metallic powder coated, switched, with white outboard rockers (when doubles) and high integrity earthing
Surface back boxes to BS 5733	Schneider Electric Metal Clad	Metallic powder coated
External areas:		

WIRING ACCESSORY	MANUFACTURER / PRODUCT RANGE	FINISH
Isolators to BS EN 60947-3	Eaton MEM RDMP Schneider Telemecanique	Complete with lockable operating handle
Fused connection units to BS 1363-4		Plastic grey with white internals
Miscellaneous:		
Isolators to BS EN 60947-3	Eaton MEM RDMP Schneider Electric – Telemecanique	Complete with lockable operating handle
Notes: <ol style="list-style-type: none"> 1) All socket outlets shall be provided with dual earth terminals. 2) All switched accessories shall be double pole switched. 3) Where more than one product range is specified above for a wiring accessory the most expensive option shall be included within the tender price. 4) Where available from the specified accessory range, accessories shall have integral labelling e.g. water heater, cooker, isolator (3 pole fans) etc. 		

E2-8 INSTALLATION RESPONSIBILITY

Appendix II of this section provides a Utility Power – Installation Responsibility Schedule which details the installation responsibilities and methods of connection for the utility power installations.

The Electrical Contractor shall provide all:-

- 1) Power supplies (including wiring, terminations and cable support / containment systems).
- 3) Wiring accessories.
- 4) Final connections from wiring accessories to fixed equipment (including wiring, terminations and cable support / containment systems).

All final connections shall be undertaken using LSZH (LSOH, OHLS) cabling with emissions of hydrogen chloride gas < 0.5%.

Fire-fighting, life safety and security final connections must be installed concealed and / or recessed within the building fabric to provide a flush finish.

Installation responsibilities and final connection details provided within subsequent sections of this specification or detailed on the drawings, shall take precedence over the information provided within Appendix II – Utility Power – Installation Responsibility Schedule.

Where discrepancy is found between the installation responsibilities / methods of final connection detailed in Appendix II and Specialist specifications / drawings, written clarification shall be obtained from the Engineer prior to submission of tender. Where a discrepancy has not been clarified prior to tender submission the most onerous requirements shall be included within the tender price.

E2-9 INSPECTION AND TESTING

The utility power installations shall be inspected and tested in strict accordance with BS 7671 and Section 2F of this specification.



APPENDIX I – UTILITY POWER – ELECTRICAL EQUIPMENT SCHEDULE

ELECTRICAL EQUIPMENT	SPECIALIST / MANUFACTURER / PRODUCT RANGE/ MATERIAL
Dado trunking –	Schneider Electric
Power poles / posts	Schneider Electric

It should be noted the above schedule does not include wiring accessories which are detailed elsewhere within this specification.

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APPENDIX II – UTILITY POWER – INSTALLATION RESPONSIBILITY SCHEDULES

GENERAL EQUIPMENT					
EQUIPMENT	EQUIPMENT		POWER SUPPLIES AND FINAL CONNECTIONS BY	WIRING ACCESSORIES	FINAL CONNECTIONS
	SUPPLIED BY	INSTALLED BY			
Hand dryers	Client	EC	EC	Switched fused connection units	Metallic conduit shall be run between a switched fused connection unit (high level) and a flush mounted back box behind the hand dryer. Hand dryers shall be wired from the high level switched fused connection unit using 3183B LSZH/LSZH heat resistant flexible cable.
Definitions: BC = Building Contractor, EC = Electrical Contractor, MC = Mechanical Contractor					

FIRE-FIGHTING / LIFE SAFETY EQUIPMENT					
EQUIPMENT	EQUIPMENT		POWER SUPPLIES AND FINAL CONNECTIONS BY	WIRING ACCESSORIES	FINAL CONNECTIONS
	SUPPLIED BY	INSTALLED BY			
Fire alarm systems	EC	EC / Fire alarm specialist	EC	Double pole lockable fire alarm key switches	Fire alarm panels shall be wired from an adjacent double pole lockable fire alarm key switch (with adjacent flush mounted back box as required) using XLPE/LSZH enhanced fire resistant cable (PH30, PH60 and PH120 classification).
Definitions: BC = Building Contractor, EC = Electrical Contractor, MC = Mechanical Contractor					

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SECURITY EQUIPMENT					
EQUIPMENT	EQUIPMENT		POWER SUPPLIES AND FINAL CONNECTIONS BY	WIRING ACCESSORIES	FINAL CONNECTIONS
	SUPPLIED BY	INSTALLED BY			
CCTV systems	EC	EC / CCTV specialist	EC	Isolators Switched fused connection units Industrial plugs and socket outlets	<p>CCTV equipment < 3kW (e.g. 230V CCTV cameras), shall be wired from an adjacent un-switched fused connection unit (with adjacent flush mounted back box as required) using 3183B LSZH/LSZH heat resistant flexible cable.</p> <p>CCTV equipment > 3kW, shall be wired from an adjacent isolator using 6491B LSZH single core cables installed within metallic flexible conduit or from an industrial plug wired using CY LSZH/LSZH flexible cable or 3183B LSZH/LSZH heat resistant flexible cable.</p> <p>CCTV equipment racks shall be wired from an industrial plug wired using CY LSZH/LSZH flexible cable or 3183B LSZH/LSZH heat resistant flexible cable. The industrial plug shall be plugged into a wall mounted industrial socket outlet.</p>
Access control systems	EC	EC / Access control specialist	EC	Un-switched fused connection units Blank plates	<p>Access control panels shall be wired from an adjacent un-switched fused connection unit (with adjacent flush mounted back box as required) using 3183B LSZH/LSZH heat resistant flexible cable.</p> <p>Access control doors shall be wired from an adjacent un-switched fused connection unit or blank plate (with adjacent flush mounted back box as required) using 3183B LSZH/LSZH heat resistant flexible cable.</p>
Definitions: BC = Building Contractor, EC = Electrical Contractor, MC = Mechanical Contractor					

Section

E3

Internal, External and Emergency Lighting

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E3-1 GENERAL REQUIREMENTS

This section details the requirements for internal, external and emergency lighting and shall be read in conjunction with all other sections of this specification and the associated drawings.

The lighting systems shall be selected, installed, tested and commissioned in strict accordance with manufacturer's recommendations and the standards detailed below.

The Contractor shall supply, install, test and commission lighting systems that are complete and fully functional.

Reference shall be made to the complete tender documentation package including architect's layouts, ceiling types/finishes, room dimensions, wall finishes and other relevant specifications.

The lighting systems required for this project shall be as follows:-

- 1) Internal lighting.
- 2) External lighting.
- 3) Emergency lighting.

E3-2 DEFINITIONS

Refer to Section 2E / Section 1B of this specification and Part 2 of BS 7671 – IET Wiring Regulations – Requirements for Electrical Installations for further details regarding definitions, symbols and abbreviations.

Other definitions specifically associated with Lighting are as follows:

Absence detection	Where lights that have been turned on via a user interface are automatically turned off once an area has been vacated
Architectural lighting control	A control system that is used in conjunction with light sources to enhance a buildings architectural features or to create a particular ambiance in a space
DALI	Digital Addressable Lighting Interface
DALI broadcast	Where Dali signals are transmitted from a device in an unaddressed format
Daylight harvesting	A technique where natural daylight passing into a space through windows and skylights is used to allow a reduction in the amount of artificial light provided
Illuminance	The density of the luminous flux incident on a surface, measured in lux
LED tell back	A visible indication of the selected button of a control panel by the use of an LED
Grouping	A number of luminaires or circuits which are configured in software to work cooperatively
Luminaire	A light fixture containing one or more light sources
Presence Detection	Where a sensor is used to turn lights on when presence is detected within the sensor coverage area, and off again once the area is vacated
Scene Control Panels	Programmable multi button user interface
Scheduler	An automatic programme which generates system event commands according to the time of day
Sensors	Devices for detecting presence or light level etc.

E3-3 REFERENCES TO OTHER SECTIONS OF THIS SPECIFICATION

This section shall not be read in isolation and must be read in conjunction with all other sections of this specification which define further requirements for the electrical installation.

Section 2E details the default requirements for electrical installation quality and materials which shall apply fully to this section of the specification. Wiring accessories shall match the appearance of those associated with utility power, voice / data and the like.

E3-4 STANDARDS APPLICABLE

Works shall be completed in accordance with all applicable industry standards. Some of the most relevant standards associated with this section are scheduled below:

STANDARDS AND DOCUMENTS	
BS 7671	IET Wiring Regulations – Requirements for Electrical Installations
IET On-Site Guide – BS 7671 – IET Wiring Regulations – Requirements for Electrical Installations	
All IET Guidance Notes – BS 7671 – IET Wiring Regulations – Requirements for Electrical Installations	
The Society of Light and Lighting – The SLL Code for Lighting	
All current and relevant SLL / CIBSE Lighting Guides	
BS 5266	Emergency lighting
BS 5499	Safety signs and fire safety notices
BS 8300	Design of buildings and their approaches to meet the needs of disabled people – Code of practice
BS 8493	Lighting reflectance value (LRV) of a surface – Method of test
BS 8519	Selection and installation of fire-resistant power and control cable systems for life safety and fire-fighting applications – Code of practice
BS 9999	Code of practice for fire safety in the design, management and use of buildings
BS EN 1838	Lighting applications – Emergency lighting
BS EN 12464	Lighting and lighting – Lighting of work places
BS EN 15193	Energy performance of buildings – Energy requirements for lighting
BS EN 17307	Daylight in buildings
BS EN 60598	Luminaires
BS EN 62717	LED modules for general lighting (Performance requirements)
BS EN IEC 62031	LED modules for general lighting (Safety Specification)
BS EN IEC 62386	Digital addressable lighting interface
ICEL 1006	Emergency lighting design guide
BRE (Building Research Establishment) – Digest 529 – Obtrusive lighting from proposed developments	
ILP (Institution of Lighting Professionals) – Guidance notes for the reduction of obtrusive light GN01	
National Calculation Methodology (NCM) modelling guide	
The Building Regulations – Approved Document L	
The Building Regulations – Approved Document M	
The Building Regulations – Non-Domestic and Domestic Building Services Compliance Guides	
All current and relevant Building Bulletin's by the DfES (Department for Education and Skills) and other government agencies	

STANDARDS AND DOCUMENTS

All standards, guidance and statutory regulations detailed within Section 2E-3

Where the above standards refer to supporting documentation and standards these shall be fully complied with in all respects.

Where discrepancy is found between this specification and the relevant standards, the Contractor shall obtain written clarification from the Engineer prior to submission of the tender. Where a discrepancy has not been clarified prior to tender submission, the Contractor shall include the most onerous requirements.

E3-5 DESIGN REQUIREMENTS

The Contractor shall provide manufacturer's lighting design calculations for any proposed luminaire selections, locations or positions that differ from the ones shown in the tender documentation to demonstrate an equivalent level of performance (including uniformity, outputs, etc).

Any such alternatives shall only be used if agreed in writing with the Engineer.

The Contractor shall validate the design and take over the design responsibility for the emergency lighting systems.

This design validation shall take place during the tender period. It shall include an assessment of whether:

- 1) Equipment specifications shown meet the overall design intent of this specification.
- 2) Equipment quantities shown meet the overall design intent of this specification.
- 3) The design intent of this specification is fully compliant with the Guides and Standards listed in this document.

Based on this assessment, the Contractor shall, during the tender period, provide written clarification to the Engineer of any non-compliances and / or additional requirements. They shall obtain from the Engineer any necessary guidance if the method of compliance is open to interpretation.

It is emphasized that the tender submission must include all necessary additional / alternative equipment necessary to achieve a fully compliant installation. Thus, in the absence of tender clarification between alternative methods of compliance, the most onerous compliant option shall be included.

E3-6 LUMINAIRE SCHEDULE / DOCUMENTATION

Manufacturers, product ranges and materials given in the appendices to this section shall be included in the tender submission.

Where possible a number of suppliers have been given for items of equipment to give a reasonable choice to the Contractor. However where a single specialist, manufacturer, product range or material is specified, this may be due to:-

- 1) Alternatives not being available which are equivalent.
- 2) The need to match existing standards.
- 3) Outright specification by the Client.

Therefore alternatives shall not be acceptable without written agreement from the Engineer. Reference shall also be made to Section 1B with regards to the proposal of alternative equipment.

E3-7 SCOPE OF WORKS

The lighting systems installation shall include the provision of the following (where required):-

- 1) Internal lighting including:-
 - a) Luminaires.
 - b) Lighting controls (e.g. presence / absence detection, daylight sensors etc.).
 - c) Lighting control network
 - d) Lighting control modules (LCM's).
- 2) External lighting.
 - a) Building mounted perimeter luminaires.

- 3) Emergency lighting:-
 - a) Luminaires.
- 4) All systems shall include the following:-
 - a) All necessary end-user management software.
 - b) All necessary attachments, fixings and connectors.
 - c) All necessary wiring accessories e.g. light switches, data outlets, switched fused connection units etc.
 - d) All necessary power and signalling cabling.
 - e) All necessary earthing and bonding.
 - f) All necessary cable support and containment systems.
 - g) Inspection, testing and commissioning.
 - h) All necessary identification, notices and labelling.
 - i) All necessary O&M information.

It shall be noted the above lists are not exhaustive and reference must be made to all sections of this specification and the associated drawings.

All due allowances shall be made within the tender submission to ensure that all necessary power supplies, wiring accessories and associated equipment are provided for the electrical installation, with particular attention paid to electrical systems where the Contractor has design responsibility.

E3-8 INTERNAL LIGHTING

GENERAL REQUIREMENTS

The internal lighting installation shall be as detailed in this specification and the associated drawings.

The basic requirements are as follows:

LUMINAIRES

All luminaires shall be supplied complete with the necessary attachments to enable them to be installed and operated as intended. Attachments refers to all fixings such as clips, wall brackets, ceiling brackets, column spigots, gaskets, seals, frames, flanges, toggles and locks, covers, diffusers, glassware, reflectors and optical components.

All reflectors shall be iridescent free.

All luminaires shall be fully compatible with the ceiling type. The Contractor shall provide information on the ceiling types to luminaire manufacturers and ensure that the correct flanges, gaskets, frames, fixings etc. are included. Any incompatible luminaires shall be highlighted to the Engineer to enable re-specification.

Any gaskets shall be non-perishable type and shall provide the ingress protection level specified and be fit for the required purpose. Gaskets shall fit securely within the products and be retained during lamp replacements when covers are removed.

All optical components such as reflectors and louvers shall be correctly earthed as appropriate, and be securely fixed to the body by retainers such that it is impossible for any attachment to fall free from the body. These retainers and fixings shall not be visible when the luminaire is assembled in its installed position.

All luminaires shall be complete with lamps/light engines.

All light sources shall:

- 1) Be from leading manufacturers/brands
- 2) Have a correlated colour temperature of 4000K unless otherwise detailed.
- 3) Have a colour rendering index >Ra80 unless otherwise detailed
- 4) If fluorescent, have tri-phosphor coatings
- 5) If linear fluorescent, have a minimum life expectancy of 40,000 hours e.g. Aura T5 Eco Saver long life
- 6) If fluorescent, be from a common manufacturer across the entire project
- 7) If LED, be selected from bins within 3 MacAdam steps for consistent colour appearance

All luminaires shall be manufactured and tested in full compliance with BS EN 60598. All LED modules for general lighting shall comply with BS EN IEC 62031 and BS EN 62717.

All LED products shall have longevity of at least L80 @ 50,000 hours (20% lumen depreciation), tested to LM80 and TM21 calculation process. Failure rate expectancy shall be less than 50% at 50,000 hours.

All LED lighting products shall be covered by a minimum 5 year warranty provided by the Contractor. This shall include the luminaire, lamps and LED driver electronics.

All luminaires shall be complete with compatible control gear which shall:

- 1) Have a power factor of 0.9 or better
- 2) Limit protective conductor current to <0.7mA per luminaire
- 3) Be integral to the luminaire unless otherwise detailed
- 4) If fluorescent, be of high frequency type
- 5) Be digital addressable, DALI type
- 6) Facilitate dimming down to 1% of full output
- 7) Be fully compatible with the lighting control system/lighting control devices

The Contractor shall provide 1No. sample of each of the luminaires specified for consideration by the Client/Architect. This procedure shall be completed early in the contract period to ensure delivery of all luminaires to suit the Main Contractor's programme.

INSTALLATION REQUIREMENTS

Prior to commencing any first fix operations, exact setting out of all components forming the lighting system shall be agreed and confirmed with the Engineer and the Architect. The Contractor shall allow within their tender for relocating items of equipment within 3m of the positions detailed on the layout drawings.

The Contractor shall ensure that no luminaires, switches, sensors etc. are damaged / spoiled by decoration, finishes or other trades. In the event of any damage, the units shall be replaced at no cost to the Employer such that the installation is new at the day of handover. The Contractor is thus advised not to install luminaires prior to decoration.

All optical components and decorative glassware etc. shall be in perfect condition upon project completion and thus clean and free from any blemishes / fingerprints. Gloves must be worn when handling luminaires and lamps.

The installation shall not be used for temporary / site lighting.

All luminaires and lighting controls shall be installed in strict accordance with the individual lighting manufacturer's literature, wiring schematics and recommendations. Where cable connections are made into equipment, a numbered marker sleeve shall be fitted to the cable-core, which shall correspond to the wiring diagram.

Cable tails to terminals shall be of sufficient length and be neatly dressed and arranged to prevent development of tension in the cable or on the termination. All cables shall be securely tethered within enclosures. Ensure that all wiring connections are correctly made before any equipment is set to work.

The Contractor shall supply and install all light switches and lighting control modules as shown on the layout drawings and room data sheets (where provided). Switches shall:

- 1) Be 20 Amp rated if operating at 230V
- 2) Include proprietary phase barriers and DANGER 400V labels where more than one phase present

All wiring, containment and accessory boxes shall be flush, i.e. concealed within the building fabric, apart from plantrooms, risers, ceiling voids and other specifically noted areas.

All power and signalling cabling shall be LSZH (LS0H, 0HLS) with emissions of hydrogen chloride gas < 0.5%.

Fixing arrangements for luminaires shall be as follows:

- 1) Modular or linear luminaires installed within or below suspended ceilings shall be independently fixed from the soffit using 8mm diameter galvanised drop rods, such that the weight of the luminaires is not borne by the suspended ceiling grid.
- 2) Modular or linear luminaires within suspended ceilings shall be fixed using manufacturers' proprietary side arm brackets. Modular or linear luminaires below suspended ceilings shall be fixed using proprietary T bar clips. In both cases a supplementary steel wire fixing (gripple wire) back to the soffit shall be provided to prevent the luminaire from falling if the ceiling is removed.

- 3) Small recessed luminaires e.g. downlights located in suspended ceilings shall be supported by means of a plywood pattress fitted to the back of the ceiling tile. Additional supports shall be provided to ensure the luminaire is not supported by the ceiling grid. A suitable hole shall be provided through the tile and liner so that the fitting can be fixed using the standard manufacturers support clip.
- 4) Suspended luminaires shall be supported using luminaire manufacturers' proprietary fixings in strict accordance with their recommendations, in particular regarding spacings. Where suspended luminaires are continuous linear systems the Contractor shall provide all necessary proprietary coupler joints and infills to ensure a continuous installation.
- 5) Surface luminaires below plasterboard ceilings shall be supported from the conduit system. The conduit boxes shall finish flush with the underside of the ceiling and additional extension rings shall be provided as necessary to achieve this.
- 6) Recessed luminaires in plasterboard ceilings shall be supported from the ceiling using spring clips or bracket arms on the luminaire. To spread the weight and prevent damage to the plasterboard, the aperture shall be trimmed using plywood panels (small aperture) or wooden battens (large aperture).
- 7) Wall mounted luminaire shall be fixed directly to conduit boxes flushed into the wall behind.
- 8) Surface luminaires in plantrooms, risers and other locations when a surface conduit system is present shall be fixed directly to conduit boxes.

In plantrooms the luminaire locations shall be determined on site to suit the final plant layout and optimise illumination at locations of equipment that require maintenance. Where this requires suspension, conduit drops from ball joints shall be used to support the luminaires.

Care shall be taken to carefully co-ordinate all ceiling mounted equipment with the Building Contractor, particularly those that require cutting of the ceiling tile. In all cases a plywood support shall be provided behind the ceiling tile, supported from the grid.

Final connection of power and data to luminaires shall be as follows:

- 1) Luminaires in areas with suspended ceilings shall be fed via plug-in devices and multi-core heat resisting 0.5mm² flexes, connected directly to individual conduit boxes located within the ceiling voids no more than 300mm horizontally or vertically from the luminaire.
- 2) Luminaires on walls or non-demountable ceilings shall be connected directly to the fixed wiring, using UV stabilised heat proof sheathing where recommended by the manufacturer.
- 3) Luminaires in plantrooms and other areas with surface conduit shall be connected directly to the fixed wiring systems via the conduit.
- 4) Suspended luminaire shall be connected via flex or as detailed on the drawings. Where continuous, the luminaire system shall include through wiring and proprietary connectors to minimise feed points from the fixed wiring. Additional dummy lengths shall be provided to conceal these feed points to the extent possible.

Where a plug-in device is used this shall provide both power and data connection from a single plug/socket, with insulation suitable for LV on all cores. However the data wiring shall be contained in separate containment up to a point immediately adjacent to the connector.

Where wired direct from the containment system the power and data shall have separate entry points into the luminaire.

E3-9 EMERGENCY LIGHTING

Emergency lighting shall be provided in strict accordance with BS 5266, BS EN 1838, ICEL 1006 and CIBSE Lighting Guide 12: Emergency Lighting Design Guide. The installation shall comply with relevant clauses on the IET Wiring Regulations. The mode of operation i.e. non-maintained and maintained shall be in full compliance with the current British Standards

A 3 hour duration system shall be provided throughout.

The Contractor shall employ the system manufacturer to validate the design for the entire emergency lighting system.

This shall include calculations to check that illumination levels and uniformity limits recommended by BS 5266 will be achieved in both horizontal and vertical planes on all:

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- Escape routes
- Hazard locations
- Open plan areas
- Fire alarm panels
- Reception areas
- Points of emphasis
- All other key areas listed in BS 5266.

Luminous intensity and mounting heights shall be checked to ensure that the limits given BS 1838 are not exceeded. In larger open areas the emergency luminaires shall have open area optics and in circulation routes then the corridor optics shall be used.

The layout drawings and/or REVIT model show indicative locations for emergency lighting but the Contractor is fully responsible for setting these out accurately as part of the working drawings to ensure that the limiting distances and illumination levels required by the stated standards are achieved.

Commissioning shall be carried out in accordance with the recommendations of the standards listed above and the system manufacturer. This shall include:

- Illumination levels check based on authenticated design data
- Visual check that a luminaire is provided close to all points of emphasis listed in BS 5266
- Functional test of all luminaires on failure of local circuit
- Duration test for all luminaires

At a date to be agreed the Contractor shall repeat the full test on the emergency lighting installation in the presence of the Employer and the consulting engineer.

For the escape routes, exit signage is to be internally illuminated such that viewing distances are increased compared to non-self-illuminated signage. These shall be provided in accordance with the signage requirements detailed on the agreed Fire Plan.

Emergency lighting shall be provided throughout the installation by means of self-contained fittings, or by conversion units fitted to the main fittings.

All emergency luminaires shall be provided within a clearly visible light to indicate that the fitting is in a healthy condition. In the case of luminaires containing conversion units, this shall be securely fitted to the flange or other location such that it is clearly visible when the luminaire is normally energised.

Final connections to emergency light fittings shall be by 4 pole plug-in ceiling roses and 4-core heat resisting flex.

Where conversion units are used, these shall be factory assembled by the manufacturer of the general luminaire. It shall not be permissible for the units to be made up on site. Interconnections between remote conversion units and light fittings shall be via factory made looms, not by loose wiring.

A label shall be fixed to the face of the internal reflector for each emergency luminaire which shall read 'DANGER – ISOLATE ELSEWHERE BEFORE REMOVING COVER' this shall also be repeated on the cover plate of each remote conversion pack.

Manufacturer's recommendations / restrictions regarding distances between luminaires and remote conversion units are to be strictly adhered to, as are all other manufacturers' recommendations relating to cabling, etc.

The Contractor shall be responsible for ensuring compatibility of conversion units to luminaires prior to tendering. Any discrepancies shall be reported to the Engineer.

Test and isolation key switches shall be provided for the emergency lighting installation and shall isolate the pilot live cable only, enabling testing while normal lights are still operating. These shall be located:

- At the light switch position in each room

Each emergency luminaire will require a test sheet on completion. These shall be incorporated into the O & M documentation and shall cover a projected 12 month period. Each luminaire shall be given a unique number referenced on the sheet.

The emergency lighting design shall take full advantage of the DALI lighting control system. Therefore the whole emergency lighting system shall incorporate individual stand-alone emergency LED luminaires with local batteries and each of these shall be DALI connected to the mains control system. The lighting control system shall perform all the emergency self-test schedules for the lighting and create logs and reports which shall be stored and emailed to the Client's staff to be nominated.

E3-10 EXTERNAL LIGHTING

The Contractor shall provide a complete and operational external lighting installation as described and in the clauses below.

The external lighting installations shall be controlled via photocell and time switch arrangements, such that the lighting will come on and off at pre-set levels and can be over-ridden 'off' by the time switch, if required. An override 'on' switch shall also be provided where necessary within the associated electrical switch room. The time clock(s) shall be of the Sangamo solar dial range complete with automatic daylight savings facility.

INSTALLATION

The Electrical Contractor shall co-ordinate with the Main Contractor during the tender period, the builders work requirements associated with the external Lighting layouts.

The luminaires shall be installed in line with the manufacturer's recommendations and the details given below. In the event of any anomalies, the Electrical Contractor shall bring these to the Engineer's attention during the tender period and in the absence of clarification shall allow for the more onerous option.

In general, column luminaires shall be root mounted and shall be cast into suitable concrete bases complete with slow radius bend PVC ducts allowing cables to be routed through the bottom of the luminaires. A sleeve shall first be installed and concreted into place then the columns installed into the sleeve and backfilled.

All columns, bollards and buried up lights shall be provided with drainage even if they are provided with gaskets. This shall consist of 300mm of screed below the fitting or as otherwise advised by the luminaire manufacturer.

All ducting installations required out from the building and to serve all external Lighting points shall be co-ordinated by the Electrical Contractor with the Main Contractor. All penetrations through the building fabric shall be fully and neatly sealed at both ends and be as small cross sectional area as possible. All ducts shall be water and vermin sealed.

All underground cabling shall be XLPE/SWA/PVC type with copper conductors. Underground cabling shall be installed within a ducting system with strategically sited access chambers. The cabling and ducting shall be buried the depths indicated in this specification and associated drawings and as a minimum be in accordance with National Joint Utilities Guidance suitable for the voltages of the installation.

The armoured cables shall be terminated at each column by the proprietary cable accessories and fused street Lighting cut outs in each column. Final connections to control gear and lamps shall be via flexible heat resistant cables.

Access chamber pits shall be provided, one for each lighting column to allow future maintenance. The pits may have lids that match the surface treatment of the surrounding paving / ground finish.

The exact location of all external lighting shall be agreed on site, prior to installation, taking into account the Architect's scheme.

The Contractor shall allow within tender to demonstrate the lighting system to the Engineer during a night period, to verify the correct system of operation and lighting levels by measurement.

E3-11 LIGHTING CONTROLS

GENERAL REQUIREMENTS

The Contractor shall supply, install, test and commission a complete lighting control system as detailed on the drawings and the clauses below:

All spaces shall include light level sensing and automatic adjustment of the luminaire light output to maintain the lux levels given. Where possible combined presence/light level sensors shall be used.

The Contractor shall coordinate the sensors with the luminaire manufacturers to ensure compatibility.

The Contractor shall, in conjunction with their lighting controls specialist, validate all sensor locations shown to ensure that detection is optimised and dead spots avoided. They shall advise if any additional detectors are needed. All sensors shall have adjustable detection patterns. Ceiling mounted sensor shall give 360° coverage.

Where possible sensors shall be recessed into the ceiling systems. Where continuous runs of luminaires are shown the sensors shall be incorporated into the infill panels. Surface mounted sensors shall be used in spaces with surface mounted conduit.

Where microwave sensors are shown in corridors these shall be positioned to ensure that a person entering the corridor at any point along its length will be detected.

FULLY NETWORKED CONTROLS

The control system shall be a complete DALI (Digital Addressable Lighting Interface) networked lighting control system to meet the following requirements:

- 1) Full compliance with BE EN IEC 62386
- 2) All luminaires, including those in plant spaces, store and external fittings shall be part of the system
- 3) Every luminaire shall be connected to the network and have its own unique address
- 4) Every control device, including all sensors and switches, shall be connected to the network and have its own unique address.
- 5) Each luminaire/control device shall be programmable to serve a number of scenes and operations in different areas.
- 6) Operation of all devices can be time scheduled using the system clock
- 7) Every space shall include a wall mounted switching point (even if shown with just presence detection) for future flexibility
- 8) All switches shall be DALI type, operating at ELV
- 9) All scene setting switches shall include at least 4 buttons
- 10) The system shall connect to the client's local area network (LAN)
- 11) System setup and reconfiguration shall be possible from any PC on the LAN using a network based software package.
- 12) Sufficient DALI bus circuits to ensure 20% spare capacity on each at completion

The DALI system shall utilise a twin core bus cable routed in dedicated containment or with other services operating at ELV, as indicated on the drawings. The DALI cabling shall be identified along its length, either by over sleeve tags or by the use of a coloured cable. This is to ensure identification between lighting power and DALI control.

COMMISSIONING

The Contractor shall ensure that the lighting controls manufacturer is employed to test and commission the entire lighting control system in accordance with client's operational requirements. Provide a full schedule of options and parameters enable discussion and agreement of these operational requirements.

The range and detection pattern on each sensor shall be adjusted to suit the location and minimise erroneous detection from adjacent areas.

Following successful commissioning and prior to Practical Completion, the lighting controls manufacturer shall also undertake demonstrations and teaching to the Client's nominated staff to enable them to make minor changes as and when required.

KEY LOCATIONS

Lighting controls in key areas shall be as described in the following table

LIGHTING CONTROLS IN KEY AREAS		
ROOM / AREAS	LUMINAIRE TYPE	CONTROLS DESCRIPTION
WC/ Shower / WC Lobby		On/off with presence detection
Workshop Areas		Manual on/off with Absence off (Sensor built in the luminaire)

LIGHTING CONTROLS IN KEY AREAS		
ROOM / AREAS	LUMINAIRE TYPE	CONTROLS DESCRIPTION
Office Spaces		Manual on/off with Absence off (Sensor built in the luminaire)
Specialist Storage Spaces		Manual on/off with Absence off (Sensor built in the luminaire)
General Store / Cleaners		On/off with presence detection
Corridor		On/off with presence detection
External lighting		Time scheduling and photo-cell With override switch

The Contractor shall ensure that the lighting controls manufacturer is employed to test and commission the entire lighting control system. The lighting controls manufacturer shall perform all demonstrations and teaching of the system to the Client's nominated staff to enable the Client to make minor changes as and when required. In addition to this, the Contractor shall allow for 3 visits by the lighting control system manufacturer during normal occupancy, spaces over the first 12 months after handover. These days are for any Client changes / adaptations in the future during the first year of occupancy from completion and therefore separate to any rectification visits due to the system not being correctly set up before occupancy.

E3-12 COMMISSIONING, MAINTENANCE FAMILIARISATIONS AND TRAINING

All equipment shall be tested and inspected prior to the systems being offered to the Engineer and the Client. A fully functional test shall be demonstrated before any certification is accepted on behalf of the Client.

The lighting systems and associated controls will require a considerable period of time to commission. The Electrical Contractor shall ensure that sufficient time is allowed in the Main Contractor's programme to fully commission the systems in line with this specification and to the satisfaction of the Engineer. The control system manufacturer (specialist) shall be employed to set up and commission their controls and it is emphasised that this shall not be undertaken until all other works in the spaces have been completed, (thus allowing the spaces to be cleared of other workers.)

The Contractor shall, immediately following handover, carry out familiarisations and training to Client staff and maintenance personnel. At least 2 full days shall be allowed for both the Electrical Contractor and their specialists to carry out systems familiarisations (Day 1), followed by system training (Day 2). The Contractor shall co-ordinate these dates with the Client, and to supervise each training day session given. The Contractor shall also manage their specialists on each day, provide an agenda for training to be given 1 week prior to the site visit, and on each day formally record all those in attendance, and at the end of each session record Q&A.

The Contractor shall also allow for 2 whole day visits by the controls specialist for any programming modification/adaptation to the installed systems around the time just after handover. This will enable any Client fine tuning required to complete the system. After this a further 3 days float shall be allowed for. These 3 days may not be taken up immediately after handover and allowance should be made for them during the first year. These are for any Client adaptations that are currently unforeseen as the Clients' energy policies adapt to ever changing climates. This is described above in the Lighting Control section.

E3-13 INSPECTION AND TESTING

The lighting system(s) shall be inspected, tested and commissioned in strict accordance with manufacturer's recommendations and the standards detailed earlier within this specification as appropriate.

The electrical installation works associated with the lighting system(s) shall be inspected and testing in strict accordance with BS 7671 and Section 2F of this specification. All circuits / test results shall be recorded on the 'Schedule of circuit details / Schedule of test results' provided within the Electrical Installation Certificates).

Section E3 Internal, External and Emergency Lighting

Job No. 230114



Formal witnessing of testing and commissioning shall be undertaken in strict accordance with Section 2F of this specification.

Upon completion the system(s) shall be demonstrated to the Engineer and the Client. The Contractor / Lighting Specialist(s) shall provide training to the Client until they fully understand the operation of the system.

Commissioning certification shall be provided to verify the correct installation and operation of the lighting system(s). The commissioning certification and as-installed drawings for the lighting system(s) shall be included within the O&M manual.



APPENDIX I – INTERNAL, EXTERNAL AND EMERGENCY LIGHTING – ELECTRICAL EQUIPMENT AND SPECIALISTS SCHEDULE

ELECTRICAL EQUIPMENT	SPECIALIST / MANUFACTURER / PRODUCT RANGE/ MATERIAL
Lighting Specialist(s) / Installer(s)	Thorlux Lighting Tim Davy tim.davy@thorlux.co.uk 44 (0)7767 273019



**APPENDIX II – INTERNAL, EXTERNAL AND EMERGENCY LIGHTING – LUMINAIRE
SCHEDULE / DOCUMENTATION**

LUMINAIRE SPECIFICATION



CLIENT: NHS Trust
PROJECT : CTC Relocation
STATUS: Stage 4
ISSUE DATE: 04/08/2023
ISSUE REVISION: T01

REVISION BY : WS
CHECKED BY:

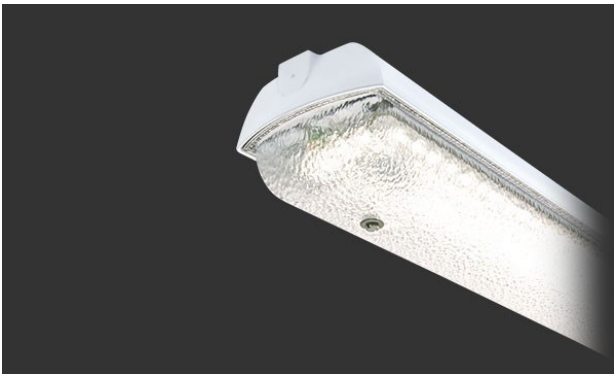
LUMINAIRE REF:

A

MANUFACTURER: Thorlux Lighting
CONTACT DETAILS: Tim Davy
EMAIL: tim.davy@thorlux.co.uk
TELEPHONE: 07767273019

LUMINAIRE: A-Line

IMAGES:



DESCRIPTION: Robust and durable extruded aluminium body with die-cast ends finished full polyester, non-yellowing white

DIMENSIONS: 1500 X 121 X 121mm (L X H X W)

ACCESSORIES: Smart Scan Integral

LOCATION: Workshops

FOR INTERNAL LUMINAIRES

LAMP TYPE: LED
LAMP POWER AND LUMEN OUTPUT: 41W / 7070lm
LUMINAIRE LL/CW: 172
OPTIC: Direct
COLOUR TEMPERATURE: 4000K
COLOUR RENDERING INDEX: 80
SERVICE LAMP LIFE: 100,000HRS
CONTROL GEAR: DALI / SmartScan

EQUAL AND/OR APPROVED LUMINAIRE:

COMMENTS:

LUMINAIRE SPECIFICATION



CLIENT: NHS Trust
PROJECT : CTC Relocation
STATUS: Stage 4
ISSUE DATE: 04/08/2023
ISSUE REVISION: T01

REVISION BY : WS
CHECKED BY:

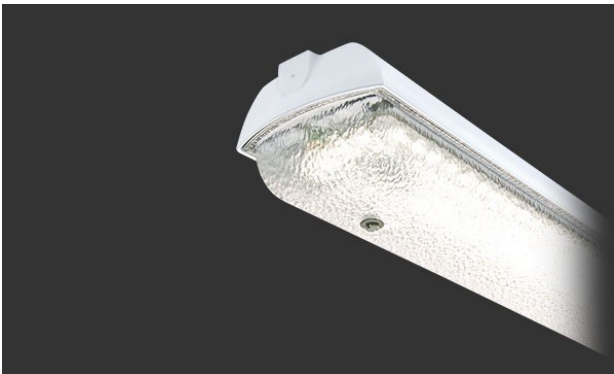
LUMINAIRE REF:

A1

MANUFACTURER: Thorlux Lighting
CONTACT DETAILS: Tim Davy
EMAIL: tim.davy@thorlux.co.uk
TELEPHONE: 07767273019

LUMINAIRE: A-Line

IMAGES:



DESCRIPTION: Robust and durable extruded aluminum body with die-cast ends finished full polyester, non-yellowing white

DIMENSIONS: 1500 X 121 X 121mm (L X H X W)

ACCESSORIES: Smart Scan Integral

LOCATION: Workshops

FOR INTERNAL LUMINAIRES

LAMP TYPE: LED
LAMP POWER AND LUMEN OUTPUT: 20W / 3670lm
LUMINAIRE LL/CW: 176
OPTIC: Direct
COLOUR TEMPERATURE: 4000K
COLOUR RENDERING INDEX: 80
SERVICE LAMP LIFE: 100,000HRS
CONTROL GEAR: DALI / SmartScan

EQUAL AND/OR APPROVED LUMINAIRE:

COMMENTS:

LUMINAIRE SPECIFICATION



CLIENT: NHS Trust
PROJECT : CTC Relocation
STATUS: Stage 4
ISSUE DATE: 04/08/2023
ISSUE REVISION: T01

REVISION BY : WS
CHECKED BY:

LUMINAIRE REF:

B1

MANUFACTURER:	Thorlux Lighting	LUMINAIRE:	Hi-Bar Surface
CONTACT DETAILS:	Tim Davy		
EMAIL:	tim.davy@thorlux.co.uk		
TELEPHONE:	07767273019		

IMAGES:



DESCRIPTION: The Hi-Bar Surface is suitable for a range of building wide applications. Slim and elegant, the Hi-Bar combines supreme efficiency and longevity with design flexibility.

DIMENSIONS: 1516 X 121 X 121mm (L X H X W)

ACCESSORIES: Smart Scan Integral

LOCATION: Office and Corridor

FOR INTERNAL LUMINAIRES

LAMP TYPE:	LED	EQUAL AND/OR APPROVED LUMINAIRE:
LAMP POWER AND LUMEN OUTPUT:	20W / 3670lm	
LUMINAIRE LL/CW:	183.5	
OPTIC:	Direct	
COLOUR TEMPERATURE:	4000K	
COLOUR RENDERING INDEX:	80	
SERVICE LAMP LIFE:	100,000HRS	
CONTROL GEAR:	DALI / SmartScan	

COMMENTS:

LUMINAIRE SPECIFICATION



CLIENT: NHS Trust
PROJECT : CTC Relocation
STATUS: Stage 4
ISSUE DATE: 04/08/2023
ISSUE REVISION: T01

REVISION BY : WS
CHECKED BY:

LUMINAIRE REF:

C1

MANUFACTURER: Thorlux Lighting
CONTACT DETAILS: Tim Davy
EMAIL: tim.davy@thorlux.co.uk
TELEPHONE: 07767273019

LUMINAIRE: G3 Pro

IMAGES:



DESCRIPTION: Surface or suspended luminaires featuring high performance metalized inner reflector with wide or narrow distribution options. Choice of white or anti-glare black injection moulded outer reflector. Glare control is excellent at 50° and above. Very efficient LEDs,

DIMENSIONS: 206 X 125 X 168 (L X H X W)

ACCESSORIES: Smart Scan Integral

LOCATION: WC's and Shower

FOR INTERNAL LUMINAIRES

LAMP TYPE: LED
LAMP POWER AND LUMEN OUTPUT: 11W / 1700lm
LUMINAIRE LL/CW: 154
OPTIC: Direct
COLOUR TEMPERATURE: 4000K
COLOUR RENDERING INDEX: 80
SERVICE LAMP LIFE: 100,000HRS
CONTROL GEAR: DALI / SmartScan

EQUAL AND/OR APPROVED LUMINAIRE:

COMMENTS:

LUMINAIRE SPECIFICATION



CLIENT: NHS Trust
PROJECT : CTC Relocation
STATUS: Stage 4
ISSUE DATE: 04/08/2023
ISSUE REVISION: T01

REVISION BY : WS
CHECKED BY:

LUMINAIRE REF:

D1

MANUFACTURER: Thorlux Lighting
CONTACT DETAILS: Tim Davy
EMAIL: tim.davy@thorlux.co.uk
TELEPHONE: 07767273019

LUMINAIRE: Cobalt

IMAGES:



DESCRIPTION: Circular wall mounted aluminium body luminaires with a high efficiency satin polycarbonate cover and a choice of four cover frame styles. SmartScan Radar and maintained emergency versions available. ,

DIMENSIONS: 1516 X 121 X 121mm (L X H X W)

ACCESSORIES: Smart Scan Integral

LOCATION: External Perimeter

FOR EXTERNAL LUMINAIRES

LAMP TYPE: LED
LAMP POWER AND LUMEN OUTPUT: 11W / 1490lm
LUMINAIRE LL/CW: 134
OPTIC: Direct
COLOUR TEMPERATURE: 4000K
COLOUR RENDERING INDEX: 80
SERVICE LAMP LIFE: 100,000HRS
CONTROL GEAR: DALI / SmartScan

EQUAL AND/OR APPROVED LUMINAIRE:

COMMENTS:

LUMINAIRE SPECIFICATION



CLIENT: NHS Trust
PROJECT : CTC Relocation
STATUS: Stage 4
ISSUE DATE: 04/08/2023
ISSUE REVISION: T01

REVISION BY : WS
CHECKED BY:

LUMINAIRE REF:

EX1

MANUFACTURER: Thorlux Lighting
CONTACT DETAILS: Tim Davy
EMAIL: tim.davy@thorlux.co.uk
TELEPHONE: 07767273019

LUMINAIRE: Exit Sign

IMAGES:



DESCRIPTION: General purpose maintained or non maintained emergency luminaires with a choice of legends. Auto Test versions are available.

DIMENSIONS: 427 x 63 x 190mm (L X W X H)

ACCESSORIES:

LOCATION: Corridor and external areas

LAMP TYPE: LED
LAMP POWER : 4W
LUMINAIRE LL/CW: N/A
OPTIC: N/A
COLOUR TEMPERATURE: 4000K
COLOUR RENDERING INDEX: 80
SERVICE LAMP LIFE: 100,000hrs
CONTROL GEAR: Smart Scan

EQUAL AND/OR APPROVED LUMINAIRE:

-ALL APPROVED ALTERNATIVES MUST EQUAL OR EXCEED SPECIFIED PERFORMANCE REQUIREMENTS-

COMMENTS:

Section

E5

Voice and Data Systems

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E5-1 GENERAL REQUIREMENTS

This section details the requirements for voice and systems and shall be read in conjunction with all other sections of this specification and the associated drawings.

The voice and data systems shall be provided to the CTC workshop at Maudsley Hospital

Throughout this section references are made to requirements and recommendations detailed within several standards, guidance and statutory regulations. It shall be noted the information presented herein is in no way intended to replace the detailed information provided within these documents, which must be fully adhered to where applicable.

E5-2 DEFINITIONS

Refer to Section 2E / Section 1B of this specification and Part 2 of BS 7671 – IET Wiring Regulations – Requirements for Electrical Installations for further details regarding definitions, symbols and abbreviations.

Also refer to the 'Terms, definitions and abbreviations' sections of BS 6701, BS EN 50310, BS EN 50173 and BS EN 50174.

E5-3 REFERENCES TO OTHER SECTIONS OF THIS SPECIFICATION

This section shall not be read in isolation and must be read in conjunction with all other sections of this specification which define further requirements for the electrical installation.

Section 2E details the default requirements for electrical installation quality and materials which shall apply fully to this section of the specification. Wiring accessories shall match the appearance of those associated with utility power, light switches and the like.

E5-4 STANDARDS APPLICABLE

Works shall be completed in accordance with all applicable industry standards. Some of the most relevant standards associated with this section are scheduled below:

STANDARDS AND DOCUMENTS	
BS 7671	IET Wiring Regulations – Requirements for Electrical Installations
IET On-Site Guide – BS 7671 – IET Wiring Regulations – Requirements for Electrical Installations	
All IET Guidance Notes – BS 7671 – IET Wiring Regulations – Requirements for Electrical Installations	
ANSI/TIA/EIA-607	Grounding telecommunications bonding and grounding (earthing) for customer premises
ANSI/TIA/EIA-568	Various telecommunications standards
BS 6701	Telecommunications equipment and telecommunications cabling – Specification for installation, operation and maintenance
BS 7430	Code of practice for protective earthing of electrical installations
BS EN 50173	Information technology – Generic cabling systems
BS EN 50174	Information technology – Cabling installation
BS EN 50310	Telecommunications bonding networks for buildings and other structures
BS EN 50346	Information technology – Cabling installation – Testing of installed cabling
BS EN 60874-1	Fibre optic interconnecting devices and passive components – Connectors for optical fibres and cables
BS EN 61935	Specification for the testing of balanced and coaxial information technology cabling
BS EN IEC 61280	Fibre optic communication subsystem test procedures

STANDARDS AND DOCUMENTS	
BS IEC 61000-5-2	Electromagnetic compatibility (EMC) – Part 5: Installation and mitigation guidelines – Section 2: Earthing and cabling
BS ISO/IEC 14763	Information technology – Implementation and operation of customer premises cabling – Testing of fibre optic cabling
DIN 41494	Equipment practices for electronic equipment; mechanical structures of the 482.6mm (19 inch) series
IEC 60297	Mechanical structures for electronic equipment – Dimensions of mechanical structures of the 482.6mm (19 inch) series
IEC 60603-7	Connectors for electronic equipment
IEC 61156	Multicore and symmetrical pair/quad cables for digital communications
ISO/IEC 11801	Information technology – Generic cabling for customer premises
The Construction Products Regulation	
Construction Products Association – Guidance Note on the Construction Product Regulation	
BICSI – Telecommunications Distribution Methods Manual	
All current and relevant IEEE, ISO/IEC, CENELEC and ANSI/TIA/EIA standards	
All standards, guidance and statutory regulations detailed within Section 2E-3	

Where the above standards refer to supporting documentation and standards these shall be fully complied with in all respects.

Where discrepancy is found between this specification and the relevant standards, the Contractor shall obtain written clarification from the Engineer prior to submission of the tender. Where a discrepancy has not been clarified prior to tender submission, the Contractor shall include the most onerous requirements.

E5-5 DESIGN REQUIREMENTS

The Contractor shall employ one of the named Voice / Data Specialist(s) in Appendix I to supply, install, test and commission the voice and data systems. They shall validate the design and take over the design responsibility for the voice and data systems.

This design validation shall take place during the tender period. It shall include an assessment of whether:

- 1) Equipment specifications shown meet the overall design intent of this specification.
- 2) Main and secondary equipment rooms are suitably located and horizontal structured data cabling does not exceed 90m in length.
- 3) The design intent of this specification is fully compliant with the Guides and Standards listed in this document.

Based on this assessment, the Voice / Data Specialist(s) shall, during the tender period, provide written clarification to the Engineer of any non-compliances and / or additional requirements. They shall obtain from the Engineer any necessary guidance if the method of compliance is open to interpretation.

It is emphasised that the tender submission must include all necessary additional / alternative equipment necessary to achieve a fully compliant installation. Thus, in the absence of tender clarification between alternative methods of compliance, the most onerous compliant option shall be included.

E5-6 THE CONSTRUCTION PRODUCTS REGULATION AND BS 6701

The Contractor shall ensure all voice and data system construction products are suitably certified for their intended use and CE marked in strict accordance with the latest requirements of The Construction Products Regulation.

Voice and data system construction products shall be CE marked, accompanied by a declaration of performance (DoP) and covered by a harmonised European product standard (hEN) or European Technical Assessment (ETA).

All telecommunication cables shall satisfy the requirements of the Construction Products Regulation in respect of their reaction to fire by being provided in strict accordance with BS 6701:-

- 1) All internal telecommunications installation cabling shall as a minimum meet the requirements of EuroClass Cca –s1b, d2, a2, in accordance with BS EN 13501-6 and the flame propagation requirements of BS EN 60332-1-2 and the BS EN 60332-3 series.

This shall include cabling run externally where it enters and runs through buildings to equipment locations but does not apply to cabling run externally which terminates into equipment at the point of entry into a building.

- 2) All other telecommunications cabling shall as a minimum, either:-
 - a) Meet the requirements of EuroClass Eca, in accordance with BS EN 13501-6, or
 - b) Meet the requirements of BS EN 60332-1-2.

Under no circumstances shall these cables be run within buildings.

All internal cabling shall also be LSZH (LSOH, OHLS) with emissions of hydrogen chloride gas < 0.5%.

E5-7 WARRANTY

A complete solution inclusive of all voice / data systems equipment and cabling shall be provided from a single manufacturer and covered by a single manufacturers 25 year warranty.

E5-8 VOICE AND DATA SYSTEMS – RESPONSIBILITY MATRIX

The design, supply and installation responsibilities for the voice and data systems are detailed within Appendix II. The responsibility matrix outlines the obligations of all parties engaged in the voice and data systems installation.

All due allowances shall be made within the tender submission for all necessary liaison with the client's voice and data specialists and incoming telecommunication service providers, to ensure the voice and data systems are fully functional on completion of the works.

E5-9 CLIENTS VOICE AND DATA SYSTEMS DOCUMENTATION

The client does not have any voice and data systems documentation.

E5-10 SCOPE OF WORKS

The voice / data systems installation shall include the provision of the following (where required):-

- 1) Power over Ethernet (PoE) switches for:
 - a) CCTV cameras.
 - b) Wireless access points.
 - c) Etc.
- 2) Wireless access points.
- 3) Horizontal structured data cabling patch panels.
- 4) Horizontal structured data cabling, including:-
 - a) Patch leads.
 - b) Data outlets.
- 5) All necessary:-
 - a) Connectors, pigtails and patch leads.
 - b) Voice frames, patch panels, box connections and connectors.
 - c) Terminations.
 - d) Wiring accessories e.g. data outlets, industrial plugs and socket outlets etc.
 - e) Power and signalling cabling.
 - f) Earthing and bonding.

- g) Cable support and containment systems.
- h) Inspection, testing and commissioning.
- i) Identification, notices and labelling.
- j) O&M information.

It shall be noted the above lists are not exhaustive and reference must be made to all sections of this specification and the associated drawings.

All due allowances shall be made within the tender submission to ensure all necessary power supplies, wiring accessories and associated equipment is provided for the electrical installation, with particular attention paid to electrical systems where the Contractor has design responsibility.

E5-11 TECHNICAL REQUIREMENTS

The voice and data systems shall be designed, selected, installed, tested and commissioned in strict accordance with manufacturer's recommendations and the standards detailed earlier within this specification.

The technical requirements for the voice and data systems shall be as follows:-

TECHNICAL REQUIREMENTS	
Horizontal structured data cabling Horizontal structured data cabling patch leads	Category 6A (U/UTP) Class E _A
Data outlet provision – General use	As indicated on the drawings and room data sheets (where provided).
Data outlet provision – IP based building services systems	Access control system(s) Closed-circuit television (CCTV) system(s) Lighting management system(s) Emergency lighting management system(s)
Telephone outlet provision with internal multi-pair CW1308 cabling to be provided as required	Telephones Fire alarm system(s) – Fire alarm panel(s) only
Voice / data systems equipment and cabling warranty	25 years

E5-12 ACTIVE EQUIPMENT

Generally active equipment (e.g. servers, routers, switches, uninterruptible power supplies (UPS), wireless access points, computer equipment, interactive whiteboards / screens, displays / screens, audio systems, MDP's / DP's, telephones etc.) shall be supplied and installed by the client's specialist(s).

However, reference shall be made to Appendix II – Voice and Data Systems – Responsibility Matrix which outlines the obligations of all parties engaged in the voice and data systems installation.

E5-13 HORIZONTAL STRUCTURED DATA CABLING – PATCH PANELS

Horizontal structured data cabling shall be terminated into patch panels installed within server, equipment and communications racks.

Patch panels shall have the following minimum features:-

- 1) Screened 19" rack mountable, in multiples of 1U (44mm) in height.
- 6) 1U units shall provide 24 ports.
- 7) 2U units shall provide 48 ports.
- 8) Front connections shall be made via RJ45 jacks with:-
 - a) 50 microinch gold plated contact pins.

- b) A minimum life expectancy of 700 insertions.
- 9) Rear connections shall be made by insulation displacement connector (IDC) termination with:-
 - a) A maximum of 100 re-terminations.
- 10) Cable tie bridges between the IDC blocks to relieve cable stress.
- 11) Integral labelling fields above each port.
- 12) Be from the same manufacturer as the server, equipment and communications racks.

A minimum of 1U of manufacturer's proprietary cable management shall be installed for every 48 ports of copper horizontal structured data cabling and for every 1U of fibre patching.

E5-14 HORIZONTAL STRUCTURED DATA CABLING – CONNECTORS, WIRING ACCESSORIES AND PATCH LEADS

Horizontal structured data cabling connectors and patch leads shall be provided as follows:-

- 1) Horizontal structured data cabling shall be terminated into data outlets using insulation displacement connectors (IDC). The data outlets shall be provided with flat shuttered RJ45 connectors.
- 2) Where only a single data outlet is installed in a two gang faceplate a manufacturers proprietary blank insert of the same colour as the faceplate shall be provided.
- 3) No modification shall be made to the wiring of the terminated RJ45 jack and any adaptor must be installed outside of the faceplate, plugged into the RJ45 jack.
- 4) Patch leads shall be provided for each data outlet and shall have the same performance criteria as the horizontal structured data cabling utilised.
- 5) Each patch lead shall be screened and provided with strain relief boots / RJ45 connectors.
- 6) Horizontal structured data cabling patch leads shall be a minimum of 2m in length.
- 7) The connectors and patch leads must have current independent third party approval status at component level and include specification references.

Wiring accessories shall be provided as detailed within the Wiring Accessories section of this specification.

E5-15 HORIZONTAL STRUCTURED DATA CABLING

Horizontal structured data cabling shall be provided from server, equipment and communications racks to data outlets as indicated on the drawings and room data sheets (where provided). Cable runs shall be continuous without joins or splices and shall not exceed 90 metres in length.

The type of horizontal structured data cabling to be installed shall be as detailed in the technical requirements section of this specification and shall comply with the following performance criteria as appropriate:-

HORIZONTAL DATA CABLING TYPE	CLASS	SUPPORTED FREQUENCY (MHz)	APPLICATION			
			10BASE-T	100BASE-TX	1000BASE-T	10GBASE-T
			ETHERNET	FAST ETHERNET	GIGABIT ETHERNET	10 GIGABIT ETHERNET
Category 5e	D	100	✓	✓	✓	X
Category 6	E	250	✓	✓	✓	X
Category 6A	EA	500	✓	✓	✓	✓
Category 7	F	600	✓	✓	✓	✓
Category 7A	FA	1000	✓	✓	✓	✓

Notes:

- 1) Horizontal structured data cabling shall comply with the performance criteria detailed within BS EN 50173.

The horizontal structured data cabling must have current independent third party approval status at component level and include specification references.

Where horizontal structured data cabling is to be installed externally it shall be UV stable (commonly black in colour), moisture resistant (polyethelene outer sheath) and designated as external grade (PE).

The table below details the minimum installed bending radii for cabling and the maximum number of cables to be installed in conduit:-

HORIZONTAL DATA CABLING TYPE	CABLE DIAMETER (mm)	MINIMUM INSTALLED BENDING RADIUS (mm)	MAXIMUM NO. OF CABLES TO BE INSTALLED (FROM BICSI TDMM)		
			CONDUIT DIAMETER (mm)		
			20	25	32
Category 5e (U/UTP) Class D	5.2	TBC	3	6	10
Category 5e (F/UTP) Class D	6.4	TBC	2	3	6
Category 6 (U/UTP) Class E	5.86	45	2	4	7
Category 6 (F/UTP) Class E	7.2	TBC	1	2	5
Category 6A (U/UTP) Class EA	8.3	33	1	2	3
Category 6A (U/FTP) S-Foil Class EA	6.7	27	2	3	6
Category 6A (F/FTP) S-Foil Class EA	6.9	31	1	3	5
Category 7A (S/FTP) Class FA	7.8	32	1	2	4
Category 7A Plus S/FTP Class FA	8.5	32	1	1	3
Notes: 1) The above technical information has been obtained from horizontal structured data cabling manufacturers. 13) The Contractor and Voice / Data Specialist shall verify the above technical information with the cable manufacturer prior to installation. 14) TBC – To be confirmed with the horizontal structured data cabling manufacturer. 15) The installation of horizontal data cabling shall be undertaken with consideration of the minimum cable bending radii e.g. forming of cable basket, cable entries into conduit take-off plates / dado trunking, back box depths, conduit bends etc. 16) Cable basket and conduit shall be provided in strict accordance with Section 2E of this specification.					

The installation of horizontal structured data cabling shall be undertaken with consideration of the minimum cable bending radii e.g. forming of cable basket, cable entries into conduit take-off plates / dado trunking, back box depths, conduit bends etc.

Manufacturer's cable installation recommendations, cable pulling tensions and the standards detailed earlier within this specification shall be strictly adhered to. Wherever possible cabling shall be laid rather than pulled into containment systems.

Back box depths shall be selected in strict accordance with manufacturer's recommendations to accommodate the minimum installed bending radii of the cabling with consideration of the following:-

- 1) Data outlet type specified.
- 17) Shutter type specified.
- 18) Dado trunking (where applicable) type specified.

Back boxes shall have a minimum depth of 32mm.

Where horizontal structured data cabling is installed upon cable basket, cables shall be bundled such that a maximum of 24 cables are contained in any one bundle. An air gap shall be provided between bundles.

In both cases cables shall be Velcro tied every 500mm and secured to the cable basket at a minimum of 600mm intervals. Care shall be taken to ensure that cables are not damaged due to over tightening.

Under no circumstances shall horizontal structured data cabling be installed on cable tray.

E5-16 WIRELESS ACCESS POINTS

Wireless access points shall be provided in the form of single data outlets located at high level as indicated on the drawings and room data sheets (where provided). The wireless access points shall utilise power over Ethernet (PoE) technology.

E5-17 TELEPHONE CABLING

The Contractor and Voice / Data Specialist(s) shall provide all necessary internal multi-pair CW1308 cabling and telephone outlets as required for:-

- 1) Telephones

E5-18 IDENTIFICATION, NOTICES AND LABELLING

This section of the specification details the general requirements for the provision of identification, notices and labelling. Identification, notices and labelling shall be provided in strict accordance with BS EN 50174, BS 7671 and all supporting IET documentation.

The identification, notices and labelling systems shall also be in accordance with any existing site standards and shall be agreed with the Engineer prior to installation. Where there is a discrepancy between existing site standards and the Engineers specification / drawings, written confirmation from the Engineer shall be obtained prior to submission of tender costs to clarify the requirements, and in the absence of such the more onerous requirements shall be included.

Cable sleeves, labels and markers as a minimum shall be made from materials equivalent to that of the cabling being labelled e.g. LSZH, LSOH, OHLS etc. They shall also be selected to suit the environment in which they are installed.

Labelling shall be provided as follows:-

E5-18-1 HORIZONTAL STRUCTURED DATA CABLING SYSTEMS

Horizontal structured data cabling systems shall be provided with unique identifiers which are to be agreed with the Engineer prior to installation.

Each telecommunications / equipment room may have more than 26 RJ45 patch panels, so it is possible that multiple digits may be required for identification e.g. Panel 1 will be A-01 to A-24, Panel 2 will be B-01 to B-24 and so on until Panel 26 which will be Z-01 to Z-24. Panel 27 will be AA-01 to AA-24, Panel 28 will be AB-01 to AB-24 etc.

COPPER CABLING

Horizontal copper cabling shall be provided with wrap around printed adhesive labelling:-

- 1) 200mm from the patch panel termination point.
- 2) Within 100mm of a work area termination.

The labelling shall be co-ordinated with the patch panel and faceplate port ID.

FIBRE CABLING

Horizontal fibre optic cables shall be provided with traffolyte labelling fixed with cable ties / tie wraps, 200mm from the patch panel termination point. The labelling shall be co-ordinated with the patch panel ID.

PATCH PANELS

Each patch panel port shall be provided with a unique traffolyte label with a two digit port indicator and a two digit alphanumeric panel indicator, with the panel indicator coming first in the sequence (as detailed above). Each fibre patch panel shall be labelled with the warning signage 'WARNING – FIBRE OPTIC CABLE'.

E5-18-2 WALL AND FLOOR MOUNTED CABINETS / RACKS

Each wall or floor mounted cabinet / rack shall be provided with traffolyte labelling fixed to the front door (top right hand corner) detailed the comms room ID code.

E5-18-3 OPEN FRAMES

Each open frame shall be provided with traffolyte labelling fixed to the top of the frame detailing what it serves.

E5-18-4 GENERAL REQUIREMENTS

Also refer to Section 2E of this specification.

E5-19 TECHNICAL SUBMISSIONS

Prior to installation on-site the Contractor shall provide technical submissions for the following:-

- 1) Technical specifications and certification for all voice and data cabling to confirm compliance with the latest requirements of The Construction Products Regulation.
- 19) Technical specifications for all voice and data equipment and cabling to be installed.
- 20) Network and wiring schematic drawings for all voice / data systems to be installed, generic manufacturer's schematics will not be accepted.
- 21) Wiring schematic drawing for the voice / data system dedicated telecommunications bonding network, generic manufacturer's schematics will not be accepted.
- 22) Layout drawings for all MER's and SER's.
- 23) Layout drawings / elevations for all server, equipment and communications racks.
- 24) Schedule of all identification, notices, labels (including safety signage) and cable identification labels / markers along with a physical sample of each label type.
- 25) Full cross connected patching schedules.

The time allowed for comment by the Engineer and the clients voice and data specialist(s) shall be as detailed within section 1B of this specification.

E5-20 DIAGRAMS AND DOCUMENTATION

Diagrams and documentation shall be provided in strict accordance with BS EN 50174 and BS 6701.

The drawings shall include:-

- 1) Network and wiring schematic drawings for all voice / data systems to be installed, generic manufacturer's schematics will not be accepted.
- 26) Layout drawings detailing the locations of all voice and data equipment, telephone outlets and data outlets etc. (every telephone / data outlet shall be shown with its unique references).
- 27) Layouts drawings indicating all backbone fibre optic cabling routes including transition points and cable types.
- 28) Layout drawings for all MER's and SER's.
- 29) Layout drawings / elevations for all server, equipment and communication racks.
- 30) Full cross connected patching schedules.

The documentation shall include:-

- 1) Certification for all voice and data cabling to confirm compliance with the latest requirements of The Construction Products Regulations.
- 31) Current independent 3rd party component compliance certification for all items supplied and installed, indicating manufacturer and component references.
- 32) Technical specifications for all voice and data equipment and cabling to be installed.
- 33) Test certification for all horizontal structured data cabling and backbone fibre optic cabling (including patch leads).
- 34) Any maintenance requirements to maintain the manufacturer's warranty.
- 35) Certification for a single manufacturer's 25 year warranty.

The above drawings and documentation shall be included within the O&M manual.

E5-21 INSPECTION, TESTING AND COMMISSIONING – VOICE & DATA SYSTEMS

The voice and data system(s) shall be inspected, tested and commissioned in strict accordance with BS EN 50173, BS EN 50174, BS EN 61935, BS EN 50346, BS EN IEC 61280, ISO/IEC 11801, ANSI/TIA/EIA-568, manufacturer's recommendations and the standards detailed earlier within this specification as appropriate.

Where the above standards and those detailed earlier within this specification refer to supporting standards and documents these shall be fully complied with in all respects.

E5-21-1 DEFINITIONS

Channel – The channel is defined as the 90 metres of horizontal cable, the telecommunications connector and patch cord in the work area as well as two connectors and a maximum of two patch / equipment cords in the telecommunications room. The maximum allowable length of patch cords and equipment cords is 10 metres. Also included in the channel is an optional transition or consolidation point.

Permanent Link – The permanent link is defined as a maximum of 90 metres of horizontal cable, an optional transition or consolidation point and one connection on each end. The Permanent Link does not include the instrument cords or connectors on the field test equipment.

Link Segment – An optical fibre link includes the connectors, splices (if required) and the passive cabling between two optical fibre connection hardware termination points.

Every installed channel, permanent link and link segment shall be tested against the performance criteria detailed in the above standards.

E5-21-2 TEST EQUIPMENT

Test instruments shall be selected in strict accordance with the standards detailed earlier within this specification. Test instruments shall also be selected to meet the required instrument accuracy and performance criteria for the channels, permanent links and link segments to be tested.

As a minimum the accuracy of test instruments shall be confirmed by formal calibration / re-calibration at intervals recommended by the manufacturer and shall be supported by calibration certificates provided by laboratories accredited by the United Kingdom Accreditation Service (UKAS).

More frequent re-calibrations may be required if test instruments are exposed to changes in temperature / humidity and also if they are roughly handled and regularly transported / stored in vehicles. It shall be the Contractors / Voice & Data Specialists responsibility to ensure that the test instruments meet the required accuracy and performance criteria prior to testing.

The model and serial number for each test instrument shall be recorded on the certification, reports and schedules. A copy of the calibration certificate for each test instrument shall be provided as part of the Operation and Maintenance Manual.

BALANCED CABLING – HORIZONTAL STRUCTURED DATA CABLING

As a minimum the test instruments shall comply with or exceed the instrument accuracy requirements as required and shall be selected in strict accordance with the aforementioned standards e.g. Fluke DSX CableAnalyzer series or similar, as appropriate for the testing being undertaken.

Test instruments shall be classified as detailed below dependent upon the class of cabling and the required performance level:-

PERFORMANCE LEVEL	HORIZONTAL DATA CABLING TYPE	CLASS
Level IIE test equipment or better	Category 5e	D
Level III test equipment or better	Category 6	E
Level IIIE test equipment or better	Category 6 _A	E _A
Level IV test equipment or better	Category 7 and Category 7 _A	F and F _A

OPTICAL FIBRE CABLING – BACKBONE FIBRE OPTIC CABLING

The test instruments shall comprise of an optical source / optical power meter and shall be selected in strict accordance with the aforementioned standards and as required for the multimode and single mode fibre optic cabling to be tested e.g. Fluke OptiFiber / CertiFiber / MultiFiber or similar.

E5-21-3 BALANCED CABLING – HORIZONTAL STRUCTURED DATA CABLING

VISUAL INSPECTION

Visual inspection of installed cabling shall be performed in strict accordance with IEC 61935-1 by observing that:-

- 1) the condition, installation quality and finish are satisfactory,
- 2) the marking is legible,
- 3) mechanical damage is absent and there is not undesired movement or displacement of parts,
- 4) flaking of materials or finishes is absent.

Examination shall generally be undertaken without any magnification.

TESTING TRANSMISSION PROCEDURES

Every installed channel and permanent link shall be tested against the performance criteria detailed in the above standards and shall be provided with a 'PASS' or 'FAIL' condition for each test transmission parameter as determined by the test instrument.

As a minimum the following parameters shall be tested for every installed channel and permanent link (unless stated otherwise):-

- 1) Wire-map.
- 2) Continuity.
- 3) Propagation delay.
- 4) Delay skew.
- 5) Length.
- 6) Insertion loss.
- 7) Near-end crosstalk (NEXT) loss.
- 8) NEXT, power sum (PS NEXT).
- 9) Attenuation-to-crosstalk ratio, near end (ACR-N).
- 10) ACR-N, power sum (PS ACR-N)
- 11) Equal level far end crosstalk (ELFEXT) or attenuation-to-crosstalk ratio, far end (ACR-F).
- 12) ELFEXT, power sum (PS ELFEXT) or attenuation-to-crosstalk ratio, far end, power sum (PS ACR-F).
- 13) Return loss.

The following shall be calculated:-

- 1) Direct current d.c. loop resistance.

Sample testing shall be provided for the following where the performance criteria is not met by the design. The sample size to be tested shall be in strict accordance with BS EN 50174 / IEC 61935:-

- 1) Power sum alien NEXT (PS ANEXT).
- 2) Power sum attenuation-to-alien crosstalk ratio, far end (PS AACR-F).

Test results of individual parameters shall be marked with an asterisk if the difference between the measured result and the test limit is less than the specified measurement accuracy.

Tests that provide a PASS condition are acceptable and tests that provide a FAIL condition are not acceptable. Tests that provide a PASS* or FAIL* condition are not acceptable and shall be treated in the same way as a FAIL condition.

Any channel / permanent link that provides a PASS*, FAIL* or FAIL condition shall be diagnosed, rectified and re-tested to confirm compliance with the required performance criteria and provide a PASS condition, with the Contractor / Voice & Data Specialist bearing all costs associated with this work.

E5-21-4 OPTICAL FIBRE CABLING – BACKBONE FIBRE OPTIC CABLING

Every installed link segment shall be tested against the performance criteria detailed in the above standards and shall be provided with a 'PASS' or 'FAIL' condition for each test transmission parameter (where required) as determined by the test instrument.

As a minimum the following parameters shall be tested for every installed link segment:-

- 1) Link attenuation.
- 2) Length
- 3) Continuity.
- 4) Propagation delay.

Sample testing shall be provided for the following, provided that polarity has been confirmed:-

- 1) Delay skew.

Tests that provide a PASS condition are acceptable and tests that provide a FAIL condition are not acceptable.

Any link segment that provides a FAIL condition shall be diagnosed, rectified and re-tested to confirm compliance with the required performance criteria and provide a PASS condition, with the Contractor / Voice & Data Specialist bearing all costs associated with this work.

E5-21-5 DOCUMENTATION / CERTIFICATION

The testing results for each link shall be recorded in the memory of the test equipment and shall be transferred into an MS Windows based database software package (e.g. Fluke LinkWare or similar) that will allow for the inspection and printing of the test records.

The database for the completed works shall be stored and provided on a CD-ROM which shall include the software tools required to inspect and print the test results in report format (including colour graphical test results).

Test results shall be provided within the O&M manual for all links tested with the following summary information:-

- 1) Balanced cabling / Horizontal structured data cabling – The overall PASS / FAIL evaluation of the link-under-test including the NEXT Headroom (overall worst case) number.
- 2) Optical fibre cabling / Backbone fibre optic cabling – The overall PASS / FAIL evaluation including the Attenuation worst-case margin (margin is defined as the difference between the measured value and the test limit value).
- 3) Date and time the test results were recorded by the test equipment.

The electronic database shall provide the following information for each link:-

- 1) Identification of the link in accordance with the naming / identification conventions used.
- 2) Test results for each of the testing parameters detailed earlier.
- 3) Overall PASS / FAIL evaluation.
- 4) Balanced cabling / horizontal structured data cabling:-
 - a) Cable type and the value of NVP used for length calculations.
 - b) Test value measured at every frequency during the test where it shall be possible to inspect and print the measured parameters in colour graph format.
- 5) Optical fibre cabling / Backbone fibre optic cabling:-
 - a) Cable type and the value of the 'index of refraction' used for length calculations.
 - b) Attenuation measured at each wavelength.
 - c) Link length.
- 6) Date and time the test results were recorded by the test equipment.
- 7) Manufacturer, model and serial number of the test equipment.
- 8) Revision of the database software package.

E5-21-6 FORMAL WITNESSING OF TESTING



The person(s) undertaking the inspection / testing works shall give reasonable notice of all tests to permit them to be witnessed by the Engineer. The required period of notice shall normally be 10 days but shall be variable at the discretion of the Engineer.

Preliminary testing shall be undertaken prior to any formal witnessing by the Engineer. The preliminary test results shall be provided to the Engineer in draft certificates before inviting the Engineer to attend formal witnessing. The Engineer will then witness the formal tests in full or selectively as deemed necessary to verify the draft test results.

The proportion of tests to be witnessed by the Engineer will be 20%, though this could be reduced to 10% at the discretion of the Engineer on very large systems. The Engineer has the right to ask for a higher proportion of witnessing should the verification or witnessing exercise be unsuccessful e.g. a FAIL condition is found. In this instance the Contractor / Voice & Data Specialist shall bear all costs associated with this additional work.

Upon completion the system(s) shall be demonstrated to the Engineer and the Client. The Contractor / Voice / Data Specialist(s) shall provide training to the Client until they fully understand the operation of the system.

E5-22 INSPECTION, TESTING AND COMMISSIONING – ELECTRICAL INSTALLATION

The electrical installation works associated with the voice and data system(s) shall be inspected and testing in strict accordance with BS 7671 and Section 2F of this specification. All circuits / test results shall be recorded on the 'Schedule of circuit details / Schedule of test results' provided within the Electrical Installation Certificates).

Formal witnessing of testing and commissioning shall be undertaken in strict accordance with Section 2F of this specification.

APPENDIX I – VOICE AND DATA SYSTEMS – ELECTRICAL EQUIPMENT AND SPECIALISTS SCHEDULE

ELECTRICAL EQUIPMENT	SPECIALIST / MANUFACTURER / PRODUCT RANGE/ MATERIAL
Voice / Data Specialist(s) / Installer(s)	TBC / Agreed by/with the Hospital



APPENDIX II – VOICE AND DATA SYSTEMS – RESPONSIBILITY MATRIX

VOICE & DATA SYSTEMS – RESPONSIBILITY MATRIX



CLIENT / PROJECT:	CTC Workshop Relocation Maudsley Hospital	ISSUE DATE:	04/08/2023	PRODUCED BY:	WS	CLIENT SIGN OFF:	Awaiting
		REVISION:	T1	VERIFICATION BY:	TBC	SIGN OFF DATE:	Awaiting

Key: R = Responsible I = Input required S = Performance specification D = Design	DESIGN & SPECIFICATION			PROCUREMENT			INSTALLATION & TESTING			NOTES
	CLIENT	CPW	CONTRACTOR	CLIENT	CPW	CONTRACTOR	CLIENT	CPW	CONTRACTOR	
Horizontal structured data cabling										
Cabling	I	R(S)	R(D)			R			R	Refer to Section E5 for cabling specification
Connectors and RJ45 data outlets	I	R(S)	R(D)			R			R	Includes data outlets for building services systems e.g. security systems, lighting management systems, BMS etc.
Patch panels	I	R(S)	R(D)			R			R	
Patch leads	I	R(S)	R(D)			R			R	
Other equipment and installation works										
Wireless access points	R			R			R			
Identification, notices and labelling	I	I				R			R	Technical submission to be provided for comment prior to production / installation
Dedicated telecommunications earthing and bonding installation	I	R(S)	R(D)			R			R	
Diagrams and documentation	I	I				R			R	Technical submissions / O&M's to be provided for comment
Inspection, testing and commissioning	I	I				R			R	

Section E6A

Access Control Systems

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E6A-1 ACCESS CONTROL SYSTEMS

This section details the requirements for access control systems and shall be read in conjunction with all other sections of this specification and the associated drawings.

The access control systems shall be provided to the CTC Workshop at Maudsley Hospital

E6A-2 DEFINITIONS

Refer to Section 2E / Section 1B of this specification and Part 2 of BS 7671 – IET Wiring Regulations – Requirements for Electrical Installations for further details regarding definitions, symbols and abbreviations.

E6A-3 REFERENCES TO OTHER SECTIONS OF THIS SPECIFICATION

This section shall not be read in isolation and must be read in conjunction with all other sections of this specification which define further requirements for the electrical installation.

Section 2E details the default requirements for electrical installation quality and materials which shall apply fully to this section of the specification. Wiring accessories shall match the appearance of those associated with utility power, light switches and the like.

E6A-4 STANDARDS APPLICABLE

Works shall be completed in accordance with all applicable industry standards. Some of the most relevant standards associated with this section are scheduled below: -

STANDARDS & DOCUMENTS	
BS EN 50130-4	Alarm systems – Part 4: Electromagnetic compatibility – Product family standard: Immunity requirements for components of fire, intruder, hold up, CCTV, access control and social alarm systems
BS EN 50130-5	Alarm systems – Part 5: Environmental test methods
BS EN 50398-1	Alarm systems – Combined and integrated alarm systems
BS EN 60839-11	Alarm and electronic systems – Part 11 Electronic access control systems
BS EN IEC 62820	Building intercom systems
BS EN ISO 12944	Paints and varnishes – Corrosion protection of steel structures by protective paint systems
BS ISO / IEC 14443	Cards and security devices for personal identification – Contactless proximity objects
BS ISO / IEC 15693	Cards and security devices for personal identification – Contactless vicinity objects
NACP 2	National Security Inspectorate (NSI) – NACOSS Gold and ARC Gold – Code of practice for customer communications
NACP/ICP 30	NSI – NACOSS Gold – Code of practice for planning, installation and maintenance of access control systems
NCP 109	NSI – NSI Code of practice for the design, installation and maintenance of access control systems
SS 2002	SSAIB Access control – Code of practice
Data Protection Act & The General Data Protection Regulation (GDPR)	
All current and relevant British Security Industry Association (BSIA), National Security Inspectorate (NSI) and Security Systems and Alarm Inspection Board (SSAIB) publications	
All standards, guidance and statutory regulations detailed within Section 2E-3	

Where the above standards refer to supporting documentation and standards these shall be fully complied with in all respects.

Where discrepancy is found between this specification, specialist quotations and the relevant standards, written clarification shall be obtained prior to submission of tender. Where a discrepancy has not been clarified prior to tender submission the most onerous requirements shall be included within the tender price.

E6A-5 DESIGN REQUIREMENTS

The Contractor shall employ one of the Access Control Specialist(s) named in Appendix to supply, install, test and commission the access control systems. The Access Control Specialist(s) must be a member of a recognised accreditation body (e.g. NSI Gold, SSAIB). They shall validate the design and take over the design responsibility for the access control systems.

This design validation shall take place during the tender period. It shall include an assessment of whether:

- 1) Equipment specifications shown meet the overall design intent of this specification.
- 2) Equipment quantities shown meet the overall design intent of this specification.
- 3) The design intent of this specification is fully compliant with the Guides and Standards listed in this document.

Based on this assessment, the Access Control Specialist(s) shall, during the tender period, provide written clarification of any non-compliances and / or additional requirements. They shall obtain clarification if the method of compliance is open to interpretation.

It is emphasised that the tender submission must include all necessary additional / alternative equipment necessary to achieve a fully compliant installation. Thus, in the absence of tender clarification between alternative methods of compliance, the most onerous compliant option shall be included.

E6A-6 CAUSE & EFFECT SCHEDULE

A cause and effect schedule / matrix shall be developed by the Contractor/Access Control Specialist; this shall incorporate access strategy, fire strategy, Secured by Design and third-party system interface requirements. The cause and effect shall be submitted for comment prior to final programming and commissioning. No programming or commissioning shall be undertaken prior to agreement or acceptance.

E6A-7 SYSTEM OVERVIEW

Access control systems shall typically consist of proximity readers, electrically operated locks, door/gate controller units, request-to-exit buttons, emergency break glass overrides and fire alarm interfaces.

Access control systems shall utilise MIFARE radio-frequency identification (RFID) technology.

Access control systems shall be designed to include a series of 'online' (constant network connected), plus where indicated, 'offline' (no direct network connection) doors/gates to form a 'virtual network'. Online controllers shall be located to facilitate: -

- 1) Real time activity/events to be logged/recorded at key entry/egress points and high importance areas.
- 2) Update smart card/key fob privileges.
- 3) Transfer programming information to smart cards/key fobs to update subsequent offline doors/gates (virtual network).

To fulfil the above, 'online' controller units shall (as a minimum) be provided to the following: -

- 1) All main ingress points into the buildings / areas e.g. entrance doors.
- 2) Evenly distributed on main circulations routes e.g. entrances to corridors.
- 3) All doors/gates requiring an electrical interface to operate (e.g. turnstile, vehicle gate etc.).
- 4) All external gates.
- 5) High security risk areas (security rooms, server rooms, comms rooms etc.).
- 6) Plant rooms/switch rooms.

Where offline doors/gates are used to supplement online provisions, they shall be integrated as part of ironmongery.

E6A-8 SCOPE OF WORKS

The scope of works shall include the following non-exhaustive items: -

- 1) Proximity readers.
- 2) Smart cards
- 3) Controller units.
- 4) Request to exit pushbuttons.
- 5) Emergency break glasses.
- 6) Interfaces to fire alarm system.
- 7) All necessary: -
 - a) End-user management software.
 - b) Wiring accessories e.g. data outlets, telephone outlets, un-switched fused connection units, double pole lockable key switches etc.
 - c) Power and signalling cabling.
 - d) Earthing and bonding.
 - e) Cable support and containment systems.
 - f) Inspection, testing and commissioning.
 - g) Identification, notices and labelling.
 - h) O&M information.

It shall be noted the above lists are not exhaustive and reference must be made to all sections of this specification and the associated drawings.

All due allowances shall be made within the tender submission to ensure all power supplies, wiring accessories and associated equipment is provided for the electrical installation, with particular attention paid to electrical systems where the Contractor has design responsibility.

E6A-9 GENERAL INSTALLATION REQUIREMENTS

GENERAL

I&HAS system(s) shall be designed, selected, installed, tested and commissioned in strict accordance with all relevant standards detailed within this section of the specification and corresponding manufacturer's information.

EQUIPMENT SELECTION

The location, size, finish and fixing detail of all equipment shall account for programme and architectural requirements. Core system components shall be from a single manufacturer and updated with the most current firmware at the point of commissioning.

ENVIRONMENTAL CONDITIONS

Equipment shall account for environmental conditions with respect to water/dirt ingress (IP rating), corrosion resistance, impact, likely vandalism and longevity for an anticipated 10-year lifecycle under a suitable PPM regime; details to be provided within the technical submittal.

CABLE SUPPORT & CONTAINMENT SYSTEMS

The Contractor shall provide all necessary cable support and containment systems for all power and signalling cabling associated with the access control system installation. The cable support and containment systems shall be sized in strict accordance with BS 7671 and manufacturers' literature.

All cable support and containment systems shall be provided in strict accordance with Section 2E of this specification.

CABLING & TERMINATIONS

Cabling, terminations and identification markers shall be in accordance with other sections of this document.

Horizontal structured data cabling shall be provided as detailed within Section E5 of this specification, except where fibre is implemented due to distance, bandwidth or electrical separation requirements.

'Online' doors shall be connected to the LAN via concealed data points using secure RJ45 plug lock-in devices.

All power, signalling and earthing / bonding cabling shall be LSZH (LSOH, OHLS) with emissions of hydrogen chloride gas < 0.5%. All equipment and cabling shall be selected and installed in strict accordance with manufacturers' literature.

POWER SUPPLIES

Access control systems equipment shall be provided with dedicated circuit(s) independent to any other system or general power provision.

CONCEALED INSTALLATION

All cable support / containment systems and cabling shall be concealed within the building fabric.

E6A-10 PROXIMITY READERS

Access to a controlled door shall be by presentation of a valid programmable RFID proximity smart card to a contactless proximity reader on the unsecured side of the door, which shall be mounted adjacent to the door ('online' doors) or incorporated into the door handle ('offline' doors).

Where readers are mounted adjacent to the doors, they shall be rugged and tamperproof, complete with monitoring facilities to detect vandalism/tampering.

Readers shall be securely fixed user tamper proof fixings and shall be wired via flush conduits installed within the building fabric. Close site liaison is required to ensure that the conduit is installed to a position where the reader operation will not be undermined.

E6A-11 SMART CARDS

The Smart cards system shall be fully compatible with the existing system.

E6A-12 LOCKS

Electromagnetic locks shall be selected in accordance with doorset specifications (detailed by others). The lock type and corresponding holding force shall be tested and certified for the specific application requirements.

'Online' electronic locks shall be of the over door magnetic type (e.g. maglock) and 'offline' locks shall be incorporated into door handles. Where the over door type is used, they shall be securely fixed and incorporated into the door frame at the head of the door.

Over door electronic locks shall be supplied and installed by the Contractor / Access Control Specialist. Where locks are incorporated into door handles, they shall be supplied as part of the architectural ironmongery package and shall be installed by the Contractor / Access Control Specialist.

The Access Control Specialist shall liaise with the Contractor during the tender period to ensure all due allowances are made within the tender for door locks. All door locks shall operate at 24V AC or DC.

E6A-13 CONTROLLER UNITS

Controller units shall be provided as necessary to suit the location, number and configuration of 'online' access-controlled doors; these shall be positioned locally within a concealed accessible location (e.g. electrical service riser, plant room, switch room, DB cupboard, ceiling void etc.).

Where located within ceiling voids, consideration will need to be given to the fire strategy with respect to fire alarm void detection.

Controllers shall be provided with battery back-up so that in the event of power failure the access control shall continue to operate independently for a minimum period of 4 hours.

Controllers shall retain the latest configuration information for access privileges and not rely upon data held remotely for normal operation.

E6A-14 REQUEST TO EXIT PUSHBUTTONS

Egress shall be provided by green mushroom head pushbuttons to initiate request-to-exit; these shall be labelled 'PRESS TO EXIT' or similar. For modifications or additions to existing systems the type and appearance shall match those used elsewhere.

E6A-15 EMERGENCY BREAK GLASSES

Emergency egress shall be provided by semi-recessed green emergency exit break glasses that shall be labelled "EMERGENCY DOOR RELEASE" or similar. The green emergency exit break glass shall de-energise the door lock until it has been manually reset by key or similar proprietary tool.

E6A-16 INTERFACES TO THE FIRE ALARM SYSTEM

Each online door controller shall be connected to an addressable fire alarm interface that is part of the fire alarm system, so that upon activation, each access-controlled door 'fails safe' (unlocked).

Door locks shall re-energise upon resetting of the fire alarm system. Consideration shall be given to spaces where a 'fail safe'/open state may not be appropriate due to specific security risks and/or restricted substances; in such instances the security and fire strategy shall be fully consulted and reviewed with the appropriate persons and authorities.

The Contractor / Access Control Specialist shall supply and install all cabling between door controllers and fire alarm interfaces.

E6A-17 END-USER MANAGEMENT SOFTWARE

The access control systems shall be integrated into the existing site supervisory / end-user management software. The Access Control Specialist shall: -

- 1) Update the software so that the new access control systems within refurbished, remodelled and new build areas / buildings are fully integrated into the existing software.
- 2) Incorporate room numbers / names co-ordinated with the architectural drawings and the site room referencing system.
- 3) Upload and integrate into the existing software the latest floor plans where used as part of an end-user GUI.

E6A-18 TECHNICAL SUBMISSIONS

Prior to installation on-site the Contractor shall provide technical submissions for the following:-

- 1) Cause and effect schedule/chart.
- 2) Technical specification for all cabling, equipment and components to be installed.
- 3) Technical specifications for all software and mobile applications.
- 4) Project specific schematics and wiring diagrams; generic manufacturers' details will not be accepted.
- 5) Layout drawings detailing the locations of all equipment.
- 6) Maintenance requirements.

The time allowed for comment shall be as detailed within section 1B of this specification.

E6A-19 DIAGRAMS & DOCUMENTATION

Diagrams and documentation shall be provided in strict accordance with NACP 30 and NCP 109.

E6A-20 INSPECTION, TESTING & COMMISSIONING

The access control system(s) shall be inspected, tested and commissioned in strict accordance with all relevant standards detailed within this section of the specification and corresponding manufacturer's information.

Access control equipment and end-user software shall be programmed and commissioned so that room numbers and names used are co-ordinated with the architectural drawings and the site room referencing system.

The electrical installation works associated with the access control system shall be inspected and tested in strict accordance with BS 7671 and Section 2F of this specification. All circuits / test results shall be recorded on the 'Schedule of circuit details / Schedule of test results' provided within the Electrical Installation Certificates.

Formal witnessing of testing and commissioning shall be undertaken in strict accordance with Section 2F of this specification.

Upon completion the system(s) shall be demonstrated to the Engineer and the Client. The Contractor / Access Control Specialist(s) shall provide training to the Client until they fully understand the operation of the system.

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Commissioning certification shall be provided to verify the correct installation and operation of the access control system(s). The commissioning certification and as-installed drawings for the access control system(s) shall be included within the O&M manual.

APPENDIX I – MANUFACTURERS & MATERIALS

ELECTRICAL EQUIPMENT	SPECIALIST / MANUFACTURER / PRODUCT RANGE/ MATERIAL
Access Control Specialist(s) / Installer(s)	<p>Gretton Ward Electrical Limited</p> <p>Electrical Engineers Registered Office 3 Murray Business Centre Murray Road, Orpington, Kent BR5 3RE Registered In England No 1156878 Telephone No 01689 883970 Fax No 01689 883971 Mobile No: 07956 367219 Email: paul@grettonward.co.uk</p>
<p>Note: Reference must also be made to any accompanying equipment and specialist schedules.</p>	

Section E6C

CCTV Systems



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E6C-1 CCTV SYSTEMS

This section details the requirements for CCTV systems and shall be read in conjunction with all other sections of this specification and the associated drawings.

The CCTV systems shall be provided to the CTC workshop at Maudsley Hospital

E6C-2 DEFINITIONS

Refer to the standards / documents referenced within this section, Section 2E / Section 1B of this specification and Part 2 of BS 7671 for further details regarding definitions, symbols and abbreviations.

Note the following definitions and abbreviations specific to this section: -

DEFINITIONS			
AES	Automatic Electronic Shutter	ICO	Information Commissioner's Office
AGC	Automatic Gain Control	IP	Internet Protocol
ALC	Automatic Level Control	IR	Infrared
APP	Application for Smart Device	LAN	Local Area Network
BLC	Backlight Compensation	LCD	Liquid Crystal Display
BSIA	British Security Industry Association	MJPEG	Motion Joint Photographic Experts Group
CAST	Centre for Applied Science and Technology	MP	Mega Pixel
CBR	Constant Bit Rate	NSI	National Security Inspectorate
CCD	Charge-Coupled Device	NVR	Network Video Recorder
CCTV	Closed Circuit Television	ONVIF	Open Network Video Interface Forum
CMOS	Complementary Metal-Oxide Semiconductor	PCPI	Police Crime Prevention Initiatives
CPR	Construction Products Regulation	PIA	Privacy Impact Assessment
DDNS	Dynamic Domain Name Service	PoE	Power-over-Ethernet
DHCP	Dynamic Host Configuration Protocol	PPM	Planned Preventative Maintenance
DNR	Dynamic Noise Reduction	PSU	Power Supply Unit
DOF	Depth of Field	PTZ	Pan, Tilt and Zoom
DPA	Data Protection Act	RAID	Redundant Array of Independent Disks
DPIA	Data Protection Impact Assessment	ROI	Region of Interest
DVI	Digital Visual Interface	RTSP	Real Time Streaming Protocol
FOV	Field of View	SBD	Secured by Design
FPS	Frames Per Second	SSAIB	Security Systems and Alarms Inspection Board
GDPR	General Data Protection Regulation	TFT	Thin-Film-Transistor
GOP	Group of Pictures	UPS	Uninterruptable Power Supply
GUI	Graphical User Interface	VA	Video Analytics
HDD	Hard Disk Drive	VBR	Variable Bit Rate
HDMI	High-Definition Multimedia Interface	VR	Vandal Resistant

DEFINITIONS			
HDR	High Dynamic Range	WAN	Wide Area Network
HMI	Human-Machine Interface	WDR	Wide Dynamic Range
HOSDB	Home Office Scientific Development Branch	VMS	Video Management System

E6C-3 REFERENCES TO OTHER SECTIONS OF THIS SPECIFICATION

This section shall not be read in isolation and must be read in conjunction with all other sections of this specification which define further requirements for the electrical installation.

Section 2E details the default requirements for electrical installation quality and materials which shall apply fully to this section of the specification.

E6C-4 STANDARDS APPLICABLE

Works shall be completed in accordance with all applicable industry standards. Some of the most relevant standards associated with this section are scheduled below: -

STANDARDS AND DOCUMENTS	
BS 7958	Closed circuit television (CCTV) – Management and operation – Code of practice
BS 8418	Installation and remote monitoring of detector-activated CCTV systems – Code of practice
BS EN 50130-4	Alarm systems – Part 4: Electromagnetic compatibility – Product family standard: Immunity requirements for components of fire, intruder, hold up, CCTV, access control and social alarm systems
BS EN 50130-5	Alarm systems – Part 5: Environmental test methods
BS EN 50132	Alarm systems – CCTV surveillance systems for use in security applications (parts that are still current)
BS EN 62676	Video surveillance systems for use in security applications
Form No. 109	BSIA – Planning, design, installation and operation of CCTV surveillance systems code of practice and associated guidance
Form No. 218	BSIA – Graded requirements under BS EN 62676 Standards for CCTV – A technical guide for installers, specifiers and manufacturers
NACP 2	NSI – NACOSS Gold and ARC Gold – Code of practice for customer communications
NCP 104.3	NSI – NSI Code of practice for the design, installation and maintenance of CCTV surveillance systems
Data Protection Act & The General Data Protection Regulation (GDPR)	
All current and relevant BSIA, HOSDB/CAST, ICO, NSI and SSAIB publications	
All standards, guidance and statutory regulations detailed within Section 2E-3	

Where the above standards refer to supporting documentation and standards these shall be fully complied with in all respects.

Where discrepancy is found between this specification, specialist quotations and the relevant standards, written clarification shall be obtained prior to submission of tender. Where a discrepancy has not been clarified prior to tender submission the most onerous requirements shall be included within the tender price.

E6C-5 DESIGN REQUIREMENTS

The Contractor shall employ one of the CCTV Specialist(s) named in Appendix I to supply, install, test and commission the CCTV systems. The CCTV Specialist(s) must be a member of a recognised accreditation body (e.g. NSI Gold, SSAIB). They shall validate the design and take over the design responsibility for the CCTV systems.

This design validation shall take place during the tender period. It shall include an assessment of whether:

- 1) Equipment specifications shown meet the overall design intent of this specification.
- 2) Equipment quantities shown meet the overall design intent of this specification.
- 3) The design intent of this specification is fully compliant with the Guides and Standards listed in this document.

Based on this assessment, the CCTV Specialist(s) shall, during the tender period, provide written clarification of any non-compliances and / or additional requirements. They shall obtain clarification if the method of compliance is open to interpretation.

Formal assessment shall be undertaken and documented to fulfil all DPA, GDPR, DPIA, PIA and ICO obligations.

It is emphasised that the tender submission must include all necessary additional / alternative equipment necessary to achieve a fully compliant installation. Thus, in the absence of tender clarification between alternative methods of compliance, the most onerous compliant option shall be included.

E6C-6 SYSTEM OVERVIEW

The CCTV system shall be able to operate and record images / metadata without operator input. However, it shall also be possible for active monitoring to be undertaken as required by security personnel / designated person(s).

Cameras shall be hardwired IP-based and shall transmit images securely over the general LAN and associated VMS.

The cameras need to be fully compatible with existing system.

CCTV shall be provided in accordance with the following: -

LOCATION	OBJECTIVE (NOTE 1)	PURPOSE	CAMERA TYPE
Building Entrance(s) / Lobby(s)	Identify	Protection of residents, staff, students and property	Fixed
Corridor(s)	Recognise	Protection of residents, staff, students and property	Fixed
Site Ground(s) / Landscape Garden(s)	Observe/Recognise	Protection of residents and against misuse	Fixed
Notes: - 1) 'Objective' as defined within BS EN 62676, BSIA and NSI codes of practice and guidance. 2) Purpose/Objective of each camera shall be formally documented; refer to DPA, GDPR and ICO.			

CCTV cameras shall be provided in accordance with the principles outlined within the Camera Selection Schedule in Appendix II of this specification section.

The Contractor/Security Specialist shall adapt/adjust the concepts outlined (as appropriate) to meet the objectives and operational requirements for each camera; consequently, information shall be viewed as design intent only for further development.

E6C-7 SCOPE OF WORKS

The scope of works shall include the following non-exhaustive items: -

- 1) Internal CCTV cameras.

- 2) External CCTV cameras.
- 3) CCTV system shall be incorporated into an integrated security (or building) system.
- 4) All necessary: -
 - a) Wiring accessories e.g. data outlets, telephone outlets, un-switched fused connection units, double pole lockable key switches etc.
 - b) Power and signalling cabling.
 - c) Earthing and bonding.
 - d) Cable support and containment systems.
 - e) Inspection, testing and commissioning.
 - f) Identification, notices and labelling.
 - g) O&M information.

It shall be noted the above lists are not exhaustive and reference must be made to all sections of this specification and the associated drawings.

All due allowances shall be made within the tender submission to ensure all power supplies, wiring accessories and associated equipment is provided for the electrical installation, with particular attention paid to electrical systems where the Contractor has design responsibility.

E6C-8 GENERAL INSTALLATION REQUIREMENTS

GENERAL

CCTV system(s) shall be designed, selected, installed, tested and commissioned in strict accordance with all relevant standards detailed within this section of the specification and corresponding manufacturer's information.

EQUIPMENT SELECTION

The location, size, finish and fixing detail of all equipment shall account for programme, architectural and planning requirements present.

CCTV shall be configured for an IP architecture that is conformant to relevant ONVIF standards (latest version); this is to include profile 'S' (as a minimum). Core system components shall be compatible/interoperable with more than a single manufacturer; notwithstanding, components shall (where feasible) be selected from a single manufacturer.

Under no circumstance shall systems that can only be programmed, commissioned and/or managed by a single supplier or specialist be provided.

Equipment must be sized to accommodate the total number of cameras present, plus 25% spare capacity.

ENVIRONMENTAL CONDITIONS

Equipment shall account for environmental conditions with respect to water/dirt ingress (IP rating), corrosion resistance, impact, likely vandalism and longevity for an anticipated 10-year lifecycle under a suitable PPM regime; details to be provided within the technical submittal.

Cameras shall be of suitable build quality and strength to withstand the environment in which they are installed without detrimental effect to their operation and appearance. Where required to avoid misting or water damage, cameras shall incorporate thermostatically controlled integral heating elements to prevent condensation within the camera housing.

Camera brackets shall be of suitable strength, including robust and tamper proof fixings to withstand their environment, vandalism and wind loading. Cameras shall be mounted at a height as to minimise vandalism whilst maintaining a clear identifiable image of individuals and their features.

EXTERNAL CAMERA MOUNTING

Manufacturers' proprietary camera columns shall be provided as required to provide adequate camera coverage. The camera columns shall be of the same colour and a similar style to external lighting columns. Cameras may be mounted to external lighting columns where camera operation will not be affected by wind loads and vibration.

CABLE SUPPORT & CONTAINMENT SYSTEMS

The Contractor shall provide all necessary cable support and containment systems for all power and signalling cabling associated with the CCTV installation. The cable support and containment systems shall be sized in strict accordance with BS 7671 and manufacturers' literature.

All cable support and containment systems shall be provided in strict accordance with Section 2E of this specification.

CABLING & TERMINATIONS

Cabling, terminations and identification markers shall be in accordance with other sections of this document.

Horizontal structured data cabling shall be provided as detailed within Section E5 of this specification, except where fibre is implemented due to distance, bandwidth or electrical separation requirements.

Cameras shall be connected to the LAN via concealed data points using secure RJ45 plug lock-in devices.

All power, signalling and earthing / bonding cabling shall be LSZH (LSOH, OHLS) with emissions of hydrogen chloride gas < 0.5%. All CCTV equipment and cabling shall be selected and installed in strict accordance with manufacturers' literature.

POWER SUPPLIES

CCTV equipment shall be provided with dedicated circuit(s) independent to any other system or general power provision. Cameras shall derive power from dedicated PoE network switches, except where separate PSU(s) are required to meet power requirements (e.g. some PTZ cameras).

E6C-9 CAMERA SPECIFICATION

Cameras shall comply with the following: -

CONSTRUCTION OF FIXED CAMERAS					
TYPE	MOUNTING	IMPACT RATING	IP RATING	OPERATING TEMPERATURE	MATERIAL
Fixed Dome	Surface	IK09 or IK10	IP66 (external areas)	-30°C to +50°C (external areas)	Metal (Body)
Fixed Body				-10°C to +50°C (internal areas)	
Notes: - 1) All cameras and enclosures shall be provided with proprietary brackets, security fixings and screws. 2) Manufacturer's requirements shall be followed with respect to the provision of desiccants. 3) Build quality and strength shall withstand environmental conditions without detrimental effect to operation or appearance.					

Optical performance shall be in accordance with the following: -

OPTICAL PERFORMANCE					
IMAGE SENSOR	LENS	DYNAMIC RANGE	SNR	IR CUT FILTER	ILLUMINATION
CMOS Colour/Mono (1/2.8" minimum)	Varifocal / Fixed	WDR (internal) HLC & HDR (external) (see notes)	50dB (minimum)	Automatic Mechanical (Day/Night)	IR LED 850nm (see notes)

OPTICAL PERFORMANCE					
IMAGE SENSOR	LENS	DYNAMIC RANGE	SNR	IR CUT FILTER	ILLUMINATION
Notes: - <ol style="list-style-type: none"> Image sensor to be selected in accordance with the FOV target resolution (pixels/m); no camera shall be less than 1.3MP regardless of minimum FOV resolution density and those used for identification or recognition shall be 4MP minimum. Internal spaces subject to significant external light influence (e.g. glazed entrance doors) shall be treated as external spaces with respect to dynamic range. WDR shall be a minimum of 76dB; HLC (High Level Contrast) shall be a minimum of 90dB. Dynamic range is to be measured according to BS EN 62676. Lens aperture (F-stop) to be selected to meet image sensor sensitivity and DOF requirements. 					

Resolution shall meet the specific objective for each FOV/area of coverage; this shall be in accordance with the following minimum requirements: -

RESOLUTION DENSITY			
OBJECTIVE	DESCRIPTION	FOV OBJECT SIZE (mm/pixel)	FOV RESOLUTION (pixels/m)
Monitor	To enable viewing of the number, direction and speed of movement of people across a wide area, providing their presence is known to the operator	40 – 80	12.5 – 25
Detect	To enable the operator to reliably and easily determine whether or not any target (e.g. a person or vehicle) is present	16 – 40	25 – 62.5
Observe	To enable characteristic details of an individual, such as distinctive clothing to be seen, whilst allowing a view of activity surrounding an incident	8 – 16	62.5 – 125
Recognise	To enable the operator to determine with a high degree of certainty whether or not an individual shown is the same as someone they have seen before	4 – 8	125 – 250
Identify	To enable identification of an individual beyond reasonable doubt	2 – 4	250 – 500
Inspect	To enable characteristic details of an individual, such as distinctive clothing to be seen, whilst allowing a view of activity surrounding an incident	1	1000
Notes: - <ol style="list-style-type: none"> Information detailed above has been derived from BS EN 62676, BSIA and NSI codes of practice and guidance. 			

RESOLUTION DENSITY			
OBJECTIVE	DESCRIPTION	FOV OBJECT SIZE (mm/pixel)	FOV RESOLUTION (pixels/m)
2)	Dependent upon their purpose/objective cameras shall be selected to achieve the above FOV criteria.		
3)	Purpose/Objective of each camera shall be formally documented; refer to DPA, GDPR and ICO.		

Image compression and processing shall be in accordance with the following: -

IMAGE COMPRESSION					
ENCODING	PRIMARY STREAM	SECONDARY STREAM(S)	GOP STRUCTURE	ROI	KEY FRAME INTERVAL
VBR	H.264 H.265	H.264 H.265 MJPEG	IP or IBP	✓ (see notes)	2-Seconds (maximum)
Notes: - <ol style="list-style-type: none"> 1) Primary stream(s) to be used for recording and onsite viewing; secondary stream(s) to be used for restricted bandwidth applications (e.g. remote viewing). A minimum of two streams shall be provided per camera. 2) VBR encoding to be set against target bitrate; this shall account for resolution, frame rate, compression technology, GOP structure and scene activity level. Peak bitrate headroom to be at least 20% higher than the corresponding target bitrate. 3) ROI encoding to be implemented where specific areas of the image would benefit near-lossless compression. 					

Cameras shall include the following minimum features; these shall be enabled on a per-camera-basis dependent upon specific FOV and application: -

IMAGE PROCESSING						
AES	AGC	ALC	BLC	DNR	WHITE BALANCE CONTROL	PRIVACY ZONE MASKING
✓	✓	✓	✓	✓	✓	✓
Notes: - <ol style="list-style-type: none"> 1) Dynamic noise reduction to be in addition to temporal/spatial noise suppression. 2) Image processing modes to be enabled/engaged specific to each FOV/scene. 3) White balance control to include indoor, outdoor, fluorescent, sodium and manual (as a minimum); selection shall be subject to specific FOV/scene. 4) Privacy zone masking to be implemented in line with DPIA/PIA requirements. 						

E6C-10 TECHNICAL SUBMISSIONS

Prior to installation on-site the Contractor shall provide technical submissions for the following: -

- 1) Formal assessment/documentation to meet DPA, GDPR and ICO obligations.
- 2) Technical specification for all cabling, equipment and components to be installed.
- 3) Calculations for storage requirements.
- 4) Technical specifications for all software and mobile applications.
- 5) Project specific schematics and wiring diagrams; generic manufacturers' details will not be accepted.
- 6) Layout drawings detailing the locations of all equipment.
- 7) Maintenance requirements.

The time allowed for comment shall be as detailed within section 1B of this specification.

E6C-11 INSPECTION, TESTING & COMMISSIONING

CCTV system(s) shall be inspected, tested and commissioned in strict accordance with all relevant standards detailed within this section of the specification and corresponding manufacturer's information.

Cameras shall be commissioned to account for all lighting conditions (e.g. daytime, night time, artificial lighting, IR illumination etc.) to ensure focus shift and DOF (influenced by iris aperture) are not adversely affecting image quality or defined objective.

Home Office CAST test targets (1.7m in height) shall be used to demonstrate resolution density compliance for the FOV.

All components (e.g. cameras, NVRs etc.) shall be updated the most current firmware at the point of commissioning; under no circumstances shall any beta release be used.

The electrical installation works associated with the CCTV system shall be inspected and tested in strict accordance with BS 7671 and Section 2F of this specification. All circuits / test results shall be recorded on the 'Schedule of circuit details / Schedule of test results' provided within the Electrical Installation Certificates.

Formal witnessing of testing and commissioning shall be undertaken in strict accordance with Section 2F of this specification.

Upon completion the system(s) shall be demonstrated to the Engineer and the Client. The Contractor / CCTV Specialist(s) shall provide training to the Client until they fully understand the operation of the system.

Commissioning certification shall be provided to verify the correct installation and operation of the CCTV system(s). The commissioning certification and as-installed drawings for the CCTV system(s) shall be included within the O&M manual.



APPENDIX I – ELECTRICAL EQUIPMENT & SPECIALISTS SCHEDULE

ELECTRICAL EQUIPMENT	SPECIALIST / MANUFACTURER / PRODUCT RANGE/ MATERIAL
CCTV Specialist(s) / Installer(s)	TBC/Agreed by/with the Hospital
Note: Reference must also be made to any accompanying equipment and specialist schedules.	

Section E6C CCTV Systems

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APPENDIX II – CAMERA SELECTION MATRIX

CCTV cameras shall be provided in accordance with the performance criteria listed below. Final locations and camera types are subject to Contractors / Specialists detailed design; these shall be further developed by the Contractor / Specialist to meet the operational objectives and requirements: -

CAMERA SELECTION MATRIX														
Camera Ref	Floor Level / Area	Location	Objective	FOV Type	Aspect Ratio	FOV Resolution (pixel/m)	Minimum Resolution			Target Frame Rate (fps)	Dynamic Range	Infrared	Video Analytics	Video / Metadata Steams
							H	V	Total (MP)					
00-01	Ground Floor	Building Entrance / Lobby	Recognise	Fixed	Note 1	125-250	Note 2	Note 2	Note 2	Note 3	Note 4	Note 5	Yes	Yes
EX-01	External	Building Perimeter	Identify	Fixed	Note 1	250-500	Note 2	Note 2	Note 2	Note 3	Note 4	Note 5	Yes	Yes
EX-02	External	Building Perimeter	Identify	Fixed	Note 1	250-500	Note 2	Note 2	Note 2	Note 3	Note 4	Note 5	Yes	Yes
EX-03	External	Building Perimeter	Identify	Fixed	Note 1	250-500	Note 2	Note 2	Note 2	Note 3	Note 4	Note 5	Yes	Yes
EX-04	External	Building Perimeter	Identify	Fixed	Note 1	250-500	Note 2	Note 2	Note 2	Note 3	Note 4	Note 5	Yes	Yes
EX-05	External	Building Perimeter	Identify	Fixed	Note 1	250-500	Note 2	Note 2	Note 2	Note 3	Note 4	Note 5	Yes	Yes
Notes: - 1) Camera aspect ratio shall be selected be adjusted to suit FOV and camera resolution. 2) Camera resolutions shall be determined to meet specific objective and FOV requirements. 3) Target frame rate shall be selected to suit specific FOV scene (e.g. fast-moving objects etc.). 4) Dynamic range shall be matched to FOV and location.														

Section E6C CCTV Systems

Job No. 230114



CAMERA SELECTION MATRIX

CAMERA SELECTION MATRIX														
Camera Ref	Floor Level / Area	Location	Objective	FOV Type	Aspect Ratio	FOV Resolution (pixel/m)	Minimum Resolution			Target Frame Rate (fps)	Dynamic Range	Infrared	Video Analytics	Video / Metadata Steams
							H	V	Total (MP)					
5)	IR illumination subject to lighting conditions. Prolonged exposure, slow shutter speed, excessive temporal/spatial noise suppression etc. shall not be used as an alternative to appropriate illumination.													
6)	Purpose/Objective of each camera shall be formally documented; refer to DPA, GDPR and ICO.													

Section E6C CCTV Systems

Job No. 230114



Section E7A

Fire Alarm Systems

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E7A-1 GENERAL REQUIREMENTS

This section details the requirements for fire alarm systems and shall be read in conjunction with all other sections of this specification and the associated drawings.

The fire alarm systems shall be provided to the CTC Workshop at Maudsley Hospital

E7A-2 DEFINITIONS

Refer to Section 2E / Section 1B of this specification and Part 2 of BS 7671 – IET Wiring Regulations – Requirements for Electrical Installations for further details regarding definitions, symbols and abbreviations.

E7A-3 REFERENCES TO OTHER SECTIONS OF THIS SPECIFICATION

This section shall not be read in isolation and must be read in conjunction with all other sections of this specification which define further requirements for the electrical installation.

Section 2E details the default requirements for electrical installation quality and materials which shall apply fully to this section of the specification. Wiring accessories shall match the appearance of those associated with utility power, light switches and the like.

E7A-4 STANDARDS APPLICABLE

Works shall be completed in accordance with all applicable industry standards. Some of the most relevant standards associated with this section are scheduled below:

STANDARDS AND DOCUMENTS	
BS 7671	IET Wiring Regulations – Requirements for Electrical Installations
IET On-Site Guide – BS 7671 – IET Wiring Regulations – Requirements for Electrical Installations	
All IET Guidance Notes – BS 7671 – IET Wiring Regulations – Requirements for Electrical Installations	
BS 5839-1	Fire detection and fire alarm systems for buildings – Part 1: Code of practice for the design, installation, commissioning and maintenance of systems in non-domestic premises
BS 5839-8	Fire detection and fire alarm systems for buildings – Part 8: Code of practice for the design, installation, commissioning and maintenance of voice alarm systems
BS 6266	Fire Protection for Electronic Equipment Installations. Code of Practice.
BS 7273-4	Code of practice for the operation of fire protection measures – Part 4: Actuation of release mechanisms for doors
BS 7273-6	Code of practice for the operation of fire protection measures – Part 6: Fire detection and fire alarm systems. Interface with ancillary systems and equipment.
BS 8519	Selection and installation of fire-resistant power and control cable systems for life safety and fire-fighting applications – Code of practice
BS 9999	Code of practice for fire safety in the design, management and use of buildings
BS EN 54	Fire detection and fire alarm systems
HTM 05-03	Firecode – fire safety in the NHS – Health Technical Memorandum 05-03: Operational provisions – Part B: Fire detection and alarm systems
LPS 1014	Loss Prevention Certification Board (LPCB) / Building Research Establishment (BRE) – Loss Prevention Standards – LPS 1014: Requirements for certificated fire detection and alarm system firms
All current and relevant Loss Prevention Certification Board (LPCB) / Building Research Establishment (BRE) Loss Prevention Standards.	
All current and relevant Fire Industry Association (FIA) publications.	

STANDARDS AND DOCUMENTS

All current and relevant National Security Inspectorate (NSI) publications.

All standards, guidance and statutory regulations detailed within Section 2E-3

Where the above standards refer to supporting documentation and standards these shall be fully complied with in all respects.

Where discrepancy is found between this specification and the relevant standards, the Contractor shall obtain written clarification from the Engineer prior to submission of the tender. Where a discrepancy has not been clarified prior to tender submission, the Contractor shall include the most onerous requirements.

E7A-5 DESIGN REQUIREMENTS

The Contractor shall employ one of the named Fire Alarm Specialist(s) in Appendix I to supply, install, test and commission the fire alarm systems. They shall validate the design and take over the design responsibility for the fire alarm systems.

This design validation shall take place during the tender period. It shall include an assessment of whether:

- 1) Equipment specifications shown meet the overall design intent of this specification.
- 2) Equipment quantities shown meet the overall design intent of this specification.
- 3) The design intent of this specification is fully compliant with the Guides and Standards listed in this document.

Based on this assessment, the Fire Alarm Specialist(s) shall, during the tender period, provide written clarification to the Engineer of any non-compliances and / or additional requirements. They shall obtain from the Engineer any necessary guidance if the method of compliance is open to interpretation.

It is emphasized that the tender submission must include all necessary additional / alternative equipment necessary to achieve a fully compliant installation. Thus, in the absence of tender clarification between alternative methods of compliance, the most onerous compliant option shall be included.

E7A-6 CERTIFICATION SCHEMES

The Fire Alarm Specialist(s) must be an NSI Fire Gold certified and therefore BAFE registered. The Fire Alarm Specialist(s) must also be Loss Prevention Certification Board (LPCB) / Building Research Establishment (BRE) – Loss Prevention Standards – LPS 1014 certified.

E7A-7 FIRE ADVISOR & FIRE STRATEGY DOCUMENTATION

No fire strategy documentation has been provided.

E7A-8 SCOPE OF WORKS

The fire alarm systems installation shall include the provision of the following (where required):-

- 1) Fire alarm repeater panel(s) / remote terminal(s).
- 2) Power supplies (including standby power supplies and chargers).
- 3) Manual call points.
- 4) Fire alarm interfaces.
- 5) Smoke and Heat detection
- 6) All necessary supervisory / end-user management software.
- 7) All necessary wiring accessories e.g. data outlets, telephone outlets, un-switched fused connection units, double pole lockable key switches etc.
- 8) All necessary power and signalling cabling.
- 9) All necessary earthing and bonding.
- 10) All necessary cable support and containment systems.
- 11) Inspection, testing and commissioning.
- 12) Soak testing.

- 13) All necessary identification, notices and labelling.
- 14) All necessary O&M information.

It shall be noted the above lists are not exhaustive and reference must be made to all sections of this specification and the associated drawings.

All due allowances shall be made within the tender submission to ensure all necessary power supplies, wiring accessories and associated equipment is provided for the electrical installation, with particular attention paid to electrical systems where the Contractor has design responsibility.

E7A-9 TECHNICAL REQUIREMENTS

The fire alarm system(s) shall be designed, selected, installed, tested and commissioned in strict accordance with BS 5839, BS EN 54, BS 7273, BS 8519, BS 9999 and the standards detailed earlier within this specification as appropriate.

The technical requirements for the fire alarm systems shall be as follows:-

TECHNICAL REQUIREMENTS	
Installation location	CTC Workshop, Maudsley Hospital
Type of building / area	Non-domestic premises to BS 5839-1
Category of system	Assumed Category L1 TBC by Fire Consultant
Fire alarm repeater panel(s)	As indicated on the layout

Where the fire alarm systems are required to be 'open protocol' the fire alarm panel(s) shall be compatible with fire alarm devices (e.g. fire detectors, sounder, visual alarm devices, manual call points etc.) provided by other manufacturers. Open protocol fire alarm systems shall not be programmed, tested and commissioned by only one manufacturer / specialist.

Fire alarm equipment shall comply with the relevant parts of BS EN 54 and BS 5839. The fire alarm system(s) installation must be undertaken in strict accordance with the recommendations of BS5839.

The wiring of all fire alarm devices from the fire alarm control panel(s) shall be carried out as continuous loops. Each input / output for fire alarm devices on the loop shall have an individual address. Each loop shall not exceed 75% of its address capacity to allow for future modifications or expansion.

Detection zones shall be provided in strict accordance with BS 5839, the Fire Advisor and Building Control requirements.

Short circuit line isolator modules / devices shall be installed at regular intervals on the fire alarm loop wiring to enable the automatic disconnection of loop sections under short circuit conditions. The short circuit line isolator modules / devices shall be provided as separate standalone units or incorporated into fire alarm devices installed on the loop wiring.

Short circuit line isolator modules / devices must be installed on the boundaries of all fire alarm zones.

Where ceiling mounted fire detectors are required on plasterboard or suspended ceiling areas, these shall be installed directly on to galvanised steel conduit boxes flushed to the ceiling surface.

Exact positions of all devices shall be agreed on site, particularly where fire detectors are mounted on ceilings adjacent to light fittings, ventilation diffusers, etc. (e.g. to ensure they are not in direct air flows).

Equipment shall be wired in strict accordance with manufacturers' schematics / diagrams. Where cable connections are made into equipment, a numbered marker sleeve shall be fitted to the cable-core, which shall correspond to the wiring diagram.

Ensure that all wiring connections are correctly made before any equipment is set to work. Soldered ends shall be provided for termination.

Cable tails to terminals shall be of sufficient length and be neatly dressed and arranged to prevent development of tension in the cable or on the termination. All cables shall be securely tethered within enclosures. All wiring shall be concealed within the building fabric.

Power supplies to the fire alarm system(s) shall be provided by dedicated low voltage final circuits and double pole lockable key switches.

All power and signalling cabling shall be (as required):-

- 1) Fire alarm systems cabling e.g. loop wiring:-
XLPE/LSZH enhanced fire resistant cables manufactured to BS 7629-1 (PH30, PH60 and PH120 classification) e.g. Draka FT120, Prysmian FP Plus or similar.
 - 2) Fire alarm network cabling e.g. for network wiring between fire alarm control panel(s), fire alarm repeater panels / remote terminals:-
XLPE/LSZH enhanced fire resistant cables manufactured to BS 7629-1 (PH30, PH60 and PH120 classification) e.g. Draka FT120, Prysmian FP Plus or similar.
 - 3) Fire alarm power supply cabling e.g. power supplies to fire alarm control panel(s), fire alarm repeater panels / remote terminals etc.:-
XLPE/LSZH enhanced fire resistant cables manufactured to BS 7629-1 (PH30, PH60 and PH120 classification) e.g. Draka FT120, Prysmian FP Plus or similar.
- Or,
- 4mm² XLPE/SWA/LSZH enhanced fire resistant armoured power cables manufactured to BS 7846 (Classified Category F120) e.g. Draka FTP120, Prysmian FP600S or similar.

The above cabling requirements shall apply to all non-domestic systems to BS 5839-1 and domestic Grade A and B systems to BS 5839-6.

All power and signalling cabling for domestic Grade D and E systems to BS 5839-6, shall be LSZH (LSOH, OHLS) with emissions of hydrogen chloride gas < 0.5%.

Where possible fire alarm equipment shall be semi-recessed into the building fabric e.g. fire alarm control panels (with bezel), fire alarm repeater panels / remote terminals (with bezel), manual call points etc.

All fire alarm equipment and cabling shall be installed in strict accordance with manufacturers' literature. All fire alarm devices shall be from the same manufacturer.

Provide all necessary equipment, programming / commissioning, wiring accessories, LV power supplies, telephone / data outlets signalling cabling and containment to ensure all systems are fully functional on completion of the works.

E7A-10 MODE OF OPERATION

Mode of operation shall be chosen to cooperate with an existing fire strategy and to be confirmed by a fire consultant.

E7A-11 CONTROL AND INDICATING EQUIPMENT (CIE)

Fire alarm control and indicating equipment shall comply with BS EN 54-2 and BS 5839. Power supplies to control and indicating equipment shall be provided by dedicated low voltage final circuits and double pole lockable key switches as required by BS 5839.

FIRE ALARM REPEATER PANEL(S) / REMOTE TERMINAL(S)

The fire alarm remote terminals / repeater panel(s) shall be located within entrance lobby to new workshop areas, subject to Fire Advisor / Building Control Officer approval.

The fire alarm repeater panel(s) / remote terminal(s) shall be from the same product range and 'open protocol' manufacturer as the fire alarm control panel(s). The fire alarm repeater panel(s) / remote terminal(s) shall be 'open protocol', fully programmable / analogue addressable and shall have the following **minimum** features:-

- 1) Remote display terminal(s):-
 - a) Optional level 2 access enable key switch.
 - b) Integrated standard or fault-tolerant network interface with screen termination port.

- c) Programmable display for up to 2,000 zones along with sector base controls.
- d) Lockable glass front cover / door.
- e) Flush mounted with a bezel where possible.
- f) 25% spare capacity for future expansion.

The fire alarm repeater panel(s) / remote terminal(s) shall be programmed and commissioned so that room numbers and names used are co-ordinated with the architectural drawings and the site room referencing system.

E7A-12 POWER SUPPLIES

Power supplies to fire alarm system(s) equipment shall be provided by dedicated low voltage final circuits and double pole lockable key switches as required by BS 5839.

Power supply units shall comply with BS EN 54-4 and BS 5839. The selection of power supply units must be undertaken in strict accordance with the recommendations of BS5839.

Power supply units shall incorporate standby supplies in the form of secondary (rechargeable) batteries complete with an automatic charger. All power supply units containing secondary batteries or external secondary battery units, shall be labelled with their date of installation.

Secondary (rechargeable) batteries shall be selected to conform to the battery autonomy requirements of BS 5839.

The charging rate of the batteries shall be such, that having been discharged to its final voltage, the battery can be charged sufficiently to conform to the battery autonomy requirements of BS 5839 after a charging period of 24 hours. The requirements of BS 5839 are dependent upon:-

- 1) Category of system.
- 2) Other secondary supplies e.g. standby generators.
- 3) Building occupation.

VALVE-REGULATED LEAD ACID BATTERIES

The minimum capacity of valve regulated lead acid batteries shall be calculated in accordance with the following formula:-

$$1) \quad C_{min} = 1.25 (T_1 I_1 + D I_2 / 2).$$

Where,

C_{min} = minimum capacity of the battery when new at the 20 h discharge rate and at 20°C in ampere hours;

T_1 = total battery standby period in amperes;

I_1 = total battery standby load in amperes.

I_2 = total battery alarm load in amperes.

D = a derating factor.

Where $C_{min}/20$ will be equal to or greater than I_2 , it can be assumed that $D = 1$.

When $C_{min}/20$ is less than I_2 , the value of D shall either be based on the battery manufacturer's data or shall be 1.75.

In practice, C_{min} is unlikely to correspond exactly to an available battery capacity and therefore the next highest available capacity size shall be used.

BATTERIES OTHER THAN VALVE-REGULATED LEAD ACID BATTERIES

The minimum capacity of batteries, other than valve regulated lead acid batteries shall be determined by consultation with the battery manufacturer and shall take into account:-

- 1) Standby load.
- 2) Alarm load
- 3) Derating to take account of the higher current drawn in the alarm condition.
- 4) Derating factor to take account of battery ageing during the anticipated life of the battery.

E7A-13 FIRE ALARM DEVICES

Fire alarm devices comply with the relevant parts of BS EN 54 and BS 5839. The selection, provision, spacing and siting of fire alarm devices (e.g. fire detectors, manual call points etc.) must be undertaken in strict accordance with the recommendations of BS5839.

Fire alarm devices shall be provided in strict accordance with the defined fire alarm category to BS 5839 and also in accordance with any specific client, Fire Advisor and Building Control requirements (e.g. Category L5 systems).

All fire alarm devices shall be from the same manufacturer and shall utilise a common mounting base for ceiling mounted devices. Fire detectors shall be selected to suit the environment and room / area in which they are installed.

Sounders shall be provided in strict accordance with BS EN 54-3, BS 5839, The Building Regulations – Approved Document M and BS 8300. Visual alarm devices (VAD's) shall be provided in strict accordance with BS EN 54-23, BS 5839, The Building Regulations – Approved Document M and BS 8300.

Fire alarm equipment and devices shall comply with the latest version of all applicable standards, some of the key standards are detailed below:-

STANDARDS AND DOCUMENTS	
BS EN 54-1	Fire detection and fire alarm systems – Part 1: Introduction
BS EN 54-2	Fire detection and fire alarm systems – Part 2: Control and indicating equipment
BS EN 54-3	Fire detection and fire alarm systems – Part 3: Fire alarm – Sounders
BS EN 54-4	Fire detection and fire alarm systems – Part 4: Power supply equipment
BS EN 54-5	Fire detection and fire alarm systems – Part 5: Heat detectors – Point detectors
BS EN 54-7	Fire detection and fire alarm systems – Part 7: Smoke detectors – Point detectors using scattered light, transmitter light or ionization.
BS EN 54-10	Fire detection and fire alarm systems – Part 10: Flame detectors – Point detectors
BS EN 54-11	Fire detection and fire alarm systems – Part 11: Manual call points
BS EN 54-12	Fire detection and fire alarm systems – Part 12: Smoke detectors – Line detectors using an optical beam
BS EN 54-13	Fire detection and fire alarm systems – Part 13: Compatibility assessment of system components
BS EN 54-16	Fire detection and fire alarm systems – Part 16: Voice alarm control and indicating equipment
BS EN 54-17	Fire detection and fire alarm systems – Part 17: Short-circuit isolators
BS EN 54-18	Fire detection and fire alarm systems – Part 18: Input / output devices
BS EN 54-20	Fire detection and fire alarm systems – Part 20: Aspirating smoke detectors
BS EN 54-21	Fire detection and fire alarm systems – Part 21: Alarm transmission and fault warning routing equipment
BS EN 54-22	Fire detection and fire alarm systems – Part 22: Resettable line-type heat detectors
BS EN 54-23	Fire detection and fire alarm systems – Part 23: Fire alarm devices – Visual alarm devices
BS EN 54-24	Fire detection and fire alarm systems – Part 24: Components of voice alarm systems - Loudspeakers
BS EN 54-25	Fire detection and fire alarm systems – Part 25: Components using radio links

STANDARDS AND DOCUMENTS	
BS EN 54-26	Fire detection and fire alarm systems – Part 26: Carbon monoxide detectors – Point detectors
BS EN 54-27	Fire detection and fire alarm systems – Part 27: Duct smoke detectors
BS EN 54-28	Fire detection and fire alarm systems – Part 28: Non-resettable line-type heat detectors
BS EN 54-29	Fire detection and fire alarm systems – Part 29: Multi-sensor fire detectors – Point detectors using a combination of smoke and heat sensors
BS EN 54-30	Fire detection and fire alarm systems – Part 30: Multi-sensor fire detectors – Point detectors using a combination of carbon monoxide and heat sensors
BS EN 54-31	Fire detection and fire alarm systems – Part 31: Multi-sensor fire detectors – Point detectors using a combination of smoke, carbon monoxide and optionally heat sensors

Where the above standards and documents refer to supporting standards and documents these shall be fully complied with in all respects.

The above standards and documents are continually being updated, with new standards also becoming applicable. All personnel completing the electrical installation works shall be familiar with the latest standards applicable at contract award and complete all works in accordance with these standards.

Where discrepancy is found between this specification, specialist quotations and the relevant standards, written clarification shall be obtained from the Engineer prior to submission of tender. Where a discrepancy has not been clarified prior to tender submission the most onerous requirements shall be included within the tender price.

E7A-14 VOID AND PITCHED ROOF FIRE DETECTION

Fire detection shall be provided to any area that contains a horizontal void greater than 800mm in height. Voids less than 800mm in height need not be protected unless either:-

- 1) The void is such that extensive spread of fire or smoke, particularly between rooms and compartments, can take place before detection.

or,

- 2) On the basis of a fire risk assessment, the fire risk in the void is such as to warrant protection of the void.

Fire detection shall be located within voids and pitched roofs in strict accordance with the recommendations of BS 5839. Ceiling obstructions, such as structural beams, deeper than 10% of the overall ceiling height shall be treated as walls and additional fire detection shall be provided as required.

The Contractor and Fire Alarm Specialist responsible for the design of the fire alarm system(s) shall obtain all necessary Architects and Structural Engineering drawings to ensure all due allowances are made within the tender submission to provide fire detection to all void / pitched roof areas and as necessary for ceiling obstructions.

E7A-15 FIRE DOOR RETAINERS / DETENTES

Fire door retainers / détentes shall be provided in strict accordance with BS 7273-4. Fire door retainers / détentes shall be provided as indicated on the Architects fire strategy documentation and as required by the Fire Advisor and Building Control.

Generally, fire retainers / détentes units shall be of the over door, electromagnetic type, and shall be provided as part of the ironmongery package. Fire door retainers / détentes shall be installed in strict accordance with manufacturers' recommendations and wired as detailed within Section E2 Utility Power of this specification.

Provide all necessary equipment, power supply units, wiring accessories, LV power supplies, fire alarm interfaces, local release buttons, cabling and containment to ensure all fire door retainers are fully functional on completion of the works.

E7A-16 FIRE ALARM INTERFACES

Loop wired analogue addressable fire alarm interfaces shall be provided for connection to the following systems:-

- 1) Access controlled doors, car park barriers and entrance gates – fail open.

2) Security systems – function TBC.

It shall be noted the above lists are not exhaustive and reference must be made to all sections of this specification and the associated drawings.

The control and indicating equipment (CIE) shall be provided with programmable key switches to prevent the activation of selected fire alarm interfaces when the fire alarm system is being tested. The selected fire alarm interfaces shall be agreed prior to final programming / commissioning with the client, Fire Advisor and Building Control.

Instructions for the key switch operation (and the fire alarm interfaces not activated) shall be mounted within framed glass and screw fixed to the wall adjacent to the control and indicating equipment.

Fire alarm interfaces shall be located locally within concealed accessible locations (e.g. electrical service riser, plant room, switch room / DB cupboard, ceiling void etc.).

Provide all necessary equipment, power supply units, wiring accessories, LV power supplies, fire alarm interfaces, cabling and containment to ensure the fire alarm interfaces and associated systems are fully functional on completion of the works.

E7A-17 TECHNICAL SUBMISSIONS

Prior to installation on-site the Contractor shall provide technical submissions for the following:-

- 1) Cause and effect schedule / chart.
- 3) Technical specifications for all fire alarm equipment and cabling to be installed.
- 4) Wiring schematic drawings for all fire alarm systems to be installed, generic manufacturer's schematics shall not be accepted.
- 5) Layout drawings detailing the locations of all fire alarm system equipment.
- 6) Technical data to verify the adequate provision of sounders and visual alarm devices (VAD's).
- 7) Technical specifications for all secondary (rechargeable) batteries, detailing the selected battery autonomy.
- 8) Schedules itemising all addressable points and descriptor references (e.g. pre-alarm, fault conditions etc.) to be displayed on control and indicating equipment.
- 9) Schedule of all identification, notices, labels (including safety signage) and cable identification labels / markers along with a physical sample of each label type.

The time allowed for comment by the Engineer shall be as detailed within section 1B of this specification.

E7A-18 DIAGRAMS AND DOCUMENTATION

Diagrams and documentation shall be provided in strict accordance with BS 5839.

The drawings and documentation shall include:-

- 1) Certificates for the design, installation, testing, commissioning, acceptance and verification (where applicable) of the fire alarm system(s).
- 10) Zone plans / drawings (mimic diagrams) shall be mounted within framed glass and screw fixed to the wall adjacent to all control and indicating equipment (with the exception of repeater / remote touchscreens provided with interactive maps and zone plans).
- 11) An adequate operation and maintenance manual for the system; this should provide information, specific to the system in question, regarding the following:-
 - a) The equipment provided and its configuration.
 - b) Use of controls.
 - c) Recommendation for investigation of a fire alarm or fault signal after the incident is over and the building declared safe for reoccupation.
 - d) Recommendations for investigation in the event of a false alarm
 - e) Routine weekly and monthly testing of the systems by the user or appointed agent.
 - f) Service and maintenance of the system.
 - g) Avoidance of false alarms.

- h) The need to keep clear space around all fire detectors and manual call points.
 - i) The need to avoid contamination of detectors during Contractors' activities.
 - j) The importance of ensuring that changes to the building, such as relocation of partitions, do not affect the standard of protection.
 - k) Other user responsibilities described within BS 5839.
- 12) As-fitted drawings indicating at least the following:-
- a) The positions of all control, indicating and power supply equipment.
 - b) The positions of all manual call points, fire detectors and fire alarm devices.
 - c) The positions of all equipment that might require routine attention or replacement (e.g. short circuit isolators and remote indicators).
 - d) Wiring schematic drawings for all fire alarm systems installed, generic manufacturer's schematics shall not be accepted.
 - e) The type, sizes and actual routes of cables.
- 13) A logbook in which all events, including fire alarm signals, faults signals, system tests and maintenance visits, can be recorded.
- 14) A record of any agreed variations from the original design specification.

The above drawings and documentation shall be included within the O&M manual.

E7A-19 INSPECTION, TESTING AND COMMISSIONING

The fire alarm system(s) shall be inspected, tested and commissioned in strict accordance with BS 5839, BS 7671, Section 2F of this specification and the manufacturer's recommendations.

The electrical installation works associated with the fire alarm system(s) shall be inspected and testing in strict accordance with BS 7671 and Section 2F of this specification. All circuits / test results shall be recorded on the 'Schedule of circuit details / Schedule of test results' provided within the Electrical Installation Certificates).

Formal witnessing of testing and commissioning shall be undertaken in strict accordance with Section 2F of this specification.

The fire alarm installation shall be inspected and tested in accordance with the recommendations of BS 5839:-

- 1) Insulation resistance tests:-
- a) All insulated cables with a manufacturer's voltage rating suitable for main use shall be subject to insulation testing at 500 V d.c. Prior to this test, cables shall be disconnected from all equipment that could be damaged by the test.
 - b) Insulation resistance, measured in the above test, between conductors, between each conductor and earth, and between each conductor and any screen, shall be at least 2 MΩ.
- 15) Continuity of protective conductors and, for mains supply circuits, earth fault loop impedance, shall be tested to ensure compliance with BS 7671 and Section 2F of this specification.
- 16) The following tests shall also be undertaken where required:-
- a) Where maximum circuit resistance for any circuit is specified by the manufacturer or supplier, measurement of the resistance of every such circuit.
 - b) Any other test specified by the manufacturer of the system.
 - c) Check correct polarity of circuits where this is required for correct monitoring (to ensure operation of any manual call point while all detectors on a circuit are removed).

Test equipment shall be provided in strict accordance with the test equipment requirements of Section 2F of this specification.

The fire alarm system shall be commissioned in strict accordance with the recommendations of Section 39 Commissioning of BS 5839 and to achieve the mode of operation required by the client, Fire Advisor and Building Control.

No programming / commissioning shall be undertaken prior to agreement of the cause and effect with the aforementioned parties.

Audibility tests shall be undertaken during the testing and commissioning of the fire alarm system(s) to verify the correct sound pressure levels are achieved. In areas with mechanical plant audibility tests shall be carried out prior to the mechanical plant being put into operation and after all the plant is operational.

The Contractor / Fire Alarm Specialist shall undertake these tests using a suitable sound level meter.

Commissioning certification shall be provided to verify the correct installation and operation of the fire alarm system(s). The following separate certification shall be provided:-

- 1) Design certificate.
- 17) Installation certificate.
- 18) Commissioning certificate.
- 19) Acceptance certificate provided for completion by the client.

The Contractor / Fire Alarm Specialist shall supply the client with any special tools required for the operation and testing of the fire alarm system(s) in sufficient quantity (minimum quantity of 3No. for each item).

Upon completion the system(s) shall be demonstrated to the Engineer and the Client. The Contractor / Fire Alarm Specialist shall provide training to the Client until they fully understand the operation of the system.

The commissioning certification and as-installed drawings for the fire alarm system(s) shall be included within the O&M manual.

E7A-20 SOAK TEST PERIOD

After inspection, testing and commissioning where the fire alarm system(s) incorporate more than 50 automatic fire detectors, the Contractor and Fire Alarm Specialist shall provide a soak test period of at least one week (with the building / area occupied) in strict accordance with BS 5839.

This period shall be determined by the Fire Alarm Specialist responsible for the design of the fire alarm system(s). During the soak test period 24/7 monitoring of the fire alarm system(s) shall be undertaken to identify any unwanted false alarms and each manual call point shall bear an indication that it is not to be used.

Until successful completion of the soak test the fire alarm system(s) shall not be regarded as fully operational and therefore all necessary building insurances shall be in place to cover the use of the building / area during the soak test period.

The soak test shall only be regarded as successfully completed if:-

- 1) No false alarms occurred during the soak test period,
- or,
- 20) If false alarms occurred during the soak test period, the Fire Alarm Specialist (during the soak test period) identified the cause of these false alarms and undertook measures to rectify or minimise the potential for similar false alarms to occur in the future.

If any unwanted false alarms are not rectified by the Fire Alarm Specialist during the soak test period, the soak test period shall be repeated from the beginning for a period of one week, until the fire alarm system(s) function accurately and correctly.

All due allowances shall be made within the tender submission for all necessary supervision, testing, commissioning and attendances by the Contractor and Fire Alarm Specialist during the soak test period.

Any costs incurred as a result of or a consequence of having to restart the soak test shall be at the Contractor's / Fire Alarm Specialist's expense. Practical completion shall not be awarded until the soak test has been completed successfully.

E7A-21 MAINTENANCE

The Fire Alarm Specialist shall be required to provide full maintenance of the installation for a period of 12 months from the handover of the building. This shall be in accordance with the quarterly and annual recommendations presented by BS 5839 and shall be in addition to any items which would normally be dealt with under the twelve months defects period.

Section E7A Fire Alarm Systems

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APPENDIX I – FIRE ALARM SYSTEMS – ELECTRICAL EQUIPMENT AND SPECIALISTS SCHEDULE

ELECTRICAL EQUIPMENT	SPECIALIST / MANUFACTURER / PRODUCT RANGE/ MATERIAL
Fire Alarm Specialist(s) / Installer(s)	Gretton Ward Electrical Contact: Paul King Mobile: 07956 367 219 TBC by Hospital

Section M1

Domestic Water Services

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M1-1 GENERAL REQUIREMENTS

The domestic hot and cold water services shall serve all sanitary ware and other outlets.

Cold water services shall be distributed under main water pressure to all outlets.

Hot water shall be generated centrally at the re-commissioned existing central calorifier.

To ensure that hot water is supplied quickly to all outlets, the hot water system shall be a recirculating system with return pump.

Thermostatic mixing valves shall be provided throughout the project only to those outlets that need thermostatic mixing valves to comply with Building Regulations Approved Document G.

All sanitary ware shall be supplied by the Main Contractor but shall be piped up by the 'Water Safe' certified Mechanical Contractor. The entire installation shall be fully in accordance with best practice to minimise the risks of legionella bacteria growth in accordance with the industry 'Standards Applicable' listed below.

In accordance with the current Water Regulations, the cold water pipe shall be located away from heat sources including the circulating and non-circulating hot water pipes. Where cold water pipes route horizontally along walls the cold water pipe must always be installed below the hot water pipes.

On completion the whole installation shall be flushed and sterilised.

M1-2 DEFINITIONS

Refer to Section 1B for general definitions plus:

DEFINITIONS	
BACnet	Building automation and control networks
BCWS	Boosted Cold Water Service
DRV	Double Regulating Valve
HIU	Heat Interface Unit
HWSF	Hot Water Service Flow
HWSR	Hot Water Service Return
LON	Local operating network. Also referred to as LONworks
MCWS	Mains Cold Water Service
Modbus	Serial communications protocol developed by Modicon
PHX / PHE	Plate Heat Exchangers
Protocol Interface	Set of rules that established how systems communicate with BMS. Examples of protocols used are BACnet, LON and Modbus.
TCV	Thermal Circulation Valve
TMV	Thermostatic Mixing Valve
WRAS	Water Regulation Advisory Scheme
VFC	Volt Free Contacts
WSP	Water Safety Plan

M1-3 REFERENCE TO OTHER SECTIONS OF THIS SPECIFICATION

This section of the specification shall not be used in isolation and must be read in conjunction with the particular sections, commissioning and standard clauses, all of which define further the requirements for the installations.

The following text advises if the Contractor shall deviate from the preferred pipework material and standard or utilise one of the alternative materials and standards of construction listed in the 'General Installation Standards'

Section M1 Domestic Water Services

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sections detailed earlier in this specification. Agreed alternative materials for the installation from the preferred standard material and standard of construction are:

No deviation from the 'General Installation Standards' section preferred material and jointing method requirements.

'General Installation Standards' Sections provides all necessary details on pipework and valve materials and performance requirements that apply to this section.

M1-4 WATER SAFETY PLAN

If the client has a Water Safety Plan then the contractor shall obtain a copy of their Water Safety Plan and ensure that they adhere to the particular requirements of this WSP.

All costs associated with the Water Safety Plan shall be included in the contractor's tender return.

M1-5 STANDARDS APPLICABLE

Works shall be completed in accordance with all applicable industry standards. Some of the most relevant standards associated with this section are scheduled below:

STANDARDS	
BESA Standards	BS 1710 Identification of pipelines and services
BS 6068 Water quality	BS 6920 Suitability of non-metallic materials and products for use with water intended for human consumption
BS 7671 Requirements for electrical installations. IET Wiring Regulations	BS 8558 Design, installation, testing and maintenance of water for domestic use
BS EN 1057 Copper tubes	BS EN 806 Water for human consumption
BS EN 1287 Thermostatic mixing valves	BS EN 1254 Plumbing Fittings
BSRIA Standards and Commissioning Codes	Building Regulations, particularly Approved Document Part G
CIBSE Commissioning Codes	CIBSE Guides, particularly Guide G Public Health and Plumbing
Commission Delegated Regulation EU No. 811/2013	HSG 274 Part 2 hot and cold water systems
HSE ACOP L8 The control of legionella bacteria in water systems	NHS D08 TMV3 Thermostatic mixing valves
PD 855468 Flushing and disinfection of domestic water	Pressure Equipment Regulations & amendments

Where the above standards refer to supporting documentation and standards these shall be fully complied with in all respects.

Where discrepancy is found between this specification and the relevant standards, the Contractor shall obtain written clarification from the Engineer prior to submission of the tender. Where a discrepancy has not been clarified prior to tender submission, the Contractor shall include the most onerous requirements.

M1-6 SCOPE OF WORKS

The following brief description lists those systems required for installation on this project. Comprehensive system requirements shall be detailed in the subsequent clauses of this specification together with schematic and design drawings.

The domestic hot and cold water services installation shall include for all necessary tools, labour, materials and equipment to supply, install, commission and put into operation the domestic water services, including the following:

- 1) Incoming mains cold water services from new supply from utility company in the road.
- 2) No new incoming mains cold water service is required as the existing incoming supply shall be reused.
- 3) Mains pressure potable quality hot and cold water services to all sanitary ware outlets.
- 4) All necessary domestic water pipework, fittings, valves, brackets and fixings.
- 5) All witnessed hydraulic pressure tests, balancing, venting and commissioning.
- 6) All sterilisation, flushing, filling and venting of all services to be potable quality.
- 7) All laboratory testing to prove water quality is fit for its designated purpose as listed.
- 8) All thermal insulation in compliance with the earlier section of this specification, including vapour sealing.
- 9) Liaison with other trades on site.
- 10) All primary and secondary support systems to install the services.
- 11) Water use meters.
- 12) Design development and coordination of the tender information to fully detailed working or installation drawings. This shall include responsibility for the following areas:-
 - a) Support systems/brackets for all services.
 - b) Expansion and contraction within the system networks.
 - c) Final co-ordination of the mechanical and electrical services including the preparation of completely dimensioned double line services fabrication drawings.
 - d) Development of the Consultants' details for equipment specified to achieve the criteria described within the tender documents.
 - e) Development of the controls specification for the hardware, software, power, controls wiring and all associated equipment.

M1-7 SYSTEM PRESSURE RATING

The entire installation including all valves and equipment shall be pressure rated to PN10. All valves and components shall be certified by the manufacturer and stamped as PN10.

This requirement ensures that the system as a whole uses components, valves and fittings that have a common standard pressure rating.

This requirement applies to both mains cold water and boosted cold water systems.

M1-8 INCOMING MAINS COLD WATER SUPPLY

Incoming water supply is detailed in the external works section of this specification.

At entry into the building an injection point shall be provided to allow for the effective sterilisation of the whole installation and sampling of the incoming water supply.

After the final connection of the incoming water supply is completed and fully flushed but prior to the water supply being fed into the new pipework installation, a water sample shall be taken, and this sample shall be fully tested to confirm the incoming water is fully potable.

M1-9 INCOMING MAINS COLD WATER METERS

Incoming water supply meters are detailed in the Energy Metering section of this specification.
of this section.

M1-10 PIPEWORK, VALVES AND FITTINGS

All pipework, valves, fittings and their installation shall be as detailed in 'General Installation Standards – Pipework', deviated from only as detailed earlier in this specification section and as additionally detailed below in the following sub-clauses.

M1-10-1 SECONDARY SUPPORTS

All secondary support steel work for supporting services shall be provided by the Mechanical Contractor. For tender secondary supports are all supports that are required to support the mechanical services that are required over and above those shown on the structural drawings.

M1-10-2 WATER MANAGEMENT SYSTEM FOR URINALS

Supply and install urinal flushing systems in each Male WC as detailed on the tender drawings.

Each system shall be complete with a 'down lighter' recessed model passive infrared detector solenoid valve and tank. The systems shall be suitable for 220v 50Hz main supply. Battery operated systems shall not be permitted.

The management systems shall be designed and commissioned to limit cold water demand so that total demand does not exceed 3 litres flow per bowl per hour.

All necessary power supplies shall be included for at tender.

The units shall be manufactured by: -

- 1) Robert Pearson & Co, their Flushmatic
- 1) Chess Industries, their Smartflush

M1-10-3 FINAL CONNECTIONS TO SANITARY WARE

The Mechanical Contractor shall allow for making final connections to all sanitary ware and water consuming equipment. The Mechanical Contractor shall allow to pressure test and chlorinate all installed pipework upon the final completion of all installed work in accordance with the 'General Installations Standards – Pipework' section of this specification.

Each item of sanitary ware shall have a local and individual means of isolation, which shall be a combined quarter turn ball isolating and automatic flow restricting valve. These valves shall be as manufactured by Arrow Valves, their model AFL range. These valves are available with a variety of different cartridges to suit different sanitary ware; specific requirements are:

- 1) Wash Hand Basins shall be fitted with flow restricting cartridges to limit the peak flow rate to 6 litres / minute.
- 2) Sinks shall be fitted with flow restricting cartridges to limit the peak flow rate to 7 litres / minute.
- 3) Showers shall not be fitted with flow restricting cartridges (if the shower hose flow restricting limiters are fitted) but if not then the hot and cold water connections shall each be limited to 8 litres / minute.
- 4) WCs shall not be fitted with flow restricting valves but shall instead be fitted with strainers as is required for all compact WC float valves under WRAS Regulation Guidance and Recommendation reference 25.6.

The flow rates are preliminary for tender purposes and the design engineer shall allow for liaising with the design team and client to agree on the final cartridge selections prior to ordering.

Alternative manufacturers are acceptable provided they provide the same performance and standard criteria as the above valve, this shall include (but not be limited to):

- 1) Suitable for the maximum water pressure previously specified.
- 2) Maintain design flow rates between 90 and 110% at all pressures between 1 Bar and maximum specified peak pressure as specified in this specification.
- 3) Have full WRAS approval.
- 4) Provided with both strainers and flow restricting cartridges as standard.
- 5) Suitably temperature rated.
- 6) Provided with extended spindle lever handles for isolation without any tools (as pipe and valve shall be thermally insulated).
- 7) Cartridges and strainers can be removed / changed without additional isolation or draining down of the system.

All local isolation, with flow restrictors, strainers or neither, shall be the same manufacturer and model range throughout to maximize ease of servicing and maintaining spares. Mixed manufacturers and model ranges shall not be acceptable.

All final connections to sanitaryware shall be solid pipework connections. The use of flexible braided hoses shall not be acceptable on this project. Any flexible hoses installed on site shall be removed at the cost of the Mechanical Contractor, inclusive of programme implications that result in non-compliance of this clause.

M1-10-4 BACK FLOW PREVENTION

Single and double check valves shall be provided to all necessary branch pipes as required by the current water regulations including:

- 1) Vending machines shall be a double check valve.
- 2) Drinking fountains shall be a double check valve.
- 3) Branches where it is reasonable to assume the services will be infrequently used including kitchens, kitchenettes and showers (these examples are listed in BS8558). Single check valves shall be installed as close to the branch valve as possible.
- 4) Pressurisation units (unless the feed pipe to the pressurisation unit is looped design in which case check valves shall not be required). Looped cold feed design to pressurisation units is the preferred option that shall be adopted unless technically not possible – cost is not a technical reason for non-compliance. Single check valve shall be installed where a looped design is not installed.
- 5) HTM compliant thermostatic mixing valves (where single check valves are integrated into the thermostatic mixing valve) shall be installed with additional single check valves to provide double check valves on both hot and cold supplies.
- 6) All other non-healthcare thermostatic mixing valves to be fitted with single check valves unless the check valves are integrated into the thermostatic mixing valve.
- 7) Unblended mixer taps – single check valves in hot and cold connections.
- 8) At entry into buildings – double check valve for all buildings.

Single and double check valves shall NOT be installed in the following situation:

- 1) In mains cold water pipes serving ball valves that fill cold water tanks.

M1-10-5 DRAIN VALVES AND AIR VENTS

Air vents shall not be provided in the domestic hot and cold water system to avoid dead legs and comply with BS 8558. Both hot and cold water connections shall be self-venting, this shall be achieved by providing the branch connections from the top of the pipes at all necessary strategic points to ensure complete venting. Where hot water pipes need to be looped vertically to ensure the dead leg water content remains less than 0.5 litre limit, the design shall be installed with smaller branch connections provided between the vertical loops to ensure the pipes are automatically vented of air through the smaller branch connections.

M1-10-6 COLD WATER DEAD LEGS

Cold water branch pipes shall be limited in length to the following circuits to minimise dead legs and maintain optimum water quality:

- 1) Branch pipe to water boilers for beverage preparation shall not exceed 300mm long.
- 2) Branch pipe to water chillers for beverage preparation shall not exceed 300mm long.
- 3) Branch pipe to drinking fountains shall not exceed 300mm long.
- 4) Branch pipe to vending machines shall not exceed 300mm long.

M1-10-7 HOT WATER CIRCULATING SYSTEM DEAD LEGS

In accordance with BS8558, the maximum permitted hot water dead legs, including the blended pipework, on the hot water circulating systems shall be limited to 0.5 litre or 3 metres, whichever is the lower value.

For information only, this means that:

- 1) Where the hot water flow pipe is 22mm diameter after the HWS return connection to sinks, etc. the dead leg shall not exceed 1.7 metres.
- 2) Where the hot water flow pipe is 15mm diameter after the HWS return connection, the dead leg shall not exceed 3.0 metres (maximum permitted to meet the 0.5 litre only is 3.4 metre).
- 3) Where the hot water flow pipe is 22mm after the HWS return connection but reduces to 15mm after a branch, the hot water pipe shall be limited to 2 metres (to stay safely within the 0.5 litre volume).

Any singular references to lengths of 3 or 5 metre long hot water dead legs are superseded by this clause as the dead leg limit is a combination of the no more than 0.5 litre and 3 metre limits, whichever is the lower value.

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All outlets shall be tested, proven and documented to be compliant with the above requirement by the Commissioning Engineer.

Any non-compliant systems shall be modified to comply by the Mechanical Contractor at their expense and re-tested until compliance is proven.

M1-11 THERMAL INSULATION

The whole of the domestic hot and cold water pipework shall be thermally insulated and vapour sealed. All insulation shall be as detailed in 'General Installation Standards – Insulation' section.

M1-12 CHEMICAL DOSING, TESTING AND COMMISSIONING

The system shall be pressure tested, commissioned, chemically dosed and sterilised as described within 'General Installation Standards' sections of this specification.

All water testing necessary to determine what level of treatment is to be provided shall be included within the tender.

The Commissioning Specialist shall complete all commissioning, except equipment shall be commissioned by the equipment manufacturer.

M1-13 INJECTION POINTS REMOVAL POST DOSING AND CHLORINATION

Whether shown on any drawings or not and where added as needed to carry out chemical dosing and chlorination, all injection points that are provided shall be removed on completion of dosing and chlorination as NO dead legs are permitted to remain at handover of the project.

Section M2

Heating



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M2-1 GENERAL REQUIREMENTS

The heating systems required for this project shall be as follows:-

- 1) A new primary LTHW system to serve the building and modification and reconfiguration of the existing LTHW secondary circuits. The heating system shall consist of the following.
 - a) Gas fired boiler installation,
 - b) Plate heat exchanger(s) providing hydraulic separation of primary the new primary circuits from the aging secondary circuits,
 - c) LTHW pressurisation units.
 - d) radiator installation,
- 2) Any project specific specialist system requirement not covered in the above.

M2-2 SYSTEM DESIGN OPERATING VALUES

M2-2-1 SYSTEM TEMPERATURES

HEATING SYSTEM DESIGN OPERATING CONDITIONS		
DESCRIPTION	FLOW °C	RETURN °C
Primary Circuit LTHW Circuit	82°C	< 71°C
LTHW Radiator Panels	79°C	68°C
System maximum operating temperature	85°C	

M2-2-2 SYSTEM PRESSURE

SYSTEM DESIGN PRESSURE	
Entire installation pressure rating	PN16
Normal system operating pressure	0.5 to 4 Bar.g
System test pressure	Refer to section 2A-5

M2-2-3 REDUNDANCY REQUIREMENTS

To ensure acceptable operation of the building systems are maintained in the event of boiler failure, the main plant shall be designed and installed to provide:

- 1) 2 No. gas fired boilers sized at 100% with individual single head pumps.
- 2) 1 plate heat exchangers each rated at 100% capacity for hydraulic separation.
- 3) All twin head pumps shall be provided as 100% run and 100% standby capacity.

M2-3 DEFINITIONS

Refer to Section 1B and 2A to 2D inclusive for general definitions plus:

DEFINITIONS	
ABV or BPV	Automatic Bypass Valve
BACnet	Building automation and control networks
CHP	Combined Heat and Power Unit
DPR	Differential pressure regulators
HT	High temperature
LON	Local operating network. Also referred to as LONworks
LSV	Lock shield valve

DEFINITIONS	
LST	Low surface temperature
LT	Low Temperature
Modbus	Serial communications protocol developed by Modicon
PHX or PHE	Plate heat exchanger
Protocol Interface	Set of rules that established how systems communicate with BMS. Examples of protocols used are BACnet, LON and Modbus.
TRV	Thermostatic Radiator Valve
VFC	Volt free contact

M2-4 REFERENCE TO OTHER SECTIONS OF THIS SPECIFICATION

This section of the specification shall not be used in isolation and must be read in conjunction with the particular sections, commissioning and standard clauses, all of which define further the requirements for the installations.

The following text advises if the Contractor shall deviate from the preferred pipework material and standards or utilise one of the alternative materials and standards of construction listed in section 2A clause 2A-1-4 detailed earlier in this specification.

The agreed alternative materials from the preferred standard material and standards for this project are:-

No deviation from Section 2 preferred material requirements is permitted.

Note that under no circumstances shall galvanised steel pipework be installed in closed loop heating systems. On inspection of installation, should it be found that this type of pipework has been installed, it shall be removed and replaced at the Contractor's expense.

M2-5 STANDARDS APPLICABLE

Works shall be completed in accordance with all applicable industry standards. Some of the most relevant standards associated with this section are scheduled in section 2 standards and below:

STANDARDS	
BESA TR 30: Heat pump guide	BS EN 10028 Flat products made of steels for pressure purposes
BESA TR 38: Installation of Biofuel Heating	BS EN 10255 Non-alloy steel tubes suitable for welding and threading
BESA Guide to Good Practice: Supports and Fixings	BS EN 13203 Gas-fired domestic appliances producing hot water
BSRIA Commissioning Codes	BS EN 13501 Fire classification of construction products and building elements
BSRIA Standards	BS EN 16297 Pumps. Rotodynamic pumps. Glandless circulators
BS 853 Specifications for vessels for use in heating systems	BS EN 16752 Centrifugal pumps. Test procedure for seal packings
BS 5986 Specification for electrical safety and performance of gas fired space heating appliances with inputs 60kW to 2MW	BS EN ISO 14414 Pump system energy assessment
BS EN 656 Gas-fired central heating boilers. Type B boilers of nominal heat input exceeding 70kW but not exceeding 300kW	Pressure Equipment Regulations

STANDARDS	
BS EN 1859 Chimneys. Metal chimneys. Test methods	

HEALTHCARE STANDARDS	
All relevant NHS Health Building Notes (HBNs)	
Health Technical Memorandum (HTM) 03-01: Specialised ventilation for healthcare premises. Part A - Design and installation	Health Technical Memorandum (HTM) 03-01: Specialised ventilation for healthcare premises. Part B - Operational management

Where the above standards refer to supporting documentation and standards these shall be fully complied with in all respects.

Where discrepancy is found between this specification and the relevant standards, the Contractor shall obtain written clarification from the Engineer prior to submission of the tender. Where a discrepancy has not been clarified prior to tender submission, the Contractor shall include the most onerous requirements.

M2-6 SCOPE OF WORKS

The following brief descriptions identify those systems required for installation on this project. Comprehensive system requirements shall be detailed in the subsequent clauses of this specification together with schematic and design drawings.

The LTHW heating system installation shall include for all necessary tools, labour, materials and equipment to supply, install, commission and put into operation the heating services, including the following:-

- 1) 2 No. gas fired high efficiency condensing boilers to meet the heating requirements of this project, complete with associated flue systems.
- 2) Plate heat exchanger(s).
- 3) Pressurisation unit with expansion vessel(s).
- 4) Chemical Dosing pot.
- 5) De-aerator and dirt separator.
- 6) Individual Boiler pumps and individual secondary circuit pumps to provide a complete installation. All pumps shall be fully inverter driven and shall be separate run and standby pumps.
- 7) Steel panel radiators.
- 8) All necessary two pipe heating distribution pipework, valves, brackets and fittings to all circuits.
- 9) All control valves, actuators (sized, selected and provided by the Control Specialist).
- 10) All sensor pockets and control interfaces required by the BMS to full integrate with the heating system.
- 11) All necessary trace heating systems to external sections of pipework.
- 12) All pressure by-pass and pressure regulating valves to maximise the energy saving potential of the variable speed pumps.
- 13) All necessary flushing, filling and venting of all services.
- 14) All necessary commissioning stations for system balancing.
- 15) All testing, witnessing hydraulic pressure tests, balancing, venting and commissioning.
- 16) All thermal insulation in compliance with earlier section of this specification.

The following are the requirements that are common to all of the systems described above:

- 1) Liaison with other trades on site.
- 2) Copies of Operating and Maintenance instruction manuals including a 'brief description' of services and fault finding information list of spares, emergency telephone Nos. etc.
- 3) Full user instruction, both written and in the form of demonstrations.

- 4) All primary and secondary support systems to install the services.
- 5) Complete electrical installation works associated with this Section of the Specification including all cabling, local isolation and protective devices.
- 6) Development of the Consultants drawings and detailing from the base tender information to full construction standards as detailed previously. This shall include responsibility for the following areas:-
 - a) Support systems/brackets for all services.
 - b) Expansion and contraction within the system networks.
 - c) Final co-ordination of the mechanical and electrical services including the preparation of completely dimensioned double line services fabrication drawings.
 - d) Development of the Consultants' details for equipment specified to achieve the criteria described within the tender documents.
 - e) Development of the controls specification for the hardware, software, power, controls wiring and all associated equipment.

M2-7 INCOMING SUPPLY

The existing incoming natural gas supply shall be retained and utilised for this project.

M2-8 GAS FIRED BOILERS

A series of fully condensing, gas fired boilers shall be supplied and installed within the plant room.

Each boiler shall be as detailed below and to meet all the particular requirements listed in the appendix of this section of the specification:

- 1) Low NOx to meet the value listed in the appendix.
- 2) Shall be CE certified.
- 3) Complete with heat exchangers to maximise condensate quantity and maximise total boiler efficiency.
- 4) The boiler high limit controls thermostat shall be set at approximately 95°C with manual reset.
- 5) Complete with safety valve that shall be set to discharge at a pressure of 0.7bar/m² above the working pressure of the boiler.
- 6) Discharge of the safety valve shall terminate 150mm above the plantroom floor drain.
- 7) Complete with remote lock out indication.
- 8) Complete with burners supplied, assembled and pre-wired.
- 9) Fully automatic burner operation comprising spark ignition for an intermittent pilot with full flame proving via a flame rectification probe.
- 10) Suitable for an electrical supply of 230 Volts, single phase, 50Hz.
- 11) Complete with integral draught diverting outlet.
- 12) Complete with insulating jacket to minimise standing losses.
- 13) Complete with stove enameled common boiler casing.
- 14) Mounted on 150mm high concrete plinth / upstand.
- 15) Factory pressure tested to the maximum working pressure detailed in the appendix and certified accordingly.
- 16) Complete with radiant baffle to minimise boiler standing losses.
- 17) Provided with set of cleaning tools.

The equipment shall be supplied, installed and commissioned to meet all manufacturer's best practice recommendations.

Each boiler shall be supplied, tested and commissioned by the boiler manufacture.

M2-9 BOILER FLUES

The flue systems shall be designed, supplied and installed by one of the following Specialist Companies:

- 1) A1 Flues, Tel No. 01623 860578

- 2) SFL Flues and Chimneys, Tel No. 01271 326633
- 3) Midtherm Flue Systems Ltd, Tel No. 01384 458800
- 4) Jeremias UK Limited, Tel No. 01623 889219

Each flue systems shall comply with the following: -

- 1) Be installed fully in accordance with the equipment manufacturer's recommendations that it is connected to.
- 2) A stainless steel internal lining, manufactured from Grade 316 stainless steel.
- 3) External flue casing manufactured from Grade 304 stainless steel.
- 4) Be CE accredited.
- 5) The internal and external casings shall be separated by a 25mm annular which shall be insulated with a thermal insulation material compatible with the working temperature of the flue gases and to maintain safe surface temperatures.
- 6) The materials used for accessories and fittings shall be durable, compatible and not cause electrolytic action on any part of the flue or chimney system.
- 7) Internal stainless steel liner with continuously welded seam and integral flange at each end.
- 8) Jointing by means of an inner vee band sealed to ensure a gas and moisture proof fire rated joint.
- 9) External casing covered using channel bands to give a clean and smooth external appearance and finish. Suitable for serving fully condensing boilers.
- 10) Laid to a fall of at least 1:80 (or to manufacture's recommendations).
- 11) Incorporate a drain tee piece complete with a 25mm socket for condensate draw off.
- 12) Boiler flue connector shall also incorporate 2 No 25mm diameter sockets local to the boiler flue outlet which shall be adapted for flue gas sampling and temperature monitoring.
- 13) All necessary flashing plates/collars and fixings to ensure that the roof penetration of each flue is secure and weatherproof.
- 14) Approved inverted cowl rain cap type terminal for the flue termination, powder coated to a colour to match the roof cladding. All external components shall be powder coated to match the roof cladding. Colour to be agreed with the Architect.
- 15) Individual flue drainage pipework complete with trap (that can be replenished). The drains shall terminate 100mm above the plant room floor drain or pacification vessel
- 16) The Specialist Contractor shall include for all fabrication/working drawings detailing full construction details which shall be submitted for comment by the Engineer prior to manufacture.

Flue systems shall be supplied, installed and commissioned to meet all requirements/ recommendations stated within the boiler manufacturer's current literature.

M2-10 LTHW PRESSURISATION SET

Supply, delivery, installation and commissioning of the heating system water pressurisation unit and expansion vessel(s) The pressurisation unit(s) shall be complete with the following features:-

- 1) Performance as detailed in the appendix to this section.
- 2) Back flow pressure prevention to suit water in system (Category 4 as minimum)
- 3) Break tank, ball valve and float.
- 4) Drain valves and means of isolation for all components.
- 5) Pressurisation Pumps – run and standby.
- 6) All interconnecting wiring and a control panel suitable for connection to a 1 phase, 240 volts, 50Hz electrical supply.
- 7) Local electrical isolator.
- 8) All interconnecting pipework valves and fittings.
- 9) Electrical starter for the pumps with auto changeover and duty share.

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- 10) Test button.
- 11) Pump start frequency/leakage detector.
- 12) High and low pressure alarm.
- 13) LCD Display on the front of the control panel.
- 14) Controlled to automatically share duty between run and standby pumps for even wear.

The pressurisation unit is to be compatible with the Controls system, as detailed later in the Specification. Should the pressure switches be activated this shall deactivate the plant via the controls (hard wire interlocked) and shall provide the alarm conditions detailed within the appendix.

The pressurisation unit control panel shall incorporate a programmable microprocessor which shall, on demand, indicate the following settings on the fascia: -

- 1) System working pressure.
- 2) Cold fill pressure setting.
- 3) High pressure alarm setting.
- 4) Low pressure alarm setting.
- 5) Minimum pump running time (delay between pump starts).
- 6) High system pressure.
- 7) Low system pressure.
- 8) System 'leakage' (frequent pump starts).
- 9) Transducer failed.
- 10) Run and tripped lamps for each pump.
- 11) Panel live lamp.

Volt free contacts shall be fitted within the pressurisation unit control panel to allow remote monitoring by the BMS as detailed in the equipment schedule.

The expansion vessel(s) shall:

- 1) Have sufficient volume to take the expansion of the entire system from ambient to highest working possible temperature.
- 2) Final system volumes to be verified.
- 3) Include EPDM type diaphragm (suitable for 100°C).
- 4) Be complete with wall or floor support frame provided by the expansion vessel manufacturer.
- 5) Be provided by the pressurisation manufacturer.
- 6) System shall be installed with anti-gravity loop on discharge.

M2-11 LTHW CHEMICAL DOSING POT

To enable water treatment to be added to each heating system, a dosing pot shall be provided and connected across the system flow and return to enable maintenance doses of chemicals to be added.

The dosing pot shall be:

- 1) Of at least 13.5 litre capacity.
- 2) Manufactured from same material as the pipework, fully welded or brazed as appropriate.
- 3) Complete with pre-mounted gate valves and non-return valve in the filling line.

Note – the non-return valve is a mandatory requirement to minimise health and safety risk of incorrect use of the dosing pot.

Chemical dosing shall be:

- 1) Initial test/dosing shall be completed prior to first application of heat.
- 2) Second test dosing shall take place immediately prior to end of defects period.
- 3) All water testing necessary to determine what level and type of treatment is to be provided shall be included.

Water treatment dosing pot shall be by:

- Arrow Valves Limited.
- N. Minikin & Sons Limited.
- Water Treatment Products.
- Stourflex (J&P Supplies Limited).
- Messrs. Houseman Ltd.
- Flex EJ Limited.

M2-12 PLATE HEAT EXCHANGERS

The plate heat exchangers shall interface between the primary heating circuit and the LTHW heating systems serving the building to provide full hydraulic separation.

The packaged hot water plate heat exchanger shall be fully compliant with the technical requirements detailed in the schedule at the end of this section and be complete with the following:

- 1) The overall casing shall be manufactured from epoxy coated steel and shall be suitable to accept the insulation proprietary removable insulation jackets that shall insulate all hot surfaces.
- 2) Complete with removable insulated jacket to insulate all surfaces.
- 3) Heat exchange plates shall be stainless steel 316L with gaskets suitable for fluids handled.
- 4) The unit shall have 20% spare capacity that can be added by the installation of additional plates to the steel frame with associated increase in pressure loss limited to 20% increase.
- 5) Be designed for single pass opposing direction.

PHE shall be as manufactured by one of the plate heat exchanger manufacturers listed in the schedule at the end of this section.

M2-13 SEPARATE DE-AERATOR AND DIRT SEPARATOR

As detailed on the tender drawings a separate de-aerator and dirt separator unit shall be provided as shown on the tender drawings.

De-aerator

The unit shall be:

- 1) Installed at the point of highest temperature/lowest pressure to aid air removal.
- 2) Installed with isolation valve and binder test points either side of unit.
- 3) Made from 5mm thick high grade heavy carbon steel (or better) with flanged connections.
- 4) Suitably pressure rated.
- 5) Installed to the recommendation of the manufacturer.
- 6) Complete with 1 No. high quality automatic air vent (c/w NRV connection for ease of replacement) with threaded connection for vent pipe
- 7) Complete with 1 No. 25mm releasing valve for purging through installation stage.
- 8) Complete with 1 No. 32mm drain valve.
- 9) Refer to manufacturer's recommendations for Maximum Static Head pressure

Dirt Separator

The unit shall be:

- 1) Installed to ensure the heating equipment is protected from suspended products to ensure all equipment manufacturer's warranties are maintained.
- 2) Made of Steel or Brass.
- 3) Suitably pressure rated.
- 4) Installed in pipework where the velocity of 3m/s maximum is not exceeded.
- 5) Installed on return pipework prior to boilers.
- 6) Provide filtration down to 20 microns.

7) Provided with Isolation drain valve and suitable connections for draining/cleaning.

Components shall be installed fully in accordance with the manufacturer's requirements in terms of position in the pipework installation to ensure maximum efficiency of removing air and 'dirt' from the system.

Manufactured by:

- Hamworthy Ltd
- Spirotech
- BSS

M2-14 STANDARD RADIATORS

Standard steel panel radiators shall be installed as detailed on the drawings and the appended schedule.

Standard steel radiators shall be installed where indicated on the tender drawings. The radiators shall be selected to meet the total **heat** losses of each space and shall be positioned in conjunction with the Architect to suit the proposed layout.

All radiators shall be:

- 1) Be supplied with matched top and side grilles.
- 2) Be supplied with manufacturers matched standard fixing brackets.
- 3) Complete with any secondary supports necessary.
- 4) Fixed using rawlbolt fixings, plastic or fibre plugs shall not be used.
- 5) Provided with a thermostatic radiator valve on the flow connection.
- 6) Provided with a lock shield valve on the return.
- 7) Installed level and plumb, a common height to the top of all radiators shall be maintained when more than one radiator is fixed within a single room / space.
- 8) Taken down and reinstated up to two times for decoration purposes.
- 9) Pressure tested to system requirements.
- 10) No radiator shall project above the top of the window sill beneath which it is fitted.
- 11) Protect each of the radiators after installation by means of manufacturer's packing or polythene sheets, maintained throughout the installation period, this shall only be removed when the decorations have been completed.
- 12) Provided with a maximum of three top brackets and two bottom brackets to each radiator.
- 13) Provided with a recessed air vent which shall be provided at the high point on the radiator, accessible externally to the radiator.
- 14) Radiator connections shall be at least 15mm in size and top bottom opposite ends (TBOE) unless otherwise stated in schedules.

Prior to ordering any radiators site measurements of the area applicable, shall be undertaken to ensure that the specified radiators can be installed when building work is far enough progressed.

Any discrepancies shall be identified to the Engineer at the earliest opportunity.

M2-15 AUTOMATIC CONTROLS

Refer to Control Section for details.

Where control valves are installed local pipe sizes may be of a different size, due allowance shall therefore be made for any necessary reducers.

M2-16 THERMOSTATIC RADIATOR VALVES

Each radiator shall be fitted with 15mm pre-settable KV thermostatic valve on the flow connection, which shall incorporate the following features.

- 1) kV limiting device for pre-setting of maximum flow through the radiator.

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- 2) Mechanical Contractor to pre-set the thermostatic valves to give the correct flow rate through each radiator, this shall be based on the actual pressure drop of through the radiator for tender purposed assume drop as 5 kPa.
- 3) The gland assembly shall be suitable for replacement without draining down the system.
- 4) Be manufactured from brass with nickel plating.
- 5) Be selected to suit the configuration, location and required flow rate.
- 6) Thermostatic head to be commercial tamper proof (*key adjustable*) type with integral sensor in shared common areas and with adjustable range in areas where users require local control.
- 7) The sensor shall be suitable for connection position on the radiator. Proximity to any exposed distribution pipework located under the radiator shall be considered to ensure correct operation.
- 8) Where good temperature readings cannot be obtained with the integral sensor a remote sensor shall be provided.
- 9) Facility to restrict the temperature adjustment range.
- 10) Complete assembly to be tamper proof.
- 11) Sensor to be provided by the same manufacturer as the valve body.
- 12) The sensor shall be installed in the horizontal plane as recommended by the manufacturer to obtain optimum room temperature detection.
- 13) All valves shall be at least PN16 rated.
- 14) All sensors shall be provided with the facility for locking and limiting of temperature set point range of operation. Final ranges of operation shall be agreed at commissioning stage, for tender purposes assume:

Area	Temperature
Joinery Workshop & Store	frost to 19°C
Supervisor Office / Locksmith / AP Office	frost to 23°C
Mechanical Workshop & Store /	frost to 23°C
Shower Room	frost to 22°C
Electrical Workshop / Paint Shop	frost to 23°C

At practical completion the following shall be provided: -

- 1) One isolating cover for each series of 5 radiator bodies installed.
- 2) One tool for replacing the gland assembly.
- 3) One spare pair of setting limiting pins per series of 5 sensing heads installed.
- 4) One setting tool for the above pins (where appropriate).

The radiator valves shall be manufactured by either:

Manufacturer	Body	Head
Danfoss Randal Ltd	RA-N	RA 2000
Drayton	RT 414	RT 414
IMI Hydronic Engineering	A-exact – thermostatic flow setting	Thermostatic head K (standard limiting) Thermostatic head B (tamperproof) Thermostatic head DX (hygienic) Thermostatic head F (remote adjustable wall sensor / adjustment)
Herz Valves UK Ltd	TS-90	Herzcules Vandal Resistant Sensor

Manufacturer	Body	Head
		Design Remote Control (remote adjustable wall sensor / adjustment)

M2-17 LOCKSHIELD RADIATOR VALVES

Each radiator shall be fitted with 15mm lock shield valve on the return connection unless otherwise stated and shall incorporate the following features: -

- 1) Complete assembly to be tamper proof.
- 2) Complete with a rubber sealed nickel-plated cover.
- 3) Complete with a connection to fit an adapter for draining / filling the radiator.
- 4) Be manufactured from brass with nickel plating, to exactly match the thermostatic radiator valve.
- 5) All valves shall be at least PN16 rated.

At practical completion the following shall be provided: -

- 1) One draining adapter per series of 20 lock shield valves installed (min=1No.).
- 2) One isolating tool / Allen key per series of 20 lock shield valves installed (min=1No.).

The lock shield valves shall be as manufactured by Danfoss Limited, their RLV-S Angle pattern for radiators and RLV-S straight pattern for ceiling radiant panels and trench heating or Herz Valves UK Ltd or equivalent or equal and approved.

M2-18 PIPEWORK AND FITTINGS**M2-18-1 INTERNAL PIPEWORK**

All pipework, valves, fittings and their installation shall conform to Section 2 of this Specification and be completed as below:-

- 1) Allowances shall be made for any secondary steelwork, which may be required to support the services from the structure. For clarity any services and equipment that can be supported using 82mm X 41mm U-channel (commonly known as Unistrut) shall be secondary steelwork and included within this tender return.
- 3) Be complete with all bracketing, additional supports and drop rods required to fix to secondary supports, this shall include any ties and anchors to ensure pipe is adequately anchored as needed.
- 4) Bleed lines (complete with gate valves and plugs) from air bottles/vents shall be run to a suitable venting point within the nearest plant room or service riser space to F.F.L. and 1500mm. Suitable venting points are drains, gullies or traps. Vent pipes shall not be visible in user occupied spaces unless agreed with the engineer. Plant rooms are not user occupied areas.

M2-19 VALVES AND FITTINGS

All valves and fittings shall be as detailed in section 2A.

M2-20 THERMAL INSULATION

The whole of the pipework shall be thermally insulated and vapour sealed. All insulation shall be as detailed in Section 2D.

M2-21 TESTING AND COMMISSIONING

Testing and commissioning shall be carried out fully in accordance with General Installation Standards of this Specification.

M2-22 EXPANSION AND CONTRACTION

The selection and installation of all measures to allow for expansion and contraction shall be included for this project. This shall be in the form of loops, bellows, anchors, guides, offsets, rollers/chairs and cold draw.

Wherever feasible, natural flexibility solutions shall be employed. All provisions for expansion and contraction shall be indicated on the fabrication drawings submitted with the supporting calculations to the Engineer for comment prior to installation taking place.

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In the event that natural flexibility cannot be used due to building fabric restraints, bellows shall be installed which shall:

- 1) Be multi-layered stainless steel (316L) quality units
- 2) As manufactured by:
 - a) Pipe Solutions (01423 878888)
 - b) Bellows Technology Ltd (01663 745873)
 - c) FLEXEJ Ltd (01384 881188)

APPENDIX I – EQUIPMENT SCHEDULES

LTHW CONDENSING BOILER	
Description	Requirement
Qty	2No.
Type	Fully condensing low NOx
Duty (net) output to water	50 kW
Design temperature and pressure	Refer to clause M2-2 for 'System Design Operating Values'
Model	Hoval TopGas Classic 50
Fuel & minimum pressure	Natural Gas at 18 millibar
Duty control	Variable 20% to 100%
Maximum Nox	40mg/kWh
Connections	Refer to schematic
Meters and gauges	Hours run meter 100mm dial thermometer gauge graded from 20°C to 125°C 100mm diameter altitude gauge graded from 0 to 6 bar gauge
Minimum boiler seasonal efficiency	95% using fuel gross calorific value
LTHW flow rate	Variable must have no minimum flow requirements
Integral controls (separate from BMS)	Boiler shuts down under the following conditions: Flame failure In response to limit sensors
BMS interface	Remote start VFC Flow temp set point 0-10v Common fault VFC Burner lock out VFC High temperature lock out VFC
Manufactured by: <ul style="list-style-type: none"> Hoval Ltd Viessman Ltd Buderus Ltd / Bosch Commercial and Industrial Heating 	

HEATING WATER PRESSURISATION UNIT & EXPANSION VESSEL – PU-01	
Description	Requirement
Location	Mounted internally within plantroom
Type	Duplex
Quantity	1 No.
System duty	100 kW
Minimum size of connection to system	22mm

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HEATING WATER PRESSURISATION UNIT & EXPANSION VESSEL – PU-01	
Description	Requirement
Pressurisation Unit Head	Above unit 3m Below unit 0m
System water content	100L
Power supply	230v / 1 phase / 50Hz
BMS interface / alarms	High pressure alarm Low pressure alarm No. 1 pump tripped. No. 2 pump tripped. Break tank low level.
Expansion vessel capacity	Minimum 50 litres – For tender purposes
Design temperature and pressure	Refer to clause M2-2 for 'System Design Operating Values'
Manufactured by: <ul style="list-style-type: none"> Grundfos Ltd Armstrong Ltd Mikrofill 	

HEATING WATER PRESSURISATION UNIT & EXPANSION VESSEL – PU-02	
Description	Requirement
Location	Mounted internally within plantroom
Type	Duplex
Quantity	1 No.
System duty	100 kW
Minimum size of connection to system	22mm
Pressurisation Unit Head	Above unit 12m Below unit 0m
System water content	1400L
Power supply	230v / 1 phase / 50Hz
BMS interface / alarms	High pressure alarm Low pressure alarm No. 1 pump tripped. No. 2 pump tripped. Break tank low level.
Expansion vessel capacity	Minimum 800 litres – For tender purposes
Design temperature and pressure	Refer to clause M2-2 for 'System Design Operating Values'
Manufactured by: <ul style="list-style-type: none"> Grundfos Ltd 	

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HEATING WATER PRESSURISATION UNIT & EXPANSION VESSEL – PU-02	
Description	Requirement
<ul style="list-style-type: none"> Armstrong Ltd Mikrofill 	

LTHW PUMPS							
Ref	Description	Type	Duty (l/s)	Pressure (KPa)	Speed Control	Type	Power Supply
P01 / P02	Boiler Shunt Pump	Single head per boiler	1.087	80	Inverter	Inline	3 phase
P03	LTHW PHE-Secondary	Twin head	2.174	60	Inverter	Inline	3 phase
Electrical efficiency					To achieve: EEI = < 0.20 MEI = >0.40		
BMS interfaces					Common fault from inverter to BMS 0-10v from BMS to determine pump speed Enable signal from BMS to start pump.		
Design temperature and pressure					Refer to clause M2-2 for 'System Design Operating Values'		
Manufactured by:- <ul style="list-style-type: none">Armstrong Pumps LtdGrundfos Ltd							

LTHW PLATE HEAT EXCHANGER	
Description	Requirement
Quantity	Refer to schematic
Location	Plant room
Primary fluid	Flow 82°C Return 71°C Flow 2.174 l/s Max Pressure Drop 35kPa
Secondary fluid	Flow 82°C – Temperature loss across plate TBC. Return 71 °C Flow 2.174 l/s Max Pressure Drop 35kPa

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LTHW PLATE HEAT EXCHANGER	
Description	Requirement
Design temperature and pressure	Refer to clause M2-2 for 'System Design Operating Values'
Capacity	100 kW
Expansion vessel	Not Required
Manufactured by: <ul style="list-style-type: none"> Stokvis Limited Spirax Sarco Limited Alfa Laval Limited Hoval BSS 	

RADIATOR SCHEDULE					
Selection based on temperatures & pressures in clause M2-2 'System Design Operating Values'					
Ref.	Room Temp. (°C)	Required Output (W)	Height (mm)	Length (mm)	Rad Model Type
R.01	19	1128	600	600	VITA Compact K2
R.02	19	1004	600	600	VITA Compact K2
R.03	19	1004	600	600	VITA Compact K2
R.04	19	1004	600	600	VITA Compact K2
R.05	19	1004	600	600	VITA Compact K2
R.06	23	709	600	400	VITA Compact K2
R.07	23	613	600	400	VITA Compact K2
R.08	23	1334	600	800	VITA Compact K2
R.09	23	1334	600	800	VITA Compact K2
R.10	23	705	600	400	VITA Compact K2
R.11	22	745	1744	500	Classic Towel Rail
R.12	23	992	600	600	VITA Compact K2
R.13	23	992	600	600	VITA Compact K2
R.14	23	3138	600	1800	VITA Compact K2
R.15	23	1786	600	1000	VITA Compact K2
Manufactured by:- <ul style="list-style-type: none"> Stelrad Ltd – Current selections based on Stelrad Myson Ltd Hudevad Ltd 					

Section M3

Mechanical Ventilation Systems



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Section M3 Mechanical Ventilation Systems

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M3-1 GENERAL REQUIREMENTS

The project is naturally ventilated for the majority of the building with mechanical ventilation only provided to rooms which cannot be provided with natural ventilation or where insufficient natural ventilation is possible.

The mechanical ventilation systems required for this project shall be as follows:

- 1) Local extract fans shall be provided to shower area.
- 2) Any other ventilation system requirement not covered in the above but detailed within the tender documents.

M3-2 DEFINITIONS

Refer to Section 1B for general definitions plus:

DEFINITIONS	
AHU	Air Handling Unit
BACnet	Building automation and control networks
BCO	Building Control Officer
CV	Constant Volume
DX	Direct Expansion (refrigerant system)
LON	Local operating network. Also referred to as LONworks
Modbus	Serial communications protocol developed by Modicon
PHE	Plate Heat Exchanger
Protocol Interface	Set of rules that established how systems communicate with BMS. Examples of protocols used are BACnet, LON and Modbus.
RAC	Run Around Coil Heat Exchanger
SFP	Specific Fan Power
VAV	Variable Air Volume
VCD	Volume Control Damper
VFC	Volt Free Contacts
VRF	Variable Refrigerant Flow
VRV	Variable Refrigerant Volume

M3-3 REFERENCE TO OTHER SECTIONS OF THIS SPECIFICATION

This section of the specification shall not be used in isolation and must be read in conjunction with the particular sections, commissioning and standard clauses, all of which define further the requirements for the installations.

Sections 2 Standards provides all necessary details on Ductwork, Mechanical Commissioning and Thermal Insulation requirements that apply to this section. The following text advises if the Contractor shall deviate from the preferred requirements detailed in standard sections. Agreed amendments from the preferred standards are:

No deviation from the section 2 preferred requirements.

M3-4 STANDARDS APPLICABLE

Works shall be completed in accordance with all applicable industry standards. Some of the most relevant standards associated with this section are scheduled below:

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STANDARDS	
BESA Guides including DW Series.	BS EN 16798-7 Energy performance of buildings. Ventilation for buildings - Calculation methods for the determination of air flow rates in buildings including infiltration (Modules M5-5)
BS 7671 Requirements for electrical installations. IET Wiring Regulations	BS EN 16798-17 Energy performance of buildings. Ventilation for buildings - Guidelines for inspection of ventilation and air conditioning systems (Module M4-11, M5-11, M6-11, M7- 11)
BS 9999 Code of practice for fire safety in the design, management and use of buildings	BS EN 60038 CENELEC standard voltages
BS EN 1751 Ventilation for buildings	BS EN ISO 16890 Air filters for general ventilation - Technical specifications, requirements and classification system based upon particulate matter efficiency (ePM)
BS EN 1886 Ventilation for buildings. Air handling units. Mechanical performance	BSRIA Commissioning codes
BS EN 13501 Fire classification of construction products and building elements	BSRIA Standards
BS EN 16798-1 Energy performance of buildings. Ventilation for buildings - Indoor environmental input parameters for design and assessment of energy performance of buildings addressing indoor air quality, thermal environment, lighting and acoustics. Module M1-6.	Building Regulations, specifically Part F
BS EN 16798-3 Energy performance of buildings. Ventilation for buildings - For non-residential buildings. Performance requirements for ventilation and room-conditioning systems (Modules M5-1, M5-4)	CIBSE Commissioning Codes in particular R – Refrigeration and M – Management
BS EN 16798-5 Energy performance of buildings. Ventilation for buildings Calculation methods for energy requirements of ventilation and air conditioning systems (Modules M5-6, M5-8, M6-5, M6-8, M7-5, M7-8). Method 1: Distribution and generation	Eco-design Directives, in particular Commission Regulations in particular EU No 1253/2014 and 1254/2014
BS EN 16798-9 Energy performance of buildings. Ventilation for buildings - Calculation methods for energy requirements of cooling systems (Modules M4-1, M4-4, M4-9). General	

Where the above standards refer to supporting documentation and standards these shall be fully complied with in all respects.

Where discrepancy is found between this specification and the relevant standards, the Contractor shall obtain written clarification from the Engineer prior to submission of the tender. Where a discrepancy has not been clarified prior to tender submission, the Contractor shall include the most onerous requirements.

M3-5 SCOPE OF WORKS

The following brief description identifies those systems required for installation on this project. Comprehensive system requirements shall be detailed in the subsequent clauses of this specification together with schematic and design drawings.

The mechanical ventilation installations shall include for all necessary tools, labour, materials and equipment to supply, install, commission and put into operation the ventilation system, including the following:

- 1) Window/Wall mounted extract fan located within new shower room.

M3-6 DECENTRALISED LOCAL EXTRACT SYSTEMS (WALL / WINDOW FANS)

As detailed on the tender drawings small single fan extract fans shall be installed. Ventilation rates shall be as per the Schedules.

The fans shall:

- 1) CE Certified and Marked.
- 2) Incorporate DC motors to minimise energy consumption.
- 3) Include sealed for life bearings.
- 4) Include integral back draught dampers / shutters.
- 5) Include thermally protected motors.
- 6) Be fully interfaced with the BMS for time scheduling.
- 7) Be provided with at least two speed operation of 'low speed' and 'boost'. Low speed shall normal operating mode during occupied hours, when occupancy is detected the 'boost' shall be activated.
- 8) Occupancy shall be detected by the passive infrared detectors.
- 9) The fans shall discharge to outside via local exhaust louvres.

Local extract fans shall be manufactured by one of the manufacturers listed in the schedule at the end of this section.

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M3-7 APPENDIX I – EQUIPMENT SCHEDULES

LOCAL DIRTY EXTRACT FANS	
Reference	EF 1
Size and Type	Nuaire DAVE
Duty	0.05m³/s at 100 Pascal.
Location	Within ceiling void / Wall mounted / Window mounted / Ceiling mounted.
Accessories	PIR occupancy detection with adjustable run on timer. 12V DC.
BMS Interfaces	Enable signal. Fault signal.
Below are common requirements of all Local Dirty Extract Fans:	
BMS Interfaces	Enable signal. Fault signal.
Manufacturer: As listed in the Design Standards Preferred Manufacturer Schedule. OR <ul style="list-style-type: none">• Nuaire• VES Andover• Vent Axia	

Section M4

Fuel Systems



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M4-1 GENERAL REQUIREMENTS

The fuel supply systems required for this project shall be as follows:-

- 1) Modifications to Natural gas service to serve the new gas fired boilers.

M4-2 DEFINITIONS

Refer to Section 1B for general definitions, Institute of Gas Engineers and Managers Guide definitions and as below:

DEFINITIONS			
AECV	Additional Emergency Control Valve	GSV	Gas Solenoid Valve
ASTM	American Society for Testing and Materials (now ASTM International)	IGEM	Institute of Gas Engineers and Managers
ECV	Emergency Control Valve	NJUG	National Joint Utilities Guide

M4-3 REFERENCE TO OTHER SECTIONS OF THIS SPECIFICATION

This section of the specification shall not be used in isolation and must be read in conjunction with the particular sections, commissioning and standard clauses, all of which define further the requirements for the natural gas installations.

M4-4 STANDARDS APPLICABLE

Works shall be completed in accordance with all applicable industry standards. Some of the most relevant standards associated with this section are scheduled below:

STANDARDS	
ASTM B837 Standard Specification for Seamless Copper Tube for Natural Gas and Liquefied Petroleum (LP) for Gas Fuel Distribution Systems	BS EN 161 Automatic shut-off valves for gas burners and gas appliances
ATEX Equipment Directive (ATEX 95) (EU Directive 94/9/EC)	BS EN 13792 Colour coding of taps and valves for use in laboratories
ATEX Workplace Directive (ATEX 137) (EU Directive 99/92/EC)	Gas Safety (Installation and Use) Regulations (GSIUR)
BS 799 Oil burning equipment	HSE L56 Safety in the installation and use of gas systems and appliances
BS 5410 Code of Practice for liquid fuel firing	HSE ACOP L138 Dangerous Substances and Explosive Atmospheres Regulations (DSEAR)
BS 6173 Specification for installation and maintenance of gas-fired catering appliances for use in all types of catering establishments (2nd and 3rd family gases)	Institution of Gas Engineers and Managers (IGEM) Publications
BS 6400 Specification for installation, exchange, relocation, maintenance and removal of gas meters with a capacity not exceeding 6m ³ /hr	The Control of Pollution (Oil storage) (England) Regulations

HEALTHCARE STANDARDS	
All relevant NHS Health Building Notes (HBNs)	
Health Technical Memorandum (HTM) 07-02: EnCO2de 2015 – making energy work in healthcare.	Health Technical Memorandum (HTM) 07-02: EnCO2de 2015 – making energy work in healthcare Environment

HEALTHCARE STANDARDS	
Environment and sustainability. Part A: Policy and management	and sustainability. Part B: Procurement and energy considerations for new and existing building facilities
Health Technical Memorandum (HTM) 07-07: Sustainable health and social care buildings	

Where the above standards refer to supporting documentation and standards these shall be fully complied with in all respects.

Where discrepancy is found between this specification and the relevant standards, the Contractor shall obtain written clarification from the Engineer prior to submission of the tender. Where a discrepancy has not been clarified prior to tender submission, the Contractor shall include the most onerous requirements.

M4-5 SCOPE OF WORKS

The following brief description lists those fuel systems required for installation on this project. Comprehensive system(s) requirements are detailed in subsequent clauses of this specification together with schematic and tender drawings.

The fuel system(s) supply shall include for all plant, equipment and labour to carry out the installation, testing, commissioning and setting into operation of the following works:

- 1) Provide local pipework modifications to support the installation of the new gas fired boilers.
- 2) Carry out a pressure drop test on the incoming gas main at full boiler load prior to removal of the existing boilers.
- 3) Provide gas safety equipment.
- 4) Provide all gas pipework, including valves and fittings.
- 5) Painting and labelling all the pipework.
- 6) All necessary system(s) purging, testing and commissioning.
- 7) All primary and secondary support systems to install the services.
- 8) Design development and coordination of the tender information to fully detailed working or installation drawings. This shall include responsibility for the following areas:-
 - a) Support systems/brackets for all services.
 - b) Expansion and contraction within the system networks.
 - c) Final co-ordination of the mechanical and electrical services including the preparation of completely dimensioned double line services fabrication drawings.
 - d) Development of the Consultants' details for equipment specified to achieve the criteria described within the tender documents.
 - e) Development of the controls specification for the hardware, software, power, controls wiring and all associated equipment.
- 9) Liaise with all other trades.
- 10) incoming gas or oil meters

The incoming meters are detailed in the section 04 of this specification.

M4-6 INCOMING METERS

The incoming meters are detailed in the section 04 of this specification.

M4-7 GAS SYSTEMS

M4-7-1 INCOMING NATURAL GAS SUPPLY

The incoming natural gas supply is detailed in the section 05 of this specification. Where a new statutory supply is required the Contractor shall be responsible for all liaison with the necessary authority to provide this service.

At entry into the building the supply shall be provided with an emergency isolation valve together with required additional emergency control valves fully in accordance with IGEM recommendations.

M4-7-2 PLANT ROOM GAS SAFETY AUTOMATIC SHUTDOWN SYSTEM

A new manual re-set line sized gas solenoid valve shall be provided as the pipework enters the plantroom.

For boilers without automatic flame safe guards the gas solenoid valve shall be manual reset type and for boilers with automatic full flame safe guards protection the solenoid valve shall be automatic reset type. For tender the contractor shall allow for the more expensive solenoid valve option and shall prior to ordering carry out a gas safety risk assessment and agree with the engineer the type of solenoid valve.

The valve shall be interlocked to the automatic control system and close when any of the below are activated:

- 1) Thermal sensors inter-wired and installed above each gas appliance.
- 11) Emergency knock-off button installed locally to plantroom entrance door.
- 12) Fire alarm.

M4-7-3 INTERNAL PIPEWORK

Pipework shall be installed to the requirements set out in section 02 of this specification.

Where the pipework distribution is within concealed voids or risers ventilation shall be provided via necessary ventilation grilles as recommended by gas regulations.

M4-7-4 GAS COCKS

All items of equipment shall be provided with line size lever operated gas cock.

M4-7-5 TESTING AND COMMISSIONING

All testing and commissioning required to be carried out fully in accordance with "General installation Clauses" section of this Specification and also in accordance with Gas Board requirements.

Section M6

Above Ground Drainage

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M6-1 PIPEWORK INSTALLATIONS

Supply, install and commission the pipework installations as detailed on the Tender drawings and within this specification, employing skilled personnel to the standards described. All pipework shall be entirely suitable for operation with the particular fluids conveyed and pressures involved. Materials for specific systems are detailed in this specification section

M6-2 DEFINITIONS

Refer to section 2 for general definitions plus the following:

DEFINITIONS	
ABS	Acrylonitrile Butadiene Styrene
FCU	Fan Coil Unit
HIU	Heat interface unit
HDPE	High density polyethylene
PP	Polypropylene
PVC-C	Polyvinyl Chloride Chlorinated
PVC-u / uPVC	Polyvinyl Chloride (Un-plasticised)
Supervising Officer	Where this term is used it shall mean the person undertaking the inspection of installed work, and shall apply equally Clerk of Works or Engineer.

M6-3 REFERENCE TO OTHER SECTIONS OF THIS SPECIFICATION

This section of the specification shall not be used in isolation and must be read in conjunction with the particular sections, commissioning and standard clauses, all of which define further the requirements for the installations.

M6-4 STANDARDS APPLICABLE

Works shall be completed in accordance with all applicable industry standards. Some of the most relevant standards associated with this section are scheduled below:

STANDARDS	
BS 416 Discharge and ventilating pipes and fittings, sand-cast or spun in cast iron.	BS EN 13501 Fire classification of construction products and building elements
BS EN 12056 Gravity drainage systems inside buildings	BS EN ISO 13255 Thermoplastics piping systems for soil and waste discharge inside buildings
BS 6465 Sanitary installations	BS EN ISO 15493 Plastics piping systems for industrial applications
BS 10226 Pipe threads where pressure tight joints are made on the threads	Building Regulations, in particular Approved Document Part H 'Drainage and Waste Disposal'.
BS EN 681 Elastomeric Seals. Materials requirements for pipe joint seals used in water and drainage applications	BS ISO 16611 Plastics piping systems for drainage and sewerage without pressure – Non circular pipes and joints made of glass-reinforced thermosetting plastics (GRP) based on unsaturated polyester resins (UP)
BS EN 877 Cast iron pipes and fittings, their joints and accessories for the evacuation of water from buildings	BS EN 1124 Pipes and fittings for longitudinally welded stainless steel pipes with spigot and socket for wastewater systems

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STANDARDS	
BS EN 1057 Copper and copper alloys. Seamless, round copper tubes for water and gas in sanitary and heating applications	CIBSE Design Guides, in particular Guide G Public Health Engineering
DIN 8074 Polyethylene (PE) - Pipes PE 80, PE 100 - Dimensions	DIN 8075 Polyethylene (PE) pipes - PE 80, PE 100 - General quality requirements, testing
DIN EN 12666 Plastics piping systems for non-pressure underground drainage and sewerage - Polyethylene (PE)	BS EN 1455 - Plastics piping systems for soil and waste discharge (low and high temperature) within the building structure. Acrylonitrile-butadiene-styrene (ABS)
BS EN 1566 Plastics piping systems for soil and waste discharge (low and high temperature) within the building structure - Chlorinated polyvinyl chloride (PVC-C)	BS EN 1453 Plastics piping systems with structured-wall pipes for soil and waste discharge (low and high temperature) inside buildings - Unplasticized polyvinyl chloride (PVC-U)
BS EN 1519 Plastics piping systems for soil and waste discharge (low and high temperature) within the building structure. Polyethylene (PE)	BS EN 1451 Plastics piping systems for soil and waste discharge (low and high temperature) within the building structure - Polypropylene (PP).
BS EN 1329 Plastics piping systems for soil and waste discharge (low and high temperature) within the building structure - Unplasticized polyvinyl chloride (PVC-U)	BS EN ISO 23856 Plastics piping systems for pressure and non-pressure water supply, drainage or sewerage - Glass-reinforced thermosetting plastics (GRP) systems based on unsaturated polyester (UP) resin
BSRIA Commissioning Codes	

Where the above standards refer to supporting documentation and standards these shall be fully complied with in all respects.

Where discrepancy is found between this specification and the relevant standards, the Contractor shall obtain written clarification from the Engineer prior to submission of the tender. Where a discrepancy has not been clarified prior to tender submission, the Contractor shall include the most onerous requirements.

M6-5 SCOPE OF WORKS

(Below are a selection of suitable system descriptions, these will need to be amended to be project specific. DO NOT list all equipment as with "bills of quantities or be too descriptive and write paragraphs of text)

The above ground drainage system(s) installation shall include for all necessary tools, labour, materials and equipment to design, supply, install, test, commission and put into operation the sanitation and drainage services, including the following:-

- 1) Main gravity domestic soil, waste and ventilation system in PVC-u.
- 2) Low level branch soil and waste system in PVC-u.
- 3) Ventilation pipework in PVC-u
- 4) The fix only of sanitary appliances.
- 5) Laboratory waste systems in chemical pipework.
- 6) Radio-active waste system in chemical pipework.
- 7) Plantroom mechanical waste system in cast iron and PVC-u.
- 8) Condensate drainage from FCU's in copper.
- 9) Condensate from boilers to be in PVC-C. (Alternative material may need to be inputted here also)
- 10) Condensate from flues to be in PVC-C. (Alternative material may need to be inputted here also)
- 11) Condensate from relief valve drainage to be in copper.

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- 12) Kitchen Waste Drainage.
- 13) Dental Dry Suction (Amalgam) Drainage.
- 14) Sediment (Plaster etc.) Drainage in stainless steel.
- 15) Plantroom gullies in cast iron.
- 16) Floor gullies for laundry, pass through cage washer and drench showers in stainless steel.
- 17) Shower gullies & channels in stainless steel.
- 18) Grease removal machines for Hot kitchens.
- 19) Gravity internal rainwater systems in Cast iron.
- 20) External rainwater pipes to be in Aluminium. (Alternative material may need to be inputted here also)
- 21) External pipework fixed to the building's exterior wall shall be in Cast Iron, or to the Fire Specialists specific requirements.
- 22) Car Park drainage to be in Cast Iron or HDPE. (Choose either Cast Iron or HDPE)
- 23) Supply, install & fully commission waste/foul water pumping units, complete with electrical power supply, fault monitoring alarm and connecting copper pumped mains pipework.
- 24) Effluent Waste Systems.
- 25) Fire sleeves for PVC-u in metal. (Choose material(s) to be used with fire protection)
- 26) Unicollar fire protection for Vulcathene pipework.
- 27) All testing, witnessing hydraulic pressure tests and commissioning.
- 28) Any thermal insulation to avoid thermal bridging and condensation issues.
- 29) Any sound insulation to meet room acoustic requirements, especially in noise sensitive room – refer to room data sheets. Refer to architects/acoustic engineers technical details for information on how the acoustics are being managed.
- 30) Liaison with other trades on site.
- 31) Copies of Operating and Maintenance instruction manuals including a 'Brief Description' of services and fault-finding information list of spares, emergency telephone Nos. etc.
- 32) Full user instruction, both written and in the form of demonstrations.
- 33) All primary and secondary support systems to install the services.
- 34) Development of the Consultants drawings and detailing from the base tender information to full construction standards as detailed previously.
- 35) Support systems/brackets for all services.
- 36) Expansion and contraction within the system networks.
- 37) Final co-ordination of the mechanical and electrical services including the preparation of completely dimensioned double line services fabrication drawings.
- 38) Development of the Consultants' details for equipment specified to achieve the criteria described within the tender documents

Items and installations **excluded** from this specification are as follows: -

- 1) Underground drainage.
- 2) Weathering of all pipework and outlets through the roof.
- 3) Rainwater pipework.
- 4) Car Park Drainage.
- 5) Floor gullies that connect directly into the below ground drainage system.
- 6) Cavity Wall Drainage.
- 7) Sanitary ware.
- 8) Effluent waste plant.
- 9) Positioning/setting out of drainage pipework.

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- 10) Pre-cast fire collars and their alignment through the building.
- 11) Detailing the boxing out and lagging of pipework.
- 12) Builders work.
- 13) The design of the internal drainage within the POD.
- 14) Access panels within walls, floors and ceiling.
- 15) Basement and carpark surface water drainage.
- 16) Foul water storage tanks and associated pumping plant.
- 17) Surface water attenuation.

M6-6 DRAWINGS

Piping systems shown on the drawings are designed to comply with the above standards and are diagrammatic to indicate the general routing and sizes required. The drawings do not necessarily show all components in their true positions.

The Contractor shall be responsible for the proper erection of piping systems suitable in every respect for the design and application intent.

Any alteration to equipment installation/positioning arising during construction which may alter the run and size of piping to accommodate situations shall be reviewed with the Engineer.

M6-7 GRAVITY DRAINAGE SYSTEM

The above ground drainage system shall be designed to system III of the BS and adhere to all relevant Building Regulations.

The drainage system shall be designed as primary vented system and shall vent to atmosphere above the roof. Vertical stacks shall be located within agreed positions.

Frequency factors for usage should be as set out in the BS:

Usage of appliances K

Intermittent use, e.g. in dwelling, guesthouse, office 0,5

Frequent use, e.g. in hospital, school, restaurant, hotel, large apartment block 0,7

Congested use, e.g. in toilets and/or showers open to public 1,0

Special use, e.g. laboratory 1,2

All soil and waste branch pipes shall drain separately to its serving discharge stack as stated within BS. Pipework shall be rigid with no flexible connections being permitted; this shall particularly apply to WC connections.

Emphasis shall be given to ensure that the necessary pipe gradients are achieved to attain a self-cleansing velocity as set out in the Colebrook-White equation. Access doors and rodding eyes positioned for ease of maintenance and testing. Branch pipes should be laid to fall as per the recommendations within the BS.

Branch pipe diameters shall be calculated based on the waste water loads to be carried, the maximum travel distance and the number of bends/offsets to be incorporated.

For buildings that contain both residential and commercial drainage systems, these shall remain separate to one another until connecting into the below ground drainage. Under no circumstances shall commercial drainage systems connect into any residential drainage systems that pass through a commercial space.

Where applicable the lifetime home detail should be adhered to. Provision for a bathroom to be retrospectively modified from a bath to a shower, should be taken into account by the architect with regards to stack positioning; this enables the ease of changing a bath to a gully within the floor makeup.

Access door requirements are the responsibility of the architect, of which the positioning should be let known to the designer of the above ground system, so that testing arrangements are not hindered.

M6-7-1 PIPEWORK SYSTEM MANUFACTURERS

Refer to appendix for list of required manufacturers for specific systems. These manufacturers shall be included within tender returns.

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M6-8 MATERIAL SELECTION

All pipework and components shall be selected from the table following in respect to the type of materials required. Deviations from materials specified shall only be permitted with the written approval of the Contract Administrator.

Where a different material is proposed via a value engineered option, acoustic and fixing allowances may need to be incorporated. These will be the responsibility of the proposer of the value engineered option.

PIPE MATERIAL								
	PVC-U	HDPE	PP	ABS	COPPER	CAST IRON	STAINLESS STEEL	PVC-C
JOINTING METHOD								
Solvent Welded	✓			✓				✓
Electro Fusion		✓ *	✓ *					
Mechanical Coupling		✓ *	✓ *			✓		
Brazed Joints					✓			
Welded							✓ **	
Push Fit							✓ **	
PIPE STANDARDS APPLICABLE								
BS 416						✓		
BS 4514	✓							
BS EN 877						✓		
BS EN 1057					✓			
BSEN 1124							✓	
BS EN 1329	✓	✓	✓	✓				
BS EN 15493								✓
DRAINAGE SYSTEM TYPE								
Domestic	✓	O	X	X	X	O	O	X
Laboratory	X	O	✓	X	X	X	O	X
Radio Active Waste	X	X	✓	X	X	X	O	X
Plantroom hot water	X	X	X	X	X	✓	O	X
Plantroom cold water	✓	O	X	X	X	X	X	X
Commercial Kitchens	X	X	X	X	O	X	✓	X
Domestic Kitchens	✓	X	X	X	X	X	X	X
Boiler condensate	X	X	X	X	X	X	X	✓
Cooling coil condensate	X	X	X	O	✓	X	X	X
Pharmaceutical	X	O	✓	O	X	X	O	X
Commercial Infrastructure	O	O	X	X	X	✓	X	X
Enclosed Car Park	X	O	X	X	X	✓	X	X

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PIPE MATERIAL								
	PVC-U	HDPE	PP	ABS	COPPER	CAST IRON	STAINLESS STEEL	PVC-C
JOINTING METHOD								
Solvent Welded	✓			✓				✓
Electro Fusion		✓ *	✓ *					
Mechanical Coupling		✓ *	✓ *			✓		
Brazed Joints					✓			
Welded							✓ **	
Push Fit							✓ **	
PIPE STANDARDS APPLICABLE								
Vertical distribution in multi-storey building	O	O	X	X	X	✓	X	X
Sound attenuated required	X	O (DB20)	X	X	X	✓	X	X
Domestic internal gravity rainwater	✓	O	X	X	X	O	X	X
Commercial internal gravity rainwater	O	O	X	X	X	✓	X	X
safety valve drainage	X	X	X	X	✓	X	X	X
Effluent systems	X	X	X	X	X	X	✓	X
Sump pumped mains	X	X	X	O	✓	X	X	X

Key	X	Shall not be used.
	✓	Default material / jointing system, shall be included at Tender and used for installation.
	O	May only be used when specifically allowed in particular section of this specification.
	*	Mechanical coupling jointing only to be used where pipework is installed below laboratory benching.
	**	Push fit only to be used on kitchen waste systems.

Note External Rainwater systems are not covered by this specification. For full details of materials and installation requirements for this system refer to the Architectural Specification.

M6-9 GENERAL REQUIREMENTS FOR PIPEWORK SYSTEM

M6-9-1 INTRODUCTION

The general requirements are applicable to all pipework systems and shall be read in conjunction with the detailed requirements as specified later in this section.

M6-9-2 COMPLIANCE WITH LOCAL WATER AUTHORITY

The Contractor shall:

- 1) Issue all working drawings to the local authority for their comment with regard to water regulations and local requirements (except where Contractor is able to self-certify the scheme with the local authority).

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- 2) Ensure that any certification required is submitted within the time scales specified by the authority in order to ensure that the connection of the water supply is not delayed.
- 3) Ensure that all systems fully comply with the local water authorities particular requirements.

M6-9-3 PROTECTION

All pipes stored at site prior to installation shall be kept clean, properly racked clear of the ground and covered. Sites selected for storage shall be flat and level and free from sharp stones and flints etc. Pipework storage shall:

- 1) Utilise off-loading operations that shall only use rope or web slings and provide adequate man or machine power to accommodation this activity. Materials shall not be thrown haphazardly from vehicles by reason of size or lightness or dropped violently.
- 2) Be stored to prevent dirt and foreign matter entering open ends of pipes. Wood, rag, paper, wood shavings or other inadequate plugs shall not be permitted.
- 3) Be stored in stacks not exceeding seven layers of pipes or two metres in height, whichever is the lesser.
- 4) Not exceed a height of ten times the pipe size, up to 75mm diameter, when stacking ABS pipe.
- 5) Be protected from direct sunlight, properly racked and supported clear of the ground for ABS, PP and all types of PVC pipework and components at all times.
- 6) Where any lining or coating has been applied ensure no other pipe or material of any kind shall be placed inside the pipework.
- 7) When spigot and socket pipes are stacked, ensure the bottom layer of sockets shall be prevented from making direct contact with the ground. Succeeding pipe layers shall have sockets protruding at alternate ends of the stack
- 8) Shall only allow smaller pipes to be rested inside larger pipes which are adjacent to the ground.
- 9) Be such that when transporting of pipe lengths subsequent to off-loading the arrangement ensures that neither spigot nor socket ends or flanges become damaged by dragging along surfaces. The pipe supporting surfaces of site vehicles used for handling shall have no sharp projections, and shall provide uniform support to the pipe lengths.
- 10) Rubber joint rings they shall be stored in their delivery bags and not exposed to sunlight. These shall comply with Building Standard for Elastomeric Seals.

The use of any corroded pipes shall not be allowed. Any corroded or damaged pipework shall be removed and replaced by the Contractor at his expense.

M6-9-4 HANDLING AND CUTTING OF PIPE

All cutting of pipes required shall be:

- 1) Carried out in a neat and workmanlike manner without damage to the pipe.
- 2) Carried out in accordance with the manufacturer's recommendations.
- 3) Made with an approved type mechanical cutter. Wheel cutters shall be used when practicable.
- 4) Made square to the axis of pipes and all burrs and other irregularities removed by reaming and filing before installing.

Pipes and accessories shall be handled so as to ensure delivery to the installation position in sound, undamaged condition as the following:

- 1) Pipes shall be carried into position and not dragged.
- 2) The interiors of pipes and accessories shall be thoroughly cleaned of foreign matter before being placed in position
- 3) Pipes shall be kept clean during fixing operations by plugging or other approved method.
- 4) Where required the use of pinch bars and tongs for aligning or turning pipe shall be permitted only on the barrel of the pipe
- 5) Particular care shall be taken not to injure the pipe lining and coating. If the coating or lining of any pipe or fitting is damaged, the repair shall be made by the Contractor, at his expense

- 6) Any Rubber or compound gaskets or sleeves, which are not to be installed immediately, shall be stored in a cool area protected from direct sunlight.
- 7) Prior to installation, pipes shall be inspected for defects. Material found to be defective shall be replaced with sound material prior to installing.

M6-9-5 INSTALLATION

Pipework shall be installed as recommended by the current BS standard, particular care shall be taken to ensure the following installation is provided:

- 1) All installations should be installed to the recommendations and guidelines within BS8000.
- 2) All pipework is erected and secured truly parallel and plumb with vertical surfaces.
- 3) Where the structure is not able to bare the weight of a pipe or is absent, then secondary steel should be provided.
- 4) Where horizontal pipework is suspended by purpose-made mild steel drop rods supports, the maximum distances and diameters of the drop rods must be in accordance with the relevant pipework manufacturer's requirements.
- 5) All horizontal branch pipework shall be arranged with a minimum fall from traps as set out in the British Standard or rise in the case of anti-syphon pipework.
- 6) All connections to drain should be made via a mechanical fitting
- 7) All bends shall be long radius or two number 45° (degree) bends.
- 8) All tees shall be long sweep patterns.
- 9) Long runs of pipework shall be erected so that stresses of expansion and contraction, due to temperature variation, are taken up by expansion joints. Where small bore branches are made to mains remote from anchor points, the branches shall be arranged to form a radius arm so that the axial movement of the main does not stress the connecting fittings. All expansion and contraction requirements shall be designed and confirmed by the Contractor to suit both the installed pipework routes and the relevant pipework manufacturers requirements.
- 10) Stub stacks should be installed where appropriate. Where a 740mm dimension cannot be achieved through the lowest branch connection to a stack and offset below [after 3 stories] a stub stack should be introduced. To align with Building Regs, any offsets after a stack travels 5 stories or more should have a stub stack introduced.
- 11) Offsets from vertical to horizontal should be made up of either 2 x 45 degree bends or a long radius bend. A 45 degree bend combined with a branch connection is not acceptable and contravenes the British Standard.
- 12) The horizontal pipework should run at least 10 x diameter when offsetting from a vertical run of 3 stories or more.
- 13) Expansion devices shall be of similar material to the pipe, installed in line with the axis of the pipe and shall be free from compression, tension or torsion. The female member of the expansion devices shall be firmly anchored to allow the male member to take all movement.
- 14) Jointing rings, couplings and adaptors shall be of types recommended by the manufacturer of the pipes being jointed.
- 15) The use of Mapress or compression fittings shall not be permitted.
- 16) Where pipes pass through walls and floors, sleeves shall be fitted to allow free axial movement of the pipes. Sleeves shall be of a material compatible with the pipes they protect, non-combustible and of a minimum bore to allow such movement.
- 17) Fire collars fixed to the soffit or wall shall be used to prevent the spread of fire where deemed applicable. The annular space between pipe and sleeve shall be packed with intumescent material so as to prevent the passage of fire. Fire wraps cannot all be verified, therefore are not a suitable option.

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- 18) Where Fire collars are to be pre-cast into the structural slabs, these shall be specified and installed by the Structural Engineer. The setting-out of all pre-cast Fire collars to ensure that they are installed and aligned perfectly throughout the building shall be undertaken by the Architect, with advice provided by CPW.
- 19) The drainage systems for drainage relief valves should be as designed and installed as out in Building Regs Part G.
- 20) Slip-on cover plates shall be provided as a finish to pipework, up to and including 50mm diameter, in occupied areas where pipe work is emerging from a wall. Samples shall be first submitted to the Contract Administrator for approval prior to installation commencing.
- 21) Condensate from units such as MVHR's, FCU's, etc., should be designed with a tundish and dry trap, connecting to a ventilated stack; if the manufacturer can prove that a 'hard' connection has been tested showing that the negative pressure will not affect the opening of the dry trap valve, then the air break can be omitted.
- 22) Any concealed pipework shall be installed neatly and as close as possible to the building structure, with due allowance made for supports, brackets, adjacent services and thermal insulation which may be required.
- 23) The Architect and/or Kitchen Designer shall ensure that a minimum clear void depth of 100mm shall be provided behind their kitchen cabinets and appliances to allow for the routing and fixing of kitchen waste pipework.
- 24) Before the operation of condensate from such units as MVHR's, FCU's, etc., which are using a dry trap as part of their drainage setup, the dry trap requires to be primarily flushed with 50-100mm of water, to ensure that the trap device will then function under standard conditions (i.e. 20mm of water).
- 25) Condensate from boilers, flues & relief valve drainage must not discharge into the rainwater/surface water drainage systems. Roof mounted AHU's shall either discharge into a bunded gully specifically designed to drain condensate from these units or drop down into the building and connect into the nearest foul/waste stack. Under no circumstances shall condensate waste water be allowed to freely discharge onto the roof and enter the surface water system.
- 26) Union type fittings shall be provided to make up to outlets of basin and sink wastes, drip cups and dilution receivers etc. on pipework up to and including 50mm diameter.
- 27) Any joints in pipework shall not be made within the thickness of walls, floor or roof, or where they would later be built in.
- 28) Jointing material shall not project into the bore of pipes, fittings or appliances.
- 29) Strap-on boss connections are not to be used.
- 30) Adjustable/Flexi WC connectors shall not be permitted.
- 31) All connections between soil pipe branches and spigots of ceramic WC fittings shall be made with the appropriate fitting provided by the pipe manufacturer.
- 32) Access plates shall be provided at the foot of each vertical stack and immediately above the point where a stack passes through subsequent floor levels.
- 33) Rectangular access doors shall be provided at the foot of each Cast Iron vertical stack prior to connection into the below ground drainage system.
- 34) Access plates shall be provided at all 50mm diameter vertical discharge pipes above FFL within appliance panelling to enable the complete disposal system to be internally cleaned and rodded.
- 35) Access plates/rodding eyes at FFL level shall not be permitted.
- 36) Ventilating and anti-siphon pipes above their highest branches shall be continued upwards, at their full diameter, to such a height as to afford a safe outlet for foul air, all as detailed on the relevant drawing.
- 37) Automatic air admittance valves shall not be permitted.
- 38) All Basement and/or Ground Floor gullies that connect directly into the below ground drainage system shall be specified by the Civil Engineer.
- 39) Where appropriate flue condensate drainage should be designed as per the manufacturer guidelines.
- 40) All roof level penetrations shall be provided with water seal and weather protected installation.

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- 41) Any cast iron stacks balloon vent discharges shall be of copper wire only.
- 42) All drainage and rainwater pipework that pass through a fire compartment or barrier or floor plate shall be complete with an intumescent fire collar to maintain the fire barrier rating.
- 43) Any defective pipework installed shall be replaced at the Contractor's cost.
- 44) The acoustic performance of the pipework should be set out in the project Employer's Requirements and installed to in this manner.
- 45) A CCTV test should be carried out on the civil scheme prior to handover, to ensure there are no defects, abuse or blockages within the underground drainage system.

Should leaks develop in any system after being set in operation, it shall be the responsibility of the Contractor to repair the leak points and, if damage to the building structure or any item of contents has occurred as a result of such leakage, rectification of the damage shall be carried out by the Contractor at his own expense.

M6-9-6 ENABLING AND STRIP OUT WORKS

The Contractor shall visit site during the tender period to determine the full extent of the works required and what services are to be retained or removed.

Prior to any strip out works taking place, the Contractor shall fully liaise with the supervising officer to ensure that only the correct services are removed.

Where ceilings, floors or boxings need to be removed for stripping out or installation purposes, these shall be protected and safely stored off site for reinstatement at a later stage.

All redundant wall, floor and ceiling penetrations shall be suitably sealed and made good.

Prior to any isolation or interruption of any existing services, the client shall be notified in writing as to the full extent of the isolation. A minimum of 48 hours notice shall be provided and no works shall be undertaken until the client has given written approval and a permit to work has been issued.

The Contractor shall high water pressure jet and CCTV survey all of the existing soil and waste drain points prior to making any new connections.

Where existing drainage services are to be re-used or retained, the Contractor shall ensure that a full survey is carried out to confirm the internal and exterior condition of the existing pipework, including all joints and fittings. Any sections of existing pipework confirmed to be in too poor of condition to be reused or unable to carry additional drainage loads based on today's calculations shall be fully replaced.

M6-10 MATERIALS

M6-10-1 PIPEWORK SUPPORTS

All pipework shall be supported both vertically and horizontally throughout the entire installation. Pipework shall be supported at centres no greater than those listed below.

PIPEWORK SUPPORTS - MAXIMUM INTERVAL BETWEEN SUPPORTS (IN METRES)																
NOMINAL SIZE (mm)	PVC-U		CAST IRON		ABS		PP		COPPER		HDPE		SS		PVC-C	
H - Horizontal V - Vertical	H	V	H	V	H*	V*	H*	V*	H	V	H*	V*	H*	V*	H*	V*
≤16	-	-	-	-	0.8	1.2	-	-	-	-	-	-	1.5	2.0	-	-
≥17 and ≤23	-	-	-	-	0.9	1.3	-	-	1.8	2.4	-	-	2.0	2.5	0.5	0.5
≥24 and ≤29	-	-	-	-	1.0	1.5	-	-	1.8	2.4	-	-	2.2	3.0	0.5	0.5
≥30 and ≤36	0.5	1.2	1.5	3.0	1.1	1.6	-	-	2.4	3.0	-	-	2.5	3.0	0.5	1.2
≥37 and ≤43	0.5	1.2	1.5	3.0	1.2	1.8	1.2	1.5	2.4	3.0	0.5	1.2	3.0	3.0	0.5	1.2

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≥44 and ≤55	0.9	1.2	1.5	3.0	1.3	1.9	1.3	1.5	2.7	3.0	0.8	1.2	3.0	3.0	0.6	1.2
≥56 and ≤68	-	-	1.5	3.0	1.4	2.1	-	-	3.0	3.7	0.8	1.5	3.0	3.0	0.6	1.2
≥69 and ≤81	-	-	1.5	3.0	1.5	2.3	1.5	1.5	3.0	3.7	0.8	1.5	3.0	3.0	0.6	1.2
≥82 and ≤109	0.9	2.0	1.5	3.0	1.6	2.4	1.8	1.5	3.0	3.7	1.0	2.0	3.0	3.0	1.0	2.0
≥110 and ≤160	1.0	2.0	1.5	3.0	1.8	2.7	-	-	3.6	4.2	1.5	2.0	3.0	3.0	1.0	2.0

Notes:
 *- Refer to manufacturer's specific requirements for additional support locations to suit jointing method.
 For sizes not listed refer to manufacturer's 'best practice' recommendations.

M6-10-2 PVC-U PIPEWORK

Where PVC-U pipework is required all pipes and fittings shall be in Unplasticised Polyvinyl Chloride, shall be jointed by solvent welding and comply with the following:

- 1) Jointing procedure shall be strictly in accordance with the manufacturer's sequence of requirements.
- 2) Joints between PVC-u and the underground drainage system shall be made using a suitable drain adaptor.
- 3) Horizontal pipework suspended from the underside of floor slabs shall be supported by means of an approved corrosion resistant suspended bracketing system.
- 4) Precautions shall be taken to accommodate linear movements within the suspended pipework system. Expansion joints shall be incorporated at approximately 4 metre centres and rigidly anchored.
- 5) Where changes of direction are at angles less than 45° the bend shall be formed by two close coupled adjustable bends.
- 6) The branch angle at a junction shall be 45°, an adjustable bend is then cut to the required angle of the side connection.
- 7) The change of direction from vertical to low gradient pipework is to be achieved by using two 45° bends or a long radius bend and shall be fully supported.
- 8) Bracket spacing shall be in accordance with the previously listed pipe support section or to conform to manufacturer's requirements, whichever is the most onerous.

M6-10-3 CAST IRON PIPEWORK

Where cast iron pipes are required all cast iron pipework and fittings shall:

- 1) Be without sockets.
- 2) Carry BS Kitemark and DN numbering.
- 3) Be coated both externally and internally in accordance with the following table title 'PIPEWORK COATING'.

PIPEWORK COATING	
LOCATION / ITEM	COATING DESCRIPTION
Pipe externally	Acrylic, anti-corrosion primer coating, red-brown colour, average dry thickness 40 microns
Pipe internally	Two part epoxy coating, ochre colour, with an average thickness of 130 microns
Fittings	Red powder epoxy resin electrostatically applied to an average thickness of 150 microns, externally coated to an average thickness 70 microns
Couplings / brackets	Protected with a red water based semi-gloss paint, average thickness of 40 microns

- 4) The jointing system to be by two-piece ductile iron couplings incorporating built-in electrical continuity.
- 5) Stack supports located in accordance with manufacturer's requirements.

- 6) Bracket spacing shall be in accordance with the previously listed pipe support section or to conform to manufacturer's requirements, whichever is the most onerous.

M6-10-4 ABS SUPERFLO

Where ABS pipework is required all ABS Superflo pipes and fittings shall:

- 1) Be joined by using ABS solvent cement, no other solvents are to be used.
- 2) Be jointed strictly in accordance with the manufacturer's sequence of requirements.
- 3) Where horizontal pipework is suspended from the underside of floor slabs be supported by means of a manufacturers approved corrosion resistant suspended bracketing system and shall be sufficiently rigid to provide lateral restraint to the pipework.
- 4) Bracket spacing shall be in accordance with the previously listed pipe support section or to conform to manufacturer's requirements, whichever is the most onerous.

M6-10-5 POLYPROPYLENE PIPEWORK

Where chemical resistant and / or polypropylene pipe is required all pipes and fittings to be in polypropylene:

- 1) All materials and manufacture shall carry BBA certification.
- 2) Systems within concealed ducts and voids shall be joined by means of electrofusion welding.
- 3) Mechanical jointing system shall be installed where system is exposed to view.
- 4) All component parts of the system shall be covered by a manufacturer's warranty.
- 5) Precautions shall be taken to accommodate linear movements within the suspended pipework system. Expansion joints shall be incorporated at approximately 4 metre and rigidly anchored.
- 6) Where changes of direction are at angles less than 45o the bend shall be formed by two close coupled adjustable bends.
- 7) The branch angle at a junction shall be 45o, and adjustable bend is then cut to the required angle of the side connection.
- 8) The change of direction from the vertical to low gradient pipework is to be achieved by using two 45o bends or a long radius bend, and shall be fully supported.
- 9) Bracket spacing and fixings shall be in accordance with the manufacturer's requirements.
- 10) Bracket spacing shall be in accordance with the previously listed pipe support section or to conform to manufacturer's requirements, whichever is the most onerous.

M6-10-6 COPPER PIPEWORK

Where copper pipework is required all copper pipework, up to and including 76mm, shall:

- 1) Be half hard R250 copper tube and fittings.
- 2) Where bends and sets in R250 piping, up to and including 54mm diameter, are required these may be made on site where standard fittings cannot be used or where this method will give a neater appearance.
- 3) Not permit pulled bends or offsets which show flattening, rippling or constriction of the bore.
- 4) Be of copper or copper alloy specifically designed to carry the flow of non-corrosive wastewater under conditions of gravity head.
- 5) Use capillary type joints having either an integral solder ring or facility for introducing solder by means of heat.
- 6) Where fittings incorporating screwed threads to shall be jointed using jointing compounds complying together with PTFE tape.
- 7) Be jointed between copper tubes and capillary type fittings made in accordance with the manufacturer's recommendations.
- 8) Be jointed between copper pipes and cast iron made by the use of a suitable copper alloy connector with integral capillary fitting to receive the copper pipe.
- 9) In rooms be supported by means of single or double ring brass clips with malleable iron back plates plugged and screwed to the walls or floor.

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- 10) Within ducts and voids be supported by means of single or double ring brass clips with malleable iron back plates either rigidly bolted to mild steel channel bearers or plugged and screwed direct to the structure.
- 11) Have horizontal pipes suspended by purpose-made pipe hangers comprising mild steel drop rod, the top end threaded and fixed to the structural slab by means of a proprietary fixing, the opposite end threaded to receive a brass single pipe ring.
Alternatively, the drop rod shall pass through a hole drilled through the soffit and secured by means of a 150mm x 150mm x 6mm back plate and nut. The nut being tack welded to the rod after final adjustments have been made.
- 12) Bracket spacing shall be in accordance with the previously listed pipe support section or to conform to manufacturer's requirements, whichever is the most onerous.

M6-10-7 STAINLESS STEEL PIPEWORK

Where stainless steel pipework is required all stainless steel pipework shall:

- 1) Be a completely stainless steel system including all pipes and fittings.
- 2) Carry a BBA certificate.
- 3) Where changes of direction are at angles less than 45° the bend shall be formed by two close coupled adjustable bends. The branch angle at a junction shall be 45°.
- 4) Change direction from vertical to low gradient pipework using two 45° bends or a long radius bend, which shall be fully supported.
- 5) Only be undertaken using manufacturer's approved tools.
- 6) Be installed with bracket spacings and fixings fully in accordance with the manufacturer's requirements.
- 7) Ensure all component parts of the system shall be covered by a manufacturer's warranty.
- 8) Bracket spacing shall be in accordance with the previously listed pipe support section or to conform to manufacturer's requirements, whichever is the most onerous.

M6-10-8 PVC-C PIPEWORK

Where PVC-C pipework is required all PVC-C pipework shall:

- 1) Be jointed fully in accordance with manufacturer's jointing instructions.
- 2) Only be jointed using manufacturer's recommended solvent cement.
- 3) Be supported by means of manufacturers approved corrosion resistant bracketing systems.
- 4) Be provided with required supports and spacing to account for expansion and contraction.
- 5) Bracket spacing shall be in accordance with the previously listed pipe support section or to conform to manufacturer's requirements, whichever is the most onerous.
- 6) Be pressure rated dependant on diameter as tabulated below:

PRESSURE RATING	
SIZE	RATING
15mm diameter up to and including 160mm diameter	PN 16
Greater than 160mm diameter	PN10

M6-10-9 HDPE PIPEWORK

Where HDPE pipework is required all HDPE pipework shall:

- 1) Be jointed by electrofusion couplings throughout. The jointing procedure shall be strictly in accordance with manufacturer's sequence of requirements and using the manufacturer's approved electrofusion machine.
- 2) Pipework shall be installed to minimise stress on system and shall incorporate:
 - a) As a minimum requirement an expansion fitting at each floor.
 - b) Each expansion fitting shall be installed with anchor bracket around coupling.
- 3) Guide brackets location from the anchor bracket shall generally be located:

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- a) Vertical stacks = 15 times the pipe diameter
- b) Horizontal pipe = 10 times the pipe diameter.
- 4) All expansion joints and guide brackets in accordance with the manufacturer's requirements.
- 5) Drop rod distances and diameters must be in accordance with manufacturer's requirements.
- 6) Bracket spacing shall be in accordance with the previously listed pipe support section or to conform to manufacturer's requirements, whichever is the most onerous.

M6-11 ACCESSORIES

M6-11-1 TRAPS

General

Traps to lavatory basins, sinks and urinals shall be 75mm seal, re-sealing bottle with detachable base made from Polypropylene.

Ceramic soil appliances shall have 50mm deep seal integral traps.

Anti-syphonic traps

Anti-syphonic traps shall be installed where syphonic conditions may develop and as detailed on the drawings. These traps shall be complete with automatic air release valve to neutralise pressure and prevent any effect on the water seal within the trap.

Air Handling Coils and Recuperators

Drainage from Air handling unit shall be via a Glass trap and tundish dish direct to drain.

M6-11-2 SHOWER CHANGING ROOM CHANNELS (SPORTS HALLS ETC.)

Showers/ changing rooms shall have stainless steel floor channel drainage. These shall be:

- 1) Suitable for either tiled or vinyl floor installation
- 2) Finished with 150mm wide heel safe grating
- 3) Complete with a built-in fall, draining to trapped gulley
- 4) Gulley to be stainless steel with removable waste basket, odour trap and rodding port.
- 5) Complete with 110mm vertical outlet.
- 6) Channels to be installed to allow for co-ordination with Skirting radius.
- 7) All channels shall be installed to provide a full seal from the floor finish.

M6-12 TESTING

All pipe work systems shall be subject to the inspection and testing procedures specified herein.

No covering or enclosing of pipework whatsoever shall be applied until such inspection and testing is satisfactorily concluded.

M6-12-1 GENERAL

All above ground drainage and vent pipes within buildings shall be tested as specified and to the satisfaction of the Supervising Officer/Local Authority Representative.

Testing shall be carried out after main stacks have been fixed in position and all branch piping installed (but before the piping has been concealed and equipment fixtures and fittings have been set and connected).

The test for soundness shall be by air.

The Contractor shall provide clean water and all assistance and apparatus for the tests to be carried out.

It is the responsibility of the Contractor to notify the Supervising Officer and others concerned when the installation is ready for testing.

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The Contractor shall ensure that each section of the above ground drainage system is completely clear of any obstruction, debris or superfluous matter before any tests are applied to a section and upon completion of the contract.

Upon completion of the contract, the entire installation shall be thoroughly flushed with clean water to prove the efficiency of the system in the presence of the Supervising Officer.

All testing shall be carried out in the presence of the Supervising Officer/Local Authority Representative and a signed certificate obtained as proof of witness. This in no way absolves the Contractor of his obligations under the Contract.

M6-12-2 PROCEDURES FOR TESTING

The procedures for air testing shall be as follows:

- 1) Prior to testing, all access covers and cleaning eyes shall be removed and greased where appropriate, replaced and sealed.
- 2) Prior to testing, the section of the installation to be tested shall be sealed off by the insertion of expanding rubber or inflatable canvas stoppers into ends of all pipework to be included in the test.
- 3) Where possible, these stoppers shall be further sealed with water sufficient only to cover the internal face of the stopper.
- 4) The stopper at the top of the section of pipework to be tested shall be fitted with a 'tee' fitting complete with an efficient and serviceable air cock on each of the two free ends of the fitting.
- 5) One of the air cocks shall be connected by means of a flexible tube to a manometer. The other air cock shall be connected to a tube for applying the air pressure to the system.
- 6) Air pressure shall then be applied to the whole section of pipework and fittings under test. This shall be equal to 50mm water gauge and shall be held constant for a period of five minutes. No additional pressure shall be applied during this time.
- 7) The tests will be deemed to be satisfactory if the 50mm water gauge pressure is held.
- 8) Leaks shall be detected by the application of soap solution to the joints whilst the system on test is under pressure, the presence of bubbles indicating the affected joint.
- 9) The test pressure and requirements for pumped drainage pipework can be obtained from Section 2A of the CPW specification.

M6-12-3 TEST CERTIFICATE

An interim test certificate form shall be completed by the Contractor and presented for signing by the Supervising Officer as witness to the successful testing of each section of the work as the Contract proceeds.

A final test certificate form shall be completed by the Contractor and presented for signing by the Supervising Officer as witness to the successful testing of the system in its entirety immediately prior to the completion of the Contract and commencement of the maintenance period.

Test certificates shall show date of test, description of pipeline, or section of pipeline undergoing test, pressure applied, duration test pressure was maintained, number of leaks observed, leakage rate observed, persons present.

M6-13 DRAINAGE TRACE HEATING

All external drainage pipework shall be fully trace heated prior to insulation. The trace heating shall be of the self-regulating type, H-watt system by Raychem Ltd.

The trace heating shall consist of a self-regulating system. The trace heating shall be complete with all necessary junction boxes, fixing tape, warning labels and seals and shall be interfaced with the BMS.

All power supplies for the trace heating shall be derived from the local distribution board.

The system shall be installed as follows:

- 1) One circuit for flow and one for return joined in parallel by a suitable junction box which shall then connect back to a power supply point.
- 2) Installed spirally around each pipe to give an output sufficient to account for the heat loss of the pipework.

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- 3) Adequately wrapped around exposed items such as valves etc.
- 4) Provided with correct installation items including entry boxes.
- 5) Self-regulating to maintain pipe at 4°C at a design ambient of minus 20°C.

M6-13-1 ACCESSORIES

M6-13-1-1 RAINWATER & CHANNEL OUTLETS ON CAR PARK DECKS

Shall be Wade International D1109 vari-level non-trapped cast iron body with BS 416 spigot outlet complete with Wade K 2501 vari-level 176mm diameter grating and clamping collar.

M6-13-1-2 RAINWATER OUTLETS FOR STAIR ROOFS AND TOP DECKS OF CAR PARK

Shall be Wade International 3400 series domed roof outlet. Suitable for the roof finishes and complete with a clamping collar and spigot adaptor.

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M6-14 APPENDIX

M6-14-1 PIPEWORK SYSTEM MANUFACTURERS

SYSTEM	MANUFACTURER	
PVC-U PIPEWORK AND FITTINGS	Polypipe Terrain Limited ME20 7PJ Tel No. 01622 717 811	Wavin Ltd SN15 5PN Tel No. 01249 766600
C-PVC PIPEWORK	Durapipe UK WS11 9NS Tel No. 01543 279909	
HDPE PIPEWORK	Polypipe Terrain Limited ME20 7PJ Tel No. 01622 717 811	Geberit Sales Ltd. Geberit House, Edgehill Drive, GB- CV34 6NH Warwick
CAST IRON PIPEWORK AND FITTINGS	Saint-Gobain Pipelines PLC DE7 4QH Tel No. 0115 930 5000	
ABS PIPEWORK SUPERFLO	Durapipe UK WS11 9NS Tel No. 01543 279909	
CHEMICAL PIPEWORK (VULCATHENE)	Durapipe UK WS11 9NS Tel No. 01543 279909	
STAINLESS STEEL PIPEWORK AND FITTINGS	ACO Building Drainage ACO Business Centre, Caxton Road, Bedford, Bedfordshire, MK41 0LF	Blucher UK LS24 9SG Tel No 01937 838000
STAINLESS STEEL GULLIES & CHANNELS (in kitchens, plaster rooms and channels in wet change areas)	Component Developments TF7 4QP Tel No. 01952 588488	ACO Building Drainage ACO Business Centre, Caxton Road, Bedford, Bedfordshire, MK41 0LF
SEDIMENT TRAPS	Component Developments TF7 4QP Tel No. 01952 588488	
GREASE REMOVAL MACHINES	Clearflow Enviro Tech Ltd 6 Lakeland Business Est, Faverdale Ind Est Darlington England DL3 0PX	ACO Building Drainage ACO Business Centre, Caxton Road, Bedford, Bedfordshire, MK41 0LF
FIRE SLEEVES FOR PVC-U	Dufaylite Developments Limited Tel No. 01480 215000	

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SYSTEM	MANUFACTURER	
PLANTROOM GULLIES	Wade International Limited Tel No. 01787 475151	
WASTEWATER PUMPS	Flow Mech CT4 6DQ Tel No. 01227832389 Mobile No. 07977 911790	
ALUMINIUM PIPEWORK AND FITTINGS	Guttermaster OL12 6ND Tel No. 01706 869550	Alumasc Burton Latimer Kettering NN15 5JP
RAINWATER OUTLETS (INTERNAL)	ACO Building Drainage ACO Business Centre, Caxton Road, Bedford, Bedfordshire, MK41 0LF	Alumasc Burton Latimer Kettering NN15 5JP