

SECTION A

TECHNICAL SPECIFICATION

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1 GENERAL DESCRIPTION OF THE CONTRACT

1.1 Scope of Contract Works

The Contractor shall include for the complete supply, delivery, off-loading, installation, connection, testing and commissioning of all plant, equipment and materials shown on the drawings, described in this specification, and otherwise necessary to provide fully complete, operational and satisfactory **Electrical** Services installations at Cavan Institute, Cathedral Road, Cavan, Co. Cavan.

All services shall be provided in accordance with the relevant Standards, Codes of Practice, the Department of Education TGDs, Local Authorities and Statutory Bodies requirements. The completed electrical services installations shall be handed over to the Client in a condition suitable for immediate use.

The schedules and drawings accompanying this specification, whilst indicating the extent of the works, do not purport to be Bills of Quantities and do not include such items as fixings, accessories, etc., which shall be supplied together with all other items, whether specifically mentioned or not, necessary to complete the installation in every respect.

Any difference between, or omission from, the said drawings and specification shall not absolve the Contractor from liability to provide a complete installation in accordance with the true meaning and intent of all taken together. The Contractor shall supply and erect everything implied therein requisite to the satisfactory completion and convenient working of the installation.

The Contractor is deemed to have visited the site prior to completing his tender and satisfied himself as to the site conditions, e.g. accessibility and local conditions.

Each service, when complete, shall be tested and commissioned in full accordance with the relevant sections of this specification and the various commissioning procedures lay down by the professional bodies.

Any equipment, appliance or material not shown on the drawings, but mentioned in the specification or vice versa, or any minor details or accessories not shown or specified, but necessary for the proper installation and operation of the contract works, shall be delivered, supplied and installed by the mechanical contractor, without additional expense to the contract.

1.2 Description of Project

The project comprises the complete strip-out and remodelling of the existing training room to form a new catering/training facility. The proposed layout will require the installation of new mechanical and electrical services to serve the catering equipment, associated ventilation and extract systems, lighting, small power, controls and all other ancillary services required for the completed installation.

A new suspended ceiling will be installed throughout the area, with the ceiling void accommodating a significant proportion of the new mechanical and electrical services. The ceiling void will be relatively congested due to the space required for ventilation ductwork, extract systems, cable containment, lighting services and other associated equipment.

The Mechanical and Electrical Contractors, together with their respective sub-contractors, shall liaise closely with each other and with the Main Contractor prior to commencement of first-fix works. Particular attention shall be given to the coordination of all services within the ceiling void and around the catering extract hoods, taking account of the physical dimensions of the ductwork, required clearances, access for maintenance, electrical supplies to mechanical plant and equipment, fire stopping requirements and the locations of ceiling-mounted equipment.

Prior to commencing any first-fix works, the Mechanical and Electrical Contractors shall liaise with the catering equipment supplier(s) and shall confirm the final service requirements for all catering equipment. This shall include, but shall not be limited to, electrical power requirements, supply voltage and phase, connected loads, gas supplies, cold and hot water supplies, drainage and waste connections, ventilation requirements and any associated controls or interlocks. The Contractors shall verify the required connection sizes, ratings, locations and termination arrangements against the final approved catering equipment selections and manufacturer's installation requirements. Any discrepancies between the tender information, drawings, equipment schedules and the catering

equipment supplier's requirements shall be brought to the attention of the Design Team prior to commencement of first-fix works.

The Contractors shall fully coordinate their installations in advance of first fix and shall ensure that sufficient space is maintained for all services, access panels and future maintenance requirements. Any potential clashes or coordination issues shall be identified and resolved before installation works commence. Services shall not be installed on a first-come, first-served basis where this would restrict the installation or maintenance of other services.

Where required, coordinated services drawings shall be prepared and agreed between the relevant contractors prior to installation. The final arrangement of services shall also be coordinated with the suspended ceiling grid, lighting layout, extract hoods, fire alarm devices, access panels and all other ceiling-mounted equipment to provide a neat, coordinated and fully maintainable installation.

1.3 Scope of Works

1.3.1 Existing Services

Existing electrical services within the works area shall be disconnected and removed, with the exception of the existing general lighting and emergency lighting circuits. These circuits shall be stripped back to the first suitable existing point and altered and extended as necessary to suit the new layout.

1.3.2 Electrical Centres & Mains Distribution Services

A new dedicated distribution board shall be installed to serve the new fitout of the training room.

The distribution board shall be custom-built and manufactured in accordance with the schematic arrangement and specification.

1.3.3 LV Submains

Supply to the new dedicated Training Room distribution board shall be taken from the existing main switchboard serving a nearby recently upgraded catering training room. The submains cable shall be installed within exposed trunking, as indicated on the drawings.

1.3.4 Cable Containment

Existing containment within the works area shall be removed where redundant. New dedicated LV, ELV and fire alarm cable containment shall be provided, including cable tray and trunking, as indicated on the drawings.

1.3.5 General Services

New general-purpose socket outlets shall be installed as indicated on the drawings. Socket outlets shall be supplied from the General Services section of the new local distribution board.

Faceplates shall be brushed stainless steel with white inserts and outboard rocker switches.

1.3.6 Catering Equipment Services

Electrical supplies to plug-in and fixed catering equipment shall be provided from the Catering Equipment section of the new local distribution board.

Emergency stop devices shall be provided as indicated on the drawings and shall, when operated, isolate the catering equipment supplies associated with the relevant section of the distribution board.

1.3.7 Telecommunications Services

A new wall mounted Comms cabinet shall be installed as shown. All new data points shall be terminated back into this Comms cable. A number of Cat 6 links shall be extended to the existing 1st

floor Comms cabinet as indicated.

Data cabling shall be wired in Cat 6.

1.3.8 **General Lighting Services**

All new general lighting shall be LED type and shall incorporate Organic Response (OR) lighting controls to match the recently installed lighting control system elsewhere within the building.

Luminaires shall be manufactured by Fagerhult and shall be as detailed in the Luminaire Schedule.

Existing lighting circuits shall be altered and extended as necessary to suit the new arrangement.

1.3.9 **Emergency Lighting Services**

Emergency lighting shall comprise self-contained LED emergency luminaires and exit signs as indicated on the drawings.

Existing emergency lighting circuits shall be altered and extended as necessary to suit the new arrangement.

1.3.10 **Fire Alarm Services**

The existing fire detection and alarm system shall be altered and extended to suit the new layout.

The existing fire alarm control panel is an Advanced MxPro 5 system incorporating Apollo detection devices. All new devices shall be fully compatible with the existing system.

The Contractor shall liaise closely with all relevant equipment suppliers and specialist contractors in relation to equipment requiring interface with the fire alarm system.

1.3.11 **Boiler Services**

The Contractor shall liaise closely with the Mechanical Contractor in relation to all electrical power supplies, control wiring and associated interfaces required for the new boiler services installation.

1.3.12 **Gas Services**

The Contractor shall liaise closely with the Mechanical Contractor in relation to all electrical power supplies, control wiring and associated interfaces required for the new gas services installation, including the gas detection and gas pressure proving systems.

1.3.13 **Ventilation Services**

The Contractor shall liaise closely with the Mechanical Contractor in relation to all electrical power supplies, control wiring and associated interfaces required for the new ventilation systems.

Particular attention shall be given to the required interlocking between the ventilation system, gas detection system and gas pressure proving system to ensure that gas supplies cannot be enabled unless the required ventilation systems are proven to be operational.

1.3.14 **Bonding and Earthing**

Fixed metallic catering equipment, stainless-steel worktops, tables, sinks and other conductive items shall be bonded where required for electrical safety. Bonding conductors shall be suitably sized and mechanically protected, and shall be securely connected using purpose-made terminals, clamps or crimped lugs fixed to clean bare metal surfaces.

All bonding connections shall be mechanically sound, corrosion-resistant and accessible for inspection, and continuity shall be verified during final testing and commissioning.

2 **GENERAL ITEMS**

2.1 **CE Marking**

All equipment shall show and signify compliance by CE Marking being present in a visible location as defined by the applicable directives.

2.2 **Contract Supervisor**

The contractor shall engage a site-based contract supervisor for the entire duration of the contract. The supervisor shall maintain a presence on site at all times. He shall be responsible for liaison with the engineer and the client. He shall prepare weekly site reports and query lists etc. as required. The contract supervisor shall have a minimum of five years' experience in a contract supervisory role.

2.3 **Compliance with the specification**

Prior to commencing his works, the Contractor, his foreman, purchaser and any other senior personnel who may become involved in the project must read the specification. They shall each sign a standard declaration form stating that they have read and understood the requirements of the specification.

Any ambiguities will be clarified with the engineers and agreed with the contractor prior to signing the declaration form.

The contractor shall note that the engineer will be visiting site occasionally to inspect the works. Any works installed in a manner which is deemed not to be in accordance with the specification will be taken down and reinstalled in the specified manner at the contractor's own expense.

2.4 **Completion of Work**

The contract works shall be carried out with best quality plant, equipment, materials and workmanship in the manner specified and shall be installed, connected up, tested and left in complete operational order to the Engineer's satisfaction, in accordance with the meaning of this Specification.

Any equipment, appliance, material or work not shown on drawings but mentioned in the specification or vice versa or any incidental accessories necessary to make the work complete and perfect in all respects, and ready

2.5 **Inspection of Site**

Tenderers are advised to visit the site to inspect the extent of the work involved before completing their tender. No additions or variations to the contract due to lack of site environment and conditions will be entertained. Site visits shall be arranged through the Main Contractor on whose behalf the tender is being submitted.

2.6 **Material & Equipment of Alternative Manufacture – “Equal And Approved”**

When this specification and/or drawings refer to any item of equipment to be manufactured by a particular and specified manufacturer and no reason is given for exclusive use of such equipment, it shall be clearly understood by the contractor that this is for the purpose of making clear the nature and quality of the equipment required and does not imply that the contractor shall use the named equipment to the exclusion of equipment of other manufacture, provided that such is of equal nature and quality and is approved by the Engineer.

The tenderer must, however, base his tender on the materials specified but may quote separately, in a covering letter, for materials of alternative manufacture at the time of tendering.

The contractor shall obtain written approval of the engineer for the substitution of materials of an

alternative manufacturer.

2.7 Regulations

All plant and materials shall comply in all respects with the requirements of the relevant standards and shall be installed in accordance with the manufacturer's recommendations, CIBSE Guide to Good Practice, Local Authority Byelaws, Water Regulations and Health and Safety at Work Order.

2.8 Location of Equipment

The location of pipework and equipment shown on the drawings is diagrammatic and the final location, mounting height, etc. of each item and run of pipe shall be agreed with the Engineer in writing before the commencement of work.

2.9 Definitions of Electro-technical Terms

The definition of electro-technical terms used throughout this specification shall be as outlined in the National Rules for Electrical Installations as published by the Electro-Technical Council of Ireland or (ii) I.E.C. publication 50 "Electro technical Vocabulary" or (iii) I.E.C., B.S. or I.S. Publications, dealing with the particular subjects concerned.

2.10 NSAI National Wiring Rules

The whole of the electrical work shall be carried out in strict accordance with the latest Edition of the NSAI National Wiring Rules for Electrical Installations and any other relevant local, statutory or government authority.

In particular he shall note the specific requirements in relation to the most recent edition of the NSAI Rules (I.S. 10101: 2020) and shall ensure that nothing in this tender document or any subsequent post tender instruction, written or verbal, is in contravention of the requirements of these Wiring Rules. All such matters shall be referred to the engineer in writing for clarification and instruction

2.11 Tie wrapping and clipping of cables

The contractor shall ensure that cables are neatly clipped and tie wrapped to cable trays etc.

Where small cables, up to 20mm diameter, are to be clipped directly to a wall etc. the contractor shall use Thorsman clips and matching nail plugs. Cables shall be clipped perfectly vertically or horizontally with clips spaced evenly.

The contractor shall ensure that submain cables are not bunched i.e. only one layer of cables is acceptable.

Final sub circuit cables shall be bunched in groups of four cables maximum i.e. two on two, so that each cable can dissipate heat effectively.

Larger cables shall be fixed with proprietary cleats and screws or anchor bolt fixings.

2.12 Steel Conduit Systems

Steel conduit shall be heavy gauge, welded, hot dipped galvanised (Class 4) steel type with minimum size 20 mm and complying with the relevant B.S. The Contractor shall refer to the ETCI National Rules for the determination of the sizes of conduit necessary to accommodate the various cables.

Conduit boxes and fittings shall be malleable cast iron, galvanised and screwed to receive the conduit. In general fittings with tapped bush spouts with stop ends shall be used. Bushes, glands, plugs etc. shall be brass. Adaptable boxes shall be galvanised sheet steel pattern. Weatherproof gaskets shall

be used in external or damp locations.

Screwed flanged couplings shall be used in all surface conduit installations for connection of conduits to outlets boxes, miscellaneous switchgear items, trunking outlets etc., screwed flanged couplings shall be fixed complete with male brass bushes and compression washers shall be used. Normal couplings will not be acceptable in these circumstances.

Sufficient draw-in boxes shall be provided to ensure the cables shall be easily drawn into position. The number of cables installed in a conduit shall be such that cables can be easily withdrawn without causing damage to the other cables. In any event the number of cables shall not exceed 75% of the amount allowed in the ETCI National Rules. Conduit runs shall not exceed 10 m in length or have more than 2 right angle bends in without the provision of a draw-in box unless approved by the Engineers. Expansion couplings shall be installed where necessary at structural expansion joints.

All bends as far as possible shall be made from conduit. Inspection elbows and tees shall not be used in installations, except for sizes greater than 32 mm diameter. All joints in conduit shall be made by screwed couplings with locknuts on running couplings. Suitable condensation drainage outlets shall be provided wherever necessary.

Threading and de-burring etc. shall be carried out in an approved manner consistent with good practice and workmanship. All cut threads etc. where the galvanising has been removed, shall be coated immediately with suitable rust proofing paint and all joints shall be coated again after erection. Threading of conduits shall be carried out using a proprietary threading paste.

Circuit protective conductors shall be installed in all steel conduits.

2.13

Cables Installations - Common Requirements

This section of the specification outlines common requirements in relation to composite cable systems of two or more cores which would be loose laid, clipped direct or run on cable trays. It does not cover single core cables run in conduit and trunking systems.

Where cables are installed in stud partitions or block work walls they shall have, in the suspended ceiling void, a loop of one complete turn allowed for the re-making off of the termination, should it be so required a future date.

Where a cable is recessed into the building fabric it shall be run in steel conduit, thus being rewirable. Where cables pass through holes on the building structure, short lengths of insulated conduit shall be threaded over the cables for protection against abrasion.

Where surface mounted cable pass through floors they shall be protected to a height of 2000mm by steel conduit fitted with coupling, bush and sealing compound through which the cable shall pass in order that moisture etc., is excluded.

All parallel cable runs shall be grouped in a neat and orderly manner without crossovers, so that all cables may be easily identified and any cable removed at a later date.

Where cables are installed in walls or partitions, they shall be run square and vertical. Cables run at an angle or in a zigzag fashion will not be permitted.

Where a length of cable is required in excess of the manufacturer's maximum manufactured length the cable shall be extended by means of a factory-made cable joint subject to the Engineers agreement. The joint shall be readily accessible and marked on record drawings etc.

Cables shall not otherwise be jointed. All adjacent cables shall be run in the same horizontal or vertical straight lines, diagonal runs are not permitted. Joints shall not compromise the fire-resistant qualities of the cable.

Note. All LV and ELV cables shall be low smoke and fume (LSF) type throughout the entire project.

3 **REMOVAL OF OBSOLETE SERVICES**

3.1 **Introduction**

The Contractor shall include for disconnecting, taking down, removal from site and disposal of all obsolete electrical services.

Included in this is the disconnection of services connected to existing catering equipment, some of which will be retained and reused as part of the new fitout.

All discharge lamps and hazardous materials shall be disposed of in accordance with manufacturer's health and safety recommendations.

3.2 **Site Inspection**

The extent of the existing services is not indicated on the drawing. The Contractor shall be deemed to have inspected the site and made an assessment of the work involved prior to submitting his tender. The Contractor is strongly advised to inspect the site before completing his tender. The Engineer will entertain no claims for extras arising out of lack of knowledge of site conditions and site access.

4 LV SWITCHGEAR

4.1 Introduction

All switchboards and distribution boards shall comprise factory-built low-voltage switchgear and controlgear assemblies manufactured by a reputable switchgear manufacturer to the Engineer's approval.

Assemblies shall be designed, manufactured, assembled, verified and tested in accordance with I.S. EN IEC 61439-1 and I.S. EN IEC 61439-2, including all current amendments and corrigenda. Distribution boards classified as assemblies intended to be operated by ordinary persons shall additionally comply with I.S. EN IEC 61439-3, where applicable.

All electrical installations and equipment selections shall comply with the current edition of I.S. 10101 - National Rules for Electrical Installations.

Each assembly shall be fully factory assembled and wired prior to delivery to site. The assembly manufacturer shall be responsible for the complete assembly and shall provide, upon request, evidence of design verification together with routine verification records for the completed assembly.

All switchboards and distribution boards shall be designed, manufactured, verified and delivered to site by one of the following approved manufacturers:

- M&L Manufacturing - Dublin
- BMC - Ashbourne, Co Meath
- Davenham Engineering – Dublin.

4.2 Distribution Boards

Distribution boards shall comprise factory-built low-voltage switchgear and controlgear assemblies manufactured and verified in accordance with I.S. EN IEC 61439-1 together with I.S. EN IEC 61439-2, or I.S. EN IEC 61439-3 where applicable.

The new Catering Training Room distribution board shall be a custom-built assembly arranged generally in accordance with the schematic drawings and shall incorporate separate sections for:

- General Services;
- Catering Equipment; and
- other services as indicated on the schematic.

The Catering Equipment section shall be arranged for emergency isolation as described hereinafter.

Distribution boards shall incorporate a dedicated busbar system. Multiple loops from the incoming isolator, or looping between protective devices in lieu of a purpose-designed busbar system, shall not be accepted.

Busbars shall be high-conductivity copper, suitably supported for the rated current and prospective short-circuit current.

Enclosures shall be fabricated from minimum 1.5 mm sheet steel or an equivalent proprietary enclosure system and shall incorporate removable top and bottom gland plates as required.

Unless otherwise indicated, distribution boards shall be suitable for surface mounting, shall have a durable powder-coated finish and shall provide a minimum enclosure rating of IP54.

All live parts shall be protected by suitable barriers or internal covers providing protection against direct contact when the outer door is opened.

The main switch shall be a padlockable switch-disconnector complying with I.S. EN IEC 60947-3,

rated to suit the connected load and applicable utilisation category.

All distribution board sections and protective devices shall be permanently and clearly labelled.

4.2.1 **Distribution Board Protective Devices**

Unless otherwise indicated on the drawings or distribution board schedules, outgoing protective devices shall comply with the following requirements.

Socket Outlet Circuits

General socket outlet circuits shall be protected by individual 30 mA Type A RCBOs, with current ratings selected to suit the circuit design and cable size.

Type AC RCDs and RCBOs shall not be accepted.

Catering Equipment Circuits

Individual catering equipment circuits shall be protected by MCBs, MCCBs or RCBOs of the type and rating indicated on the drawings and distribution board schedules and as appropriate to the connected equipment.

Protective devices shall be selected having regard to starting current, inrush current, leakage current and equipment manufacturer's requirements.

Security and Miscellaneous Power

Security systems and miscellaneous fixed power circuits shall be protected by MCBs or RCBOs of the ratings and characteristics indicated on the drawings and schedules.

Motor Circuits

Motor circuits shall incorporate appropriate short-circuit, overload and phase-loss protection to suit the particular motor and control arrangement.

Motor protective circuit breakers and contactors shall comply with I.S. EN IEC 60947-4-1 and shall be selected for the applicable motor duty and utilisation category.

Where motors are supplied through variable-speed drives, protective devices shall be coordinated with the VSD manufacturer's requirements.

Catering Equipment Section and Emergency Stop System

The Catering Training Room distribution board shall incorporate a dedicated and clearly identified Catering Equipment section serving the fixed and plug-connected catering equipment circuits indicated on the drawings.

The Catering Equipment section shall be electrically separated from the General Services, Lighting, Emergency Lighting, Fire Alarm and other circuits which are required to remain operational following operation of the catering equipment Emergency Stop system.

The Catering Equipment section shall be controlled through a suitably rated contactor arrangement, electrically operated MCCB or other approved switching arrangement capable of disconnecting all live conductors as required by the system design.

Emergency Stop devices shall be installed throughout the Catering Training Room at the locations indicated on the drawings. Devices shall be:

- red mushroom-head type;
- latching operation;
- manually reset;
- clearly labelled EMERGENCY STOP - CATERING EQUIPMENT; and
- suitably protected against inadvertent operation where appropriate.

Operation of any Emergency Stop device shall immediately disconnect the electrical supply to all

circuits associated with the Catering Equipment section.

The control circuit shall be arranged on a fail-safe basis such that loss of the control supply, where applicable, causes the Catering Equipment section to de-energise.

Resetting an operated Emergency Stop shall not automatically restore power to the Catering Equipment section. Re-energisation shall require a separate deliberate manual reset at the designated control position.

Operation of the Catering Equipment Emergency Stop system shall not disconnect:

- general lighting;
- emergency lighting;
- fire detection and alarm systems;
- general services not associated with catering equipment;
- ventilation equipment required to operate for safety purposes; or
- other essential safety systems,

unless specifically indicated otherwise on the drawings or control schematics.

The Contractor shall provide all contactors, control relays, auxiliary contacts, control wiring, terminals and associated equipment necessary to provide a complete operational system.

The Catering Equipment section shall be permanently labelled:

- **CATERING EQUIPMENT - EMERGENCY STOP CONTROLLED**

The Contractor shall fully test and demonstrate the Emergency Stop system prior to handover.

Surge Protection Devices

The Catering Training Room distribution board and other distribution boards indicated on the drawings shall incorporate Surge Protective Devices (SPDs) in accordance with I.S. 10101, the applicable I.S. EN IEC 61643 series and, where applicable, the I.S. EN IEC 62305 series.

Unless otherwise indicated, a Type 2 SPD shall be provided within the new Catering Training Room distribution board.

Where the upstream installation incorporates a lightning protection system or where required following assessment of the existing installation, the Contractor shall ensure appropriate coordination between upstream Type 1 or Type 1+2 devices and the downstream Type 2 SPD.

SPDs shall:

- be suitable for the system voltage and earthing arrangement;
- incorporate visual status indication;
- incorporate replaceable protection modules where available;
- be installed with connection conductors kept as short and direct as practicable;
- have suitable upstream backup protection in accordance with the manufacturer's requirements; and
- be Furze manufacture or approved equivalent.

The SPD arrangement shall be coordinated with the existing upstream surge protection system prior to installation.

kWh Metering

The new Catering Training Room distribution board shall incorporate digital energy metering to enable

the electrical consumption of the board to be monitored.

Meters shall provide measurement of:

- active energy (kWh);
- instantaneous active power (kW);
- voltage;
- current;
- power factor; and
- maximum demand where available.

Meters shall be DIN-rail mounted or panel mounted as appropriate and shall be suitable for direct connection or current-transformer operation according to the circuit rating.

Meters shall incorporate Modbus RTU/TCP or other approved open-protocol communications suitable for future connection to the building's BEMS/energy monitoring system.

Current-transformer-operated meters shall comply with the applicable requirements of I.S. EN IEC 62053-22. Where reactive energy measurement is required, the applicable requirements of I.S. EN IEC 62053-23 shall apply.

Metering shall be permanently labelled to clearly identify the installation or load being monitored.

5 **LV MAIN AND SUB-MAIN CABLES**

5.1 **Introduction**

Under this section, the Contractor shall include for the supply, installation, termination, testing and commissioning of all LV main and sub-main cables as indicated on the drawings, schedules and specification.

Unless otherwise indicated, all LV main and sub-main cables shall be multicore cables suitable for operation on a 400/230 V, 50 Hz system.

The Contractor shall include for all cables, glands, cleats, supports, containment, fixings, identification labels, terminations, earthing and bonding connections and all other accessories necessary to provide a complete installation.

5.2 **Confirmation of Cable Sizes**

Prior to ordering any main or sub-main cables, the Contractor shall submit a cable schedule to the Engineer for review and approval.

The schedule shall include, as a minimum:

- Cable reference.
- Origin and destination.
- Load being served.
- Proposed cable size and number of cores.
- Estimated cable route length.
- Method of installation.
- Design current and protective device rating.
- Any grouping, ambient temperature or other applicable correction factors.

The Engineer will review the proposed cable sizes and voltage drops based on the design information and tender-stage assumptions.

The Contractor shall verify all cable routes and actual cable lengths on site prior to ordering cables. Any significant variation between the tender drawings and the proposed installation shall be brought to the attention of the Engineer prior to procurement or installation.

Approval of the cable schedule shall not relieve the Contractor of responsibility for verifying actual site conditions, installation methods and cable lengths.

5.3 **Multicore LV Main and Sub-Main Cables**

LV main and sub-main cables shall generally be 600/1000 V grade multicore, stranded copper conductor, XLPE insulated, steel wire armoured and low-smoke zero-halogen (LSZH) oversheathed cables, unless otherwise specifically indicated.

Cables shall be manufactured and tested in accordance with the applicable current BS/EN standards and shall be suitable for the environment and method of installation in which they are installed.

Each circuit shall be provided with an appropriate circuit protective conductor. The steel wire armour shall be effectively bonded to earth at the cable terminations in accordance with the applicable wiring rules and the requirements of the installation.

Cables shall be installed on cable tray, cable ladder, within ducts or directly buried where indicated on the drawings.

Cables installed on cable tray or ladder shall be securely supported using suitably rated proprietary cable cleats, clamps or other approved mechanical fixings appropriate to the cable diameter, weight

and installation conditions. Cable ties shall not be relied upon as the sole means of mechanical support for main or sub-main power cables.

Cable supports and cleats shall be spaced in accordance with the cable manufacturer's recommendations and shall provide adequate restraint under normal operating and fault conditions.

Adequate bending radii shall be maintained throughout the installation in accordance with the cable manufacturer's recommendations. Cables shall be installed without undue stress, twisting or damage to the outer sheath.

Each cable shall be permanently labelled at both ends, at distribution boards and switchboards, and at accessible intermediate locations where necessary, using the cable reference indicated on the drawings and cable schedules.

All armoured cables shall be terminated using approved brass compression glands suitable for the cable type and environment. Glands shall be complete with appropriate locknuts, earth tags, banjo washers where required and LSZH shrouds.

All gland plates shall be suitably sized and arranged to permit proper termination of the cables without compromising minimum bending radii or access for maintenance.

5.4

Buried Cables

Where LV main or sub-main cables are installed underground, the following minimum depths of cover shall apply unless more onerous requirements are indicated on the drawings or required by the relevant authority:

Cable Installation	Open Ground	Under Roadways / Pavements
Street lighting cables	600 mm	750 mm
LV power cables up to 650 V	600 mm	750 mm
Power cables above 650 V up to 20 kV	800 mm	1,000 mm

LV cables shall be laid on a minimum 100 mm bed of selected sand and shall be covered with a further minimum 100 mm depth of selected sand above the cable.

Selected backfill, free from stones, rubble and other material liable to damage the cable, shall then be installed above the sand surround.

A continuous non-degradable warning tape clearly marked:

"DANGER – ELECTRIC CABLES"

shall be installed above the cable route at an appropriate depth and generally not less than 300 mm above the cables.

Where additional mechanical protection is indicated or required due to the installation conditions, proprietary cable protection tiles, covers or equivalent approved protection shall be provided.

Where cables pass beneath roadways, through concrete slabs, foundations, beneath walls or other structures, they shall be installed within suitable heavy-duty ducts. Unless otherwise indicated, power cable ducts shall have a minimum nominal diameter of 125 mm and shall be adequately sized to facilitate cable installation without exceeding the manufacturer's permitted pulling tensions or bending radii.

Ducts shall be provided with draw ropes and shall be sealed following cable installation to prevent the ingress of water, vermin or debris.

All cables installed underground shall have an outer sheath suitable for direct burial and shall be resistant to moisture and the anticipated ground conditions. The Contractor shall establish the

prevailing ground conditions prior to installation and shall notify the Engineer where potentially aggressive or unsuitable ground conditions are encountered.

Underground cable routes shall be coordinated with all other buried services prior to excavation and installation. Appropriate separation shall be maintained from gas, water, telecommunications, drainage and other utility services.

Cables shall be clearly and permanently identified within all cable chambers, manholes, switchboards and distribution boards. Identification shall include the circuit reference and, where appropriate, cable size, number of cores and phase designation.

The Contractor shall record the final routes and depths of all buried cables and ducts and incorporate this information into the as-installed drawings and handover documentation.

6 CABLE MANAGEMENT SYSTEMS

6.1 Introduction

Under this section the Contractor shall include for the supply and installation of Cable Management Systems as shown on the drawings.

- Cable Tray for conveyance of Sub Mains cables
- Cable Tray for conveyance of Telecommunication cables
- Cable Tray for conveyance of Fire Alarm cables
- Cable Tray & trunking for conveyance of Emergency Lighting cables
- Cable Tray & trunking for conveyance of LV cables
- Dado Trunking for conveyance of desk power cables.

6.2 Cable Management Systems Common Requirements

The ladder, tray and trunking sizes as indicated shall be the minimum size acceptable. The Contractor shall, prior to installation, satisfy himself as to their adequacy and shall advise the engineers if any of the tray sizes need to be increased.

The Contractor shall include for all necessary supports and brackets. Ceiling void trays shall be fixed to the roof slab using a Unistrut trapeze bracket arrangement. Supports shall be in accordance with manufacturer's recommendations and in any event shall not be greater than 600mm apart.

The Contractor shall include for all vertical ladder, tray and trunking runs through the risers from basement through to the top floor. The extent of these tray runs, which are not shown on the drawings, are to be assessed by the contractor and included for in full in his tender.

All tee and bends etc. shall be 45° gusset type and of proprietary manufacture.

6.3 Cable Trays and Ladders

Cable ladders shall be heavy duty to BS 1449. They shall be formed from galvanised steel of not less than 1.5 mm thickness.

Cable trays shall be medium duty galvanised perforated sheet steel to BS 1449. Cable trays shall be formed from perforated steel of not less than 1.0 mm thickness up to and including 100 mm width; 1.5 mm thickness from 150 mm up to an including 300 mm width; and 1.5 to 2.00 mm thickness with return edge above 300 mm width.

Unmetered Mains cable ladder installations shall be fitted with a galvanised cover and side panels to prevent access to the cables. The cover and inside panels shall be fitted with labels at 2 metre intervals along the entire run endorsed "Danger ESB Cables"

6.4 Cable Trunking

Cable trunking shall be galvanised sheet steel to BS 4678. The systems shall be complete in every respect with all necessary tees, angles connected ends etc. as made by the manufacturer.

Trunking shall only be installed in situations which will remain readily accessible throughout the life of the building. No cable trunking shall be installed behind a plastered ceiling or in other inaccessible situations.

Trunking runs shall be arranged so that the lid is always on the top or side unless this cannot be avoided in which case permission shall be obtained in writing.

Earth links shall be installed outside the trunking at every joint coupling, manufactured bend, tee, etc.,

throughout the entire system to maintain continuity.

6.5 Fire Stopping

Where cableway systems pass through fire compartment walls and floors the fire barrier must be maintained by installing suitable fire seals around cables, trunkings, conduits etc.

The Electrical Contractor shall include for all fire sealing of all electrical services. The fire seals shall provide a fire resistance not less than that provided by the building fabric.

The Contractor shall be responsible for ensuring that such activities do not cause any damage to the services installed.

Where trunking in excess of 2500 mm² cross sectional area systems pass through fire compartment walls and floors the Contractor shall install an intumescent pad fire seal inside the trunking. In vertical rising ducts these fire seals shall be installed at every floor level. Fire seals for use inside trunking systems shall be purposely designed and shall not reduce the current carrying capacity of the cables within. PVC trunking systems shall be fitted with an intumescent wrap which shall be capable of crushing the trunking in the event of fire.

Major openings for the passage of cable trays and trunkings shall be sealed using intumescent fire and smoke seal pillows or intumescent high-density rock fibre slab.

7 GENERAL SERVICES SOCKET OUTLETS

7.1 Introduction

Under this section the Contractor shall include for the supply and installation of all General Services Socket Outlets as shown on the drawings and as specified herein.

7.2 Wiring

The wiring installation shall be carried out using LSF insulated single-core copper conductors installed throughout in galvanised steel conduit and/or steel trunking, as applicable.

All final circuit wiring serving socket outlets shall be installed in steel conduit from the distribution system to the respective outlets. All conduit drops to socket outlets and other electrical accessories shall be surface mounted in galvanised steel conduit.

The Contractor shall coordinate the installation of conduit and outlet boxes with the wall construction and finishes to ensure that all containment is securely fixed, neatly aligned and installed in a uniform manner. Surface-mounted conduit shall be installed vertically and horizontally, with appropriate galvanised steel saddles, couplings, bends and fittings. All installations shall be neat, symmetrical and suitably arranged to minimise visual impact.

Steel conduit systems shall be mechanically and electrically continuous throughout and shall be suitably earthed in accordance with I.S. 10101. All bends shall be formed using appropriate conduit bending equipment. Inspection fittings and draw-in boxes shall be provided as necessary to facilitate installation and future rewiring.

Socket outlet circuits shall generally be wired in radial format using 4mm² LSF copper conductors, unless otherwise indicated on the drawings or schedules. Circuit protective conductors shall be provided in accordance with I.S. 10101.

7.3 Socket Outlet Type

Socket outlets shall generally be mounted 450mm above finished floor level unless otherwise indicated on the drawings.

All socket outlets shall be switched 13A type complying with BS 1363, complete with LED indicators where specified.

Socket outlets shall be provided with brushed stainless steel faceplates complete with white socket inserts and outboard rocker switches. The appearance and finish of all accessories shall be consistent throughout and a sample shall be submitted to the Architect and Engineer for approval prior to ordering.

Where the precise location of socket outlets is critical, the Contractor shall check the latest Architect's furniture layouts, fixed equipment layouts and other relevant specialist layouts prior to commencing first-fix installation. The final positions of all socket outlets shall be agreed with the Architect and Engineer prior to installation.

For circuits supplied from TN or TT systems, all socket outlets shall be correctly polarised and wired such that plugs are non-reversible and no fuse or single-pole protective device is connected in the neutral conductor.

All socket outlets and associated accessories shall be from an approved manufacturer such as MK Electric, Eaton/MEM or equal and approved, and shall be provided with a minimum manufacturer's

warranty of 15 years.

7.3.1 **Mounting Heights**

Unless otherwise indicated on the drawings, socket outlets shall generally be mounted:

- 450mm above finished floor level to the centre of the accessory box; or
- 150mm above finished worktop level to the centre of the accessory box where serving worktops.

For coordination purposes, worktop level shall generally be deemed to be 750mm above finished floor level for office desks and 900mm above finished floor level for kitchen worktops, unless otherwise indicated on the Architect's drawings.

It shall be the Contractor's responsibility to verify all finished floor levels, worktop levels, wall finishes and PVC cladding build-ups on site prior to installation of outlet boxes and conduit drops.

7.4 **Bench Trunking**

The Contractor shall include for the supply and installation of double-sided aluminium hygienic bench trunking suitable for use in laboratories, training kitchens and other hygienic areas.

The trunking shall be of extruded aluminium construction with smooth, easily cleanable surfaces, rounded edges and removable covers, and shall be arranged to accommodate electrical accessories on both sides of the bench.

The system shall include internal segregation for power and ELV/data services and all necessary proprietary end caps, couplers, bends, tees, mounting brackets and accessories required for a complete installation.

Socket outlets and other accessories shall be flush mounted within the trunking using proprietary modules and positioned as indicated on the drawings.

All joints and exposed surfaces shall be neat, close fitting and readily cleanable.

Finish shall be natural anodised aluminium or powder-coated aluminium as scheduled.

7.5 **Bench Socket Outlets**

The Contractor shall include for the supply and installation of bench-mounted 13A switched socket outlets suitable for use in teaching and training environments.

Socket outlets shall be of robust construction, securely mounted to the teaching benches and positioned as indicated on the drawings.

Sockets shall be Part M compliant.

Each bench socket outlet assembly shall be supplied via a flexible 3 x 1.5mm² cable complete with a 13A fused plug for connection to a fixed socket outlet installed in the spine wall between desks.

Flexible cables shall be neatly installed within the proprietary cable management system beneath the desks, providing mechanical protection and preventing trailing cables.

The installation shall include all necessary mounting brackets, cable management accessories, plugs, connections and associated components required for a complete installation.

8 **KITCHEN CATERING EQUIPMENT**

8.1 **Introduction**

Under this Section the Contractor shall include for the supply, installation, connection, testing and commissioning of all electrical power services associated with kitchen and catering equipment, including equipment for the preparation, cooking, refrigeration and storage of food, dishwashing, washing and other associated appliances, as indicated on the drawings and equipment schedules.

The complete installation shall comply with the latest applicable editions of the following standards and regulations:

- I.S. 10101:2020+A1:2024/AC2:2025 – National Rules for Electrical Installations;
- BS 1363, as applicable, for 13A plugs, socket-outlets and connection units;
- I.S. EN IEC 60309-1 and I.S. EN IEC 60309-2, as applicable, for industrial plugs, socket-outlets and appliance inlets;
- I.S. EN IEC 60309-4, where switched or interlocked industrial socket-outlets are specified;
- I.S. 820:2019 – Non-Domestic Gas Installations, where gas-fired catering equipment is installed; and
- the equipment manufacturer's installation instructions and all applicable product standards.

The Contractor shall obtain the final catering equipment schedule prior to commencement of first fix and shall confirm for each item of equipment:

- electrical load and maximum demand;
- voltage and number of phases;
- starting or inrush current where applicable;
- manufacturer's recommended protective device;
- RCD requirements;
- connection method;
- local isolation requirements; and
- any interface required with kitchen ventilation, gas safety or emergency shutdown systems.

Any discrepancy between the drawings, catering equipment schedule and manufacturer's requirements shall be referred to the Engineer prior to installation.

8.2 **Wiring**

Unless otherwise indicated, wiring associated with catering equipment shall comprise LSF insulated single-core copper conductors installed in galvanised steel conduit and/or steel trunking, in accordance with the requirements specified elsewhere in this Specification.

All conduit drops to catering equipment, isolators, connection units and socket outlets shall be **surface mounted in galvanised steel conduit**. Conduit, outlet boxes and associated accessories shall be securely fixed to the wall surface, neatly aligned and installed using appropriate galvanised steel saddles, couplings, bends and fittings. All installations shall be arranged in a neat and uniform manner, with no concealed conduit drops permitted.

Circuit conductor sizes and protective devices shall be selected in accordance with I.S. 10101, taking

account of:

- Equipment design current;
- Installation method;
- Grouping;
- Ambient temperature;
- Voltage drop;
- Prospective fault current;
- Earth fault loop impedance;
- Disconnection times; and
- Equipment manufacturer's requirements.

All final circuits shall be individually identified at the distribution board and at local isolators where appropriate.

8.3 Domestic-Type Electric Cookers and Ranges

Domestic-type electric cookers, ranges and similar high-load cooking appliances shall be supplied from individual dedicated final circuits from the local distribution board.

The circuit rating, conductor size and protective device shall be selected to suit the connected load and manufacturer's requirements. Where indicated on the drawings, circuits shall generally be wired using 10mm² LSF copper conductors installed in steel conduit, subject to confirmation of the equipment load and installation conditions.

Each cooker circuit shall be provided with a suitably rated double-pole local isolation switch, generally 45A or greater as required by the connected load.

The cooker isolator shall:

- be readily accessible to the user;
- be located adjacent to the appliance;
- not be positioned directly above or behind the cooking appliance;
- be positioned clear of areas subject to excessive heat, steam or splashing; and
- be mounted approximately 150mm above worktop level unless otherwise indicated.

Final connection to the appliance shall be through a proprietary cooker connection unit or other connection arrangement recommended by the appliance manufacturer.

The rating of the cooker switch, connection unit, circuit conductors and protective device shall be coordinated with the actual appliance rating.

8.4 Dishwashers, Washing Machines and Other Small Appliances

Dishwashers, washing machines, tumble dryers and similar appliances shall generally be supplied from dedicated radial final circuits from the local distribution board unless otherwise indicated.

Final circuits shall be protected by individual 30mA RCBOs. RCBOs shall generally be Type A as a minimum, with Type F, Type B or other RCD characteristics provided where required by the connected equipment manufacturer.

The circuit breaker characteristic, including Type B, C or other required operating curve, shall be selected having regard to equipment starting current and manufacturer's requirements.

Where an appliance is located beneath a worktop, it shall not normally rely upon an inaccessible switched socket-outlet behind the appliance as the sole means of isolation.

A readily accessible double-pole isolation switch shall be provided above the worktop or at another

approved accessible location.

For appliances rated up to 13A, final connection may be by either:

- a switched or unswitched 13A socket-outlet complying with BS 1363-2, complete with a BS 1363 plug and fuse; or
- a fused connection unit and flex outlet,

as appropriate to the appliance manufacturer's requirements.

Where the socket-outlet is installed below a worktop, the associated isolating switch shall be suitably labelled to identify the appliance controlled.

15A BS 546 socket-outlets shall not be used unless specifically indicated for a particular specialist appliance.

BS 1363-2:2023 is the current specification for 13A switched and unswitched socket-outlets.

8.5 Refrigerators and Freezers

Refrigerators, freezers, cold counters and similar refrigeration equipment shall be supplied from dedicated circuits or suitably segregated circuits as indicated on the drawings.

Where dedicated circuits are indicated, each circuit shall be protected by an individual 30mA RCBO, generally Type A minimum unless otherwise required by the equipment manufacturer.

Refrigeration circuits shall not be controlled by the general kitchen emergency shutdown system, unless specifically indicated otherwise.

Local isolation shall be provided in an accessible location. Where the socket-outlet or connection point is concealed behind or below equipment, a separate labelled double-pole isolation switch shall be provided at an accessible location.

Where multiple refrigeration appliances are installed, circuits shall be arranged so that operation of a single protective device does not unnecessarily disconnect all refrigeration equipment.

8.6 Commercial and Industrial Catering Equipment

Commercial and industrial catering appliances shall generally be supplied from individual dedicated final circuits from the local distribution board.

Each circuit shall be sized and protected in accordance with the manufacturer's electrical data.

Where plug-and-socket connections are specified for commercial catering equipment, they shall be industrial type and comply with:

- I.S. EN IEC 60309-1:2022/AC:2023, and
- I.S. EN IEC 60309-2:2022.

Industrial socket-outlets shall have a current rating, voltage designation, number of poles and ingress protection rating appropriate to the appliance and environmental conditions.

Where frequent connection or disconnection is anticipated, or where required by the drawings, switched and/or mechanically interlocked socket-outlets complying with I.S. EN IEC 60309-4:2022 shall be provided.

The current IEC 60309 series covers industrial plugs and socket-outlets and the Irish editions of Parts 2 and 4 are current standards.

Hardwired equipment shall be provided with a suitably rated lockable local isolator positioned in a readily accessible location adjacent to the equipment.

Isolators shall disconnect all live conductors as required by I.S. 10101 and shall be clearly and

permanently labelled to identify the equipment served.

8.7 Catering Equipment Islands and Bays

Where electrically powered catering appliances are grouped together in an island, cooking line or equipment bay, the Contractor shall provide local distribution and control arrangements as indicated on the drawings.

Where specified, a suitably rated contactor or contactor arrangement shall be provided to permit the group of cooking appliances to be disconnected by the kitchen emergency shutdown system.

Contactors shall:

- be suitably rated for the connected load and utilisation category;
- be provided with adequate short-circuit protection;
- be installed in a suitable accessible enclosure;
- automatically de-energise upon operation of the emergency shutdown system; and
- require deliberate manual resetting of the emergency shutdown device before equipment can be re-energised.

Individual appliances shall continue to be provided with their own circuit protection and local means of isolation.

8.8 Kitchen Emergency Shutdown System

A kitchen emergency shutdown system shall be provided where indicated on the drawings to permit the rapid shutdown of cooking equipment in an emergency.

Emergency shutdown push buttons shall be provided at strategic and readily accessible locations, including adjacent to principal exits from the kitchen and at other locations indicated on the drawings.

Emergency shutdown devices shall comprise red mushroom-head, latching, manual-reset push buttons mounted on a contrasting background and clearly labelled:

KITCHEN EMERGENCY SHUTDOWN

The devices shall incorporate a suitable protective shroud or collar to minimise inadvertent operation without restricting rapid operation in an emergency.

Emergency shutdown devices shall operate through a fail-safe control circuit. Normally closed contacts shall generally be employed such that a break in the control circuit or loss of control power causes the associated contactors and safety valves to assume their safe condition.

Operation of any emergency shutdown push button shall disconnect the electrical supply to designated:

- electric cooking appliances;
- electric heating appliances;
- associated catering equipment identified on the drawings; and
- gas cooking appliances through the associated gas safety shut-off valve where applicable.

The emergency shutdown system shall **not normally disconnect**:

- refrigerators or freezers;
- cold rooms;
- general lighting;
- emergency lighting;
- fire alarm equipment;
- other life-safety systems; or
- kitchen extract/ventilation systems,
- unless specifically indicated otherwise.

Following operation of an emergency shutdown device, restoration of supplies shall require deliberate manual resetting. Resetting the emergency shutdown device shall not cause cooking equipment to automatically restart where this would create a hazard.

8.9 Gas-Fired Catering Equipment and Gas Interlocks

Where gas-fired catering equipment is installed, the electrical Contractor shall coordinate fully with the Mechanical Contractor and catering equipment supplier in relation to the gas safety and ventilation interlock system.

The installation shall comply with the applicable requirements of I.S. 820:2019 – Non-Domestic Gas Installations. I.S. 820:2019 is the approved Irish code of practice for non-domestic gas installations.

The Contractor shall include for all electrical power supplies, control wiring, contactors, relays and interfaces associated with:

- gas safety shut-off valves;
- gas proving systems where specified;
- kitchen extract and supply-air ventilation systems;
- air-flow or fan-status proving devices;
- gas detection systems where specified; and
- emergency shutdown push buttons.

Where required by the gas installation design, gas shall only be made available to the catering appliances when the required ventilation system operation has been proven.

Operation of a kitchen emergency shutdown device, failure of a required safety interlock or loss of control power shall cause the gas safety shut-off valve to move to its safe position.

The gas safety system and electrical emergency shutdown system shall be demonstrated to the Engineer as part of commissioning.

8.10 Identification and Labelling

All local isolators, switched connection units, industrial socket-outlets and control devices shall be permanently engraved or otherwise permanently labelled to identify the equipment served.

Labels shall be machine engraved and shall not comprise handwritten or self-adhesive temporary labels.

Emergency shutdown devices and gas safety controls shall be clearly and unambiguously identified.

9 POWER SERVICES FOR SPECIALIST EQUIPMENT

9.1 Introduction

Under this section the Contractor shall include for the supply and installation of Power Services associated with the Fire and Security Systems as shown on the drawings.

For each item of equipment, the Contractor shall supply and install a 220-Volt power point adjacent to the equipment.

9.2 Wiring

Each item shall be wired as a dedicated circuit from a 16 Amp SP MCB in the local power distribution using 2.5mm² cable. The cable type shall be as previously described under the “General Services Socket Outlets” section of this specification. A maximum of 4 No. Items may be connected to any one circuit provided they are in the same area and on the same floor.

A 13Amp unswitched fused connection unit with neon indicator mounted locally shall serve each item. These units shall be surface-mounted where located in ceiling voids, service risers or plant areas and shall be from the metal clad range as manufactured by MK Electric Ltd or MEM.

Each fused connection unit shall be labelled using a self-adhesive triplex label stating the circuit reference number and the item of equipment to be served.

Wiring from fire alarm equipment power supply units (PSUs) to equipment served from PSUs shall be carried out in 3x1.5mm² fire rated cable, e.g. AOVs, door hold open devices, etc.

10 **TELECOMMUNICATION SERVICES INSTALLATION**

10.1 **Introduction**

The Contractor shall include for the supply and installation of Telecommunication Services as indicated on the drawings and detailed below.

The Contractor shall liaise with the College's incumbent IT personnel prior to installation to confirm the existing network arrangement, final termination requirements, patching configuration and interface with existing active equipment.

10.2 **Telecommunications Structured Cabling System**

The Contractor shall include for the supply, installation, testing and commissioning of telecommunications cabling as indicated on the drawing.

The infrastructure to be provided shall include the structured cabling, RJ45 sockets, RJ45 patch panels and cabinets, these shall all be compatible and from the same manufacturer to ensure optimum performance.

The warranty for the entire system shall be for 20 years and shall cover both the product and the installation.

10.2.1 **System Requirements**

The system shall support analogue and digital applications, data, local area networks (LAN), and video on a common cabling platform.

The systems that shall be flexible and capable of including new facilities or technologies as they become required or available.

The Contractor shall supply a statement of compliance that the system proposed meets the requirements of the EEC Directives on EMC. This statement shall be backed by test documentation showing the compliance of the cabling system under stated test conditions. The recommended test networks are 100 Mbps TPPMD, 16Mbps Token Ring and 10Mbps 10BaseT. EMC compliance shall be provided as part of a 20-Year Extended Product and Applications Assurance Warranty.

The cabling installation shall comply with ISO IS14763, EN50174 and TIA/EIA 569. It shall also comply with the channel performance of the proposed new editions of TIA/EIA 568B, IS 11801 and EN50173 standards (or the standard itself if ratified before installation commences).

10.2.2 **Horizontal Subsystem**

The Contractor shall supply and install a horizontal cable to connect each information outlet to the local patch panel as indicated on the drawings.

The type of horizontal cables used shall be 4-pair unshielded twisted pair (UTP), Category 6 LSZH and shall be of 24 AWG solid copper conductors. They shall be at minimum Independently Verified to be Category 6 by Underwriters Laboratories (UL).

The horizontal cables shall be run using a star topology format.

Contractor shall observe the bending radius and pulling strength requirements, given below, of the 4-pair UTP, cable during handling and installation:

- Bending radius - 4 times the cable diameter
- Maximum pulling tension - 11N

Each run of cable between the termination block and the information outlet shall be continuous without any joints or splices, except for the optional use of a consolidation point.

The Contractor shall ensure that not more than 3 no. Cat 6 cables are pulling through a 20mm diameter conduit and not more than 4 no. in a 25mm diameter conduit.

Where cable trays are used or vertical runs are required, cables shall be clipped to trays using loosely

attached cable ties. Where cable ties are used to secure structured cables, they shall be tied in bundles. Bundles shall be no greater than ten cables per bundle. Under no circumstances shall cables be tied tightly.

10.2.3 Information Outlet

All information outlets shall be of EN 60603-7 (IEC 603-7) and EN 28877 (ISO 8877) 8-position modular MGS400 connectors and of the insulation displacement type. They shall be capable of receiving of 24 AWG solid and stranded wires.

The information outlet shall be either surface or flush mounted in appropriate face plates or floor boxes.

Outlet faceplates shall be of brushed stainless steel from the same product family as the socket faceplates.

The RJ45 information outlet shall be multivendor supportive and shall be wired in an EIA/TIA 568B configuration.

The RJ45 information outlet shall meet or exceed the Category 6 requirements of the ANSI/EIA/TIA 568-A, ISO IS 11801 and EN 50173 standards.

10.2.4 Patch Panel Cabinet

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

Cables shall be run as tight as possible to the side of the rack/cabinet in order to ensure that the entire depth and width of the rack/cabinet is available for the installation of active equipment.

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

Cable tray or ladder shall be mounted up both sides of the rack, to support data and power cables. The contractor will supply patch and device leads for every cabinet and field point within the installation. The details of these will be agreed at the initial site meeting. All racks shall be firmly fixed to the floor, and special care shall be taken for the avoidance of pinch-points in order to protect cables run from the cable tray/ladder whether above or below the rack.

Specified cabinets shall be suitable for computer room environments and shall conform to IP21 EN60.529/IEC 529. Note that IP21 conformance is required on the installed cabinet after completion of installation. It is the installer's responsibility to ensure that sufficient care is taken during installation to achieve this.

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

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

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

Suppliers shall declare conformance or otherwise with regard to the EU EMC directive relating to electromagnetic interference, on the completed installation, EU89 / 363 with all amendments.

A dedicated earth from the main earth bar at the main LV switchboard shall be provided to the DCC to serve each of the data cabinets.

10.2.5 Cable Identification and Labelling

All labelling shall conform to the agreed labelling and identification standards. The Contractor shall also include for slip-over ferrule type numbers to be fitted to each with the exception of cables terminating at rear of Workstation outlets. Numbering shall consist of a four-digit system. Labelling of Workstation outlets may be glued to the face of each plate using Loctite Super Glue. Labels shall be Traffolite or a similar engraved type.

The Contractor shall include for maintaining an accurate detailed record of the Works as they progress. The Contractor shall include for supplying copies of 'As-Installed' Port Plans upon completion of each

area. Drawings shall be in Autocad 2012 format and shall be submitted to the Engineer as directed.

10.2.6 Testing and Termination of Cables

The Contractor shall be responsible for punch down at each end of each Voice/Data Cable, together with testing and commissioning to current requirements and for Warranty purposes. All cables shall be 100% continuity tested with results recorded on disc in Excel format.

All circuits shall be tested with an approval proprietary tester and all results shall be recorded in tabular form for the client.

Level III test instruments shall be used, and all test results recorded on disc and included in the hand-over documents

Cables that fail the test must be replaced. The Engineer reserves the right witness some or all of the testing.

10.2.7 Numbering and Labelling Scheme

All links, cables, fibre optic or copper, shall be clearly labelled with a consistent numbering scheme. Radio, IR and Laser links shall be defined using the same numbering scheme.

In the following scheme:

- “x” denotes a building number
- “y” denotes an IDF; this shall be a letter.
- “z” denotes an incremental number

It is suggested to label as per the following for MDF:

- Each MDF multimode fibre cable be marked as MDF MFz (MDF Multi Mode Fibre number “z”)
- Each MDF single mode fibre cable be marked as MDF SFz (MDF Single Mode Fibre number “z”)
- Each MDF balanced cable be marked as MDF BCz (MDF Balanced Cable number “z”)

It is suggested to label as per the following for IDF:

- A number, “x” will describe each building.
- Each IDF multimode fibre cable be marked as IDF x MFz (IDF for building “x” Multi Mode Fibre number “z”)
- Each IDF single mode fibre cable be marked as IDF x SFz (IDF for building “x” Single Mode Fibre number “z”)

Each IDF balanced cable be marked as IDF x BCz (IDF for building “x” Balanced Cable number “z”)

Each IDF CAT6 cable be marked as “xyz”; e.g. outlet number 64 from IDF distributor E in building 3 would be 3E64.

This numbering scheme shall be used to represent the wiring system when providing the client with interim and As-constructed drawings.

The following letter abbreviations may be used when describing links:

- MDF Main Distributor Facility
- IDF Intermediate Distributor Facility
- MM Multimode Fibre
- SM Single Mode Fibre
- BC Balanced Cable
- RF Radio Frequency link
- IR Infra-Red link
- LR Laser Link

10.3 **Operating and Maintenance Manuals**

The Contractor shall provide the Engineer with three copies of Operating and maintenance manuals consisting generally of As-Installed Drawings, Hardware Manuals, Test Sheets, Port Plans, Certification and Warranty.

The installation shall be fully tested (i.e. 100% of all cables) to comply with ISO/TEC 11801, TIA/EIA 568A to Category 6 limits.

11 **GENERAL LIGHTING INSTALLATION**

11.1 **General Requirements**

The lighting control system shall be Fagerhult Organic Response to tie in with recently installed installation throughout the college, comprising a distributed intelligence lighting control system using sensor nodes integrated within luminaires and/or standalone Organic Response sensor nodes.

The system shall provide automatic occupancy control, daylight harvesting, programmable lighting levels, zoning and scene control without the requirement for a conventional central lighting controller.

Organic Response luminaires shall generally incorporate integral sensor nodes providing PIR occupancy detection, daylight sensing and wireless communication with adjacent sensor nodes.

The complete installation shall comply with the latest applicable editions of the following standards:

- EN 12464-1 – Light and lighting – Lighting of work places – Indoor work places.
- EN 60598-1 and relevant Parts of EN 60598-2 – Luminaires.
- EN 55015 – Limits and methods of measurement of radio disturbance characteristics of electrical lighting and similar equipment.
- EN 61547 – EMC immunity requirements for general lighting equipment.
- EN 62386 – Digital Addressable Lighting Interface (DALI), where applicable.
- I.S. 3217:2023 – Emergency lighting.
- I.S. 10101 – National Rules for Electrical Installations.
- Radio Equipment Directive 2014/53/EU, where applicable to wireless equipment.

All luminaires, sensors, switches, interfaces and associated control equipment shall be fully compatible and shall form part of a complete manufacturer's lighting control solution.

11.2 **System Architecture**

11.2.1 **Integrated Sensor Luminaires**

Luminaires indicated as Organic Response controlled shall incorporate Fagerhult Organic Response sensor nodes.

Each sensor node shall provide, as applicable:

- PIR occupancy detection.
- Ambient light/daylight sensing.
- Local luminaire control.
- Wireless communication with adjacent Organic Response nodes.
- Zoning and scene functionality.
- Wireless communication with compatible wall switches and system accessories.

The sensor nodes shall operate autonomously and communicate with neighbouring nodes without reliance on a central lighting controller or server for normal occupancy and daylight operation.

11.2.2 **Standalone Sensor Nodes**

Where luminaires cannot incorporate an integral Organic Response sensor, standalone Organic Response G3 sensor nodes shall be provided.

Standalone sensors shall provide equivalent occupancy, daylight and wireless control functionality and shall integrate fully with the Organic Response installation.

Where standalone sensors are used to control standard DALI luminaires, suitable Fagerhult Organic

Response DALI power supply/interface equipment shall be provided in accordance with the manufacturer's requirements.

Sensor locations and quantities shall be coordinated to achieve complete occupancy coverage of the areas being controlled.

11.2.3 **Wireless Communication**

Organic Response sensor nodes shall communicate locally using the manufacturer's wireless communication protocols.

Node-to-node lighting control shall utilise wireless infrared communication, with RF communication used for system data and associated connected functionality where applicable.

Sensor spacing and positioning shall comply with Fagerhult recommendations to ensure reliable communication and occupancy coverage.

The system shall continue to provide local occupancy, daylight and lighting control functionality in the event of loss of any external network connection, gateway or cloud service.

11.3 **Lighting Circuit Wiring**

11.3.1 **General**

Lighting circuits shall be wired using LSF single-core insulated copper cables installed within galvanised steel trunking and galvanised steel conduit.

Unless otherwise indicated, lighting circuits shall be wired in 2.5 mm² conductors and protected by 10 A Type C MCBs.

A separate circuit protective conductor shall be installed throughout each lighting circuit.

Organic Response luminaires shall generally be connected to a permanent unswitched 230 V AC supply. Local wall switches shall not interrupt the mains supply to the Organic Response luminaires.

No conventional switchwires shall be installed between the wireless wall switches and the luminaires.

No separate control cable shall be required between Organic Response sensor-equipped luminaires, except where specifically required for DALI-controlled luminaires, interfaces or other equipment indicated on the drawings.

11.3.2 **Steel Trunking and Conduit**

Main lighting circuit wiring shall generally comprise LSF single-core cables installed within galvanised steel trunking, with final routes to luminaires and other equipment installed in galvanised steel conduit, generally 20 mm diameter minimum.

Trunking and conduit shall be installed neatly, square and parallel with the principal building lines.

Changes in direction shall be made using proprietary bends, tees, boxes and fittings.

Steel conduit shall terminate at trunking and accessory boxes using suitable couplings and male bushes.

The complete metallic containment system shall be mechanically and electrically continuous and effectively bonded to earth. A separate CPC shall nevertheless be installed with the circuit conductors throughout.

Suitable expansion arrangements shall be provided where containment crosses building expansion or movement joints.

11.3.3 **Light Fittings and Final Connections**

All light fittings shall be as specified on the lighting drawings and luminaire schedules and shall be supplied complete with LED light source, driver, Fagerhult Organic Response sensor/control equipment where applicable, fixing accessories and all components necessary for a complete

installation.

Each light fitting shall be provided with a suitable plug-in connection arrangement using proprietary Klik-type lighting connectors or equivalent approved.

A local Klik outlet shall be provided adjacent to each individual fitting. Where a group of light fittings is located in close proximity, a suitably rated multi-gang Klik distribution box may be provided at an accessible location to serve the group.

Klik outlets and multi-gang boxes shall be securely fixed, accessible for maintenance and positioned so that connections can be reached without damage to ceilings or finishes.

Final connections between the Klik outlet or multi-gang Klik box and the light fitting shall be made using suitable LSF insulated and sheathed flexible cable, minimum 1.5 mm² unless otherwise required by the luminaire manufacturer.

Flexible final connection cables shall be kept as short as practicable and shall not exceed 3 m in length.

Flexible cables shall be adequately supported and shall not be laid loose across ceiling systems, sharp edges, hot surfaces or other services.

Where cables enter luminaires or are exposed to elevated temperatures, suitable heat-resistant cable or protective heat-resistant sleeving shall be provided.

Each light fitting shall be provided with permanent live, neutral and protective conductors. Plug-in connectors shall be suitably rated for the circuit current and shall incorporate protective conductor continuity.

Where luminaires are recessed within plasterboard or similar ceilings, all connection equipment shall be positioned so that it remains accessible through the luminaire aperture or an agreed access panel.

11.4 Lighting Control Functions

11.4.1 Occupancy Control

Lighting shall automatically respond to occupancy detected by the Organic Response PIR sensors.

The system shall automatically raise, dim or extinguish luminaires in accordance with the commissioned occupancy strategy.

Adjacent sensor nodes shall communicate occupancy information so that lighting responds progressively as occupants move through the building.

Occupancy time delays, background lighting levels and off levels shall be adjustable during commissioning.

11.4.2 Daylight Harvesting

Organic Response daylight sensors shall monitor available daylight and automatically adjust luminaire output to maintain the commissioned lighting level.

Daylight calibration shall be carried out following completion of the installation and with the final room finishes, furniture and working-plane arrangements substantially complete.

Daylight control shall be configured to avoid unnecessary switching or noticeable fluctuations in lighting output.

11.4.3 Task Tuning

The system shall permit maximum light output to be adjusted independently for individual luminaires or lighting zones to achieve the required maintained illuminance.

Initial light levels shall be configured during commissioning to suit the design illuminance requirements and shall not automatically be set to 100% output where a lower output achieves the required lighting

level.

11.4.4 **Scene Control**

The Organic Response system shall permit predetermined lighting scenes to be established where indicated on the drawings.

Scene settings shall be configurable using the manufacturer's approved commissioning application.

Typical scenes may include normal operation, presentation, AV, teaching, cleaning and other operational modes appropriate to the space.

11.4.5 **1.6 Wireless Wall Switches**

Local lighting switches shall comprise Fagerhult Organic Response compatible EnOcean wireless push-button panels.

Switches shall be wireless and battery-free and shall not require mains power, switchwires or hardwired control cabling.

Two-button or four-button switches shall be provided as indicated on the drawings and configured for the associated Organic Response lighting zone.

Functions shall include, as applicable:

- On / Auto
- Off
- Dim Up
- Dim Down
- Selection of commissioned lighting scenes.

Switches shall be configured and paired with the appropriate Organic Response sensor nodes using the manufacturer's approved commissioning procedure.

Wireless switches shall not be used as electrical isolation devices.

Switch locations shall be coordinated with the architectural drawings, doors, furniture and other wall-mounted services prior to installation.

11.5 **Hardware and Performance**

11.5.1 **Sensor Nodes**

Sensor nodes shall incorporate PIR occupancy sensing with detection coverage suitable for the mounting height and application.

The number and location of sensor nodes shall provide complete coverage of the controlled area and reliable communication between nodes.

Sensor spacing and positioning shall comply with the manufacturer's recommendations.

11.5.2 **DALI Interfaces**

Where standard DALI luminaires are incorporated into the Organic Response system, the Contractor shall provide the appropriate Organic Response external sensor, DALI PSU and associated interface equipment.

DALI wiring shall comply with EN 62386 and the manufacturer's installation requirements.

DALI control wiring shall only be provided where required by the selected Organic Response equipment and shall not be installed between Organic Response sensor-equipped luminaires

unnecessarily.

11.6 **Emergency Lighting**

The operation of the Organic Response system shall not compromise the required operation of emergency luminaires under mains failure conditions.

Emergency luminaires requiring a permanent supply for battery charging and monitoring shall be provided with the appropriate permanent unswitched supply.

Where emergency luminaires are also used for normal lighting, the normal lighting component may be controlled by Organic Response provided that emergency operation remains independent and fully compliant with I.S. 3217.

Where automatic emergency lighting testing or monitoring is required through Organic Response, all necessary compatible interfaces, gateways, luminaires and system licences shall be included.

11.7 **System Integration**

Where indicated on the drawings or controls specification, the Organic Response installation shall be capable of interfacing with the Building Management System.

Where BACnet/IP integration is required, the Contractor shall provide the appropriate Organic Response gateway, system solution level, licences and associated equipment necessary to provide the required BACnet interface.

Where API integration is specified, all gateways, software licences, subscriptions and commissioning necessary to provide the required interface shall be included.

The Contractor shall confirm the proposed interface arrangement and available data points with the Engineer and BMS specialist prior to ordering equipment.

Local lighting control shall remain operational independently of the BMS.

11.8 **Commissioning**

The complete Organic Response installation shall be commissioned by Fagerhult or by suitably trained and manufacturer-approved commissioning personnel.

Commissioning shall include, as a minimum:

- Confirmation of operation of all sensor nodes.
- Allocation of luminaires and sensors to the required zones.
- Pairing of wireless wall switches.
- Occupancy detection testing.
- Configuration of occupancy time-outs.
- Configuration of high, low and off lighting levels.
- Daylight calibration.
- Task tuning.
- Configuration of scenes.
- Testing of communication between adjacent sensor nodes.
- Configuration of standalone sensors and DALI interfaces.
- Configuration of BMS/API interfaces where specified.
- Verification of emergency lighting interfaces where applicable.

All final control parameters shall be agreed with the Engineer prior to completion.

11.9 Testing and Handover

The complete lighting control system shall be functionally tested following commissioning.

Testing shall include:

- Luminaire operation.
- Occupancy detection and response.
- Daylight dimming and calibration.
- Operation of wireless wall switches.
- Zone operation.
- Scene selection.
- Wireless communication reliability.
- Standalone sensor operation.
- DALI interface operation where applicable.
- BMS interface operation where provided.
- Emergency lighting functionality where integrated.

All defects identified during testing shall be rectified and the affected functions retested prior to Practical Completion.

11.10 Labelling and Documentation

Each lighting control zone shall be clearly identified on the as-built drawings and commissioning documentation.

Where individual sensor/luminaire identification is required for maintenance or system management, the identification reference shall correspond with the Organic Response commissioning records.

The Contractor shall provide within the O&M manuals:

- Final lighting control schematics.
- As-built lighting layouts.
- Lighting control zone drawings.
- Organic Response commissioning records.
- Final control parameters and scene settings.
- Details of gateways and interfaces.
- Manufacturer's product information.
- Operating and maintenance instructions.
- User guides for wireless wall switches.
- Details of software, licences and subscriptions where applicable.
- Emergency lighting interface information where relevant.

The Contractor shall provide a demonstration of the complete lighting control installation to the Client's Facilities Management personnel prior to Practical Completion.

12 **EMERGENCY LIGHTING INSTALLATION**

12.1 **Introduction**

The Contractor shall include for the supply, installation, testing, commissioning and certification of a complete new emergency lighting installation as indicated on the drawings.

The installation shall comprise self-contained LED emergency luminaires and exit signs, complete with integral batteries, charging equipment, LED indicators and all associated accessories.

Unless otherwise indicated, emergency luminaires shall have a minimum rated emergency duration of 3 hours.

12.2 **Standards**

The complete emergency lighting installation shall be designed, installed, commissioned, tested and handed over in accordance with I.S. 3217:2023 – Emergency Lighting, together with the latest applicable editions of the following:

- I.S. EN 1838:2024 – Lighting Applications – Emergency Lighting for Buildings.
- I.S. EN 50172:2024 – Emergency Escape Lighting Systems.
- EN IEC 60598-2-22 – Luminaires – Particular Requirements – Luminaires for Emergency Lighting.
- I.S. 10101:2020+AC2:2025 – National Rules for Electrical Installations.

Emergency exit and escape-route signage shall comply with I.S. 3217 and the Safety, Health and Welfare at Work (General Application) Regulations 2007, Part 7 and Schedule 9, as applicable.

All luminaires, batteries, control equipment, test facilities and associated components shall comply with the relevant standards applicable to the equipment concerned.

12.3 **Emergency Light Fittings**

The emergency lighting installation shall comprise, as indicated on the drawings:

- LED open-area emergency luminaires with appropriate optics.
- LED escape-route emergency luminaires with appropriate optics.
- LED blade-type exit signs.
- LED box-type exit signs.
- External LED emergency bulkheads.
- Wall-mounted combined circular luminaires to stairwells.
- Other emergency luminaires indicated on the drawings or required to achieve compliance.

All luminaires shall be purpose-designed emergency lighting fittings and shall be provided complete with integral battery, charger, LED status indicator and all necessary control equipment.

The Contractor shall ensure that the selected fittings provide the required emergency illuminance, uniformity and viewing distances in accordance with I.S. 3217 and I.S. EN 1838.

External fittings shall have an IP rating appropriate to their installed location.

12.4 **Specialist Emergency Lighting Company**

The Contractor shall employ a specialist emergency lighting company having demonstrable competency and experience in the design, supply, testing, commissioning and certification of

emergency lighting installations.

The specialist shall review the emergency lighting layouts prior to installation and confirm that the proposed installation complies with I.S. 3217:2023.

The appropriate confirmation documents required by I.S. 3217:2023 shall be completed by suitably competent persons, including as applicable:

- Confirmation of Installation
- Confirmation of Commissioning
- Confirmation of Handover.

Emergency lighting confirmation documentation shall be provided to the Engineer prior to Practical Completion.

12.5 Wiring

Emergency lighting circuits shall be wired using 2.5 mm² LSF single-core copper conductors installed within galvanised steel trunking and galvanised steel conduit.

The complete steel containment system shall be mechanically and electrically continuous and effectively bonded to earth. A separate circuit protective conductor shall be installed with the circuit conductors throughout.

Emergency luminaires shall be provided with a permanent unswitched 230 V supply to maintain battery charging under normal conditions.

The emergency lighting supply serving each area shall be derived from the relevant normal lighting circuit serving that area so that failure or disconnection of the local normal lighting circuit causes the associated emergency luminaires to operate in emergency mode.

Emergency lighting supplies shall generally be connected downstream of the protective device serving the associated normal lighting circuit, thereby providing monitoring of the local lighting sub-circuit.

Where the normal lighting installation incorporates Fagerhult Organic Response controls, the permanent supply to the emergency luminaires shall remain independent of the wireless lighting control commands. The charging supply to an emergency luminaire shall not be switched or interrupted by the Organic Response system during normal operation.

Wiring shall be concealed where practicable and installed in galvanised steel conduit and trunking as specified elsewhere.

12.6 Central Emergency Lighting Test Facility

A central emergency lighting test facility shall be provided to enable the emergency lighting installation to be tested without operating the associated lighting circuit protective devices.

The permanent emergency lighting feeds shall be taken from the relevant distribution board and connected through normally closed contacts of test relays controlled by the central emergency lighting test unit before being extended to the emergency luminaires.

Operation of the central test unit shall open the appropriate relay contacts and interrupt the permanent supply to the emergency luminaires, thereby simulating a local mains lighting failure and causing the luminaires to operate from their integral batteries.

Test relays shall:

- Be suitably rated for the connected load.
- Have normally closed, fail-safe contacts.
- Be provided for each relevant lighting circuit or test zone.
- Be clearly labelled with the circuit and area served.
- Automatically restore the normal charging supply following completion of a test.

The test arrangement shall not interrupt supplies to normal lighting, other essential services or equipment not forming part of the emergency lighting test.

The test unit shall be installed in an accessible location agreed with the Engineer and shall be clearly labelled “Emergency Lighting Test Unit”.

12.7 **Sub-Circuit Failure Operation**

The Contractor and Emergency Lighting Specialist shall verify that failure of each local normal lighting sub-circuit results in operation of the emergency lighting required within the affected area.

As part of commissioning, each relevant lighting circuit protective device shall be individually isolated or otherwise simulated to confirm correct emergency lighting operation.

The emergency lighting installation shall not rely solely on failure of the complete distribution board or incoming mains supply to initiate emergency operation.

12.8 **Testing and Commissioning**

The complete emergency lighting installation shall be tested and commissioned in accordance with I.S. 3217:2023.

Testing shall include, as a minimum:

- Operation of each emergency luminaire following loss of normal supply.
- Operation following failure of the associated local lighting circuit.
- Correct operation of the central emergency lighting test unit and test relays.
- Verification of charging and healthy-status indicators.
- Verification of maintained and non-maintained operation as applicable.
- Emergency-mode illuminance testing.
- Verification of escape-route and open-area coverage.
- Verification of exit-sign locations and viewing distances.
- Full rated-duration testing.
- Confirmation of battery recharge following testing.

For a 3-hour system, a full 180-minute rated-duration test shall be successfully completed prior to handover.

All defects identified during testing shall be rectified and the affected equipment retested prior to certification.

12.9 **Identification and Labelling**

Each emergency luminaire and exit sign shall be provided with a unique identification reference corresponding with the as-installed drawings and emergency lighting logbook.

Distribution board protective devices, test relays and central test equipment associated with the emergency lighting installation shall be clearly and permanently labelled.

Labels shall identify the circuit, test zone and area served.

13 **FIRE DETECTION AND ALARM SYSTEM – MODIFICATION AND EXTENSION**

13.1 **Introduction**

Under this Section the Contractor shall include for the modification and extension of the existing fire detection and alarm system as indicated on the drawings and as required to provide a complete, fully operational and compliant installation.

The works shall include all new detectors, manual call points, sounders, visual alarm devices where required, interface units, isolators, loop wiring, power supplies, batteries, programming, labelling, testing, commissioning and associated equipment necessary to integrate the new works with the existing fire alarm system.

The existing fire alarm system shall remain in service except for agreed temporary shutdowns necessary to carry out the works.

The Contractor shall employ a competent specialist Fire Alarm Contractor to survey the existing system, confirm compatibility and carry out the modification, programming, testing, commissioning and certification.

13.2 **Standards**

The complete fire detection and alarm installation, including all modifications and extensions, shall comply with I.S. 3218:2024 – Fire Detection and Alarm Systems – System Planning, Design, Installation, Commissioning, Servicing and Maintenance.

Equipment shall comply with the relevant parts of the I.S. EN 54 series, including, where applicable:

- I.S. EN 54-2 – Control and indicating equipment.
- I.S. EN 54-3 – Fire alarm devices – Sounders.
- I.S. EN 54-4 – Power supply equipment.
- I.S. EN 54-5 – Heat detectors.
- I.S. EN 54-7 – Point smoke detectors.
- I.S. EN 54-11 – Manual call points.
- I.S. EN 54-13 – Compatibility and connectability of system components.
- I.S. EN 54-17 – Short-circuit isolators.
- I.S. EN 54-18 – Input/output devices.
- I.S. EN 54-20 – Aspirating smoke detection systems, where applicable.
- I.S. EN 54-23 – Visual alarm devices, where applicable.
- I.S. EN 54-25 – Components using radio links, where applicable.

All standards shall be taken as the latest applicable editions and amendments.

The electrical installation associated with the fire alarm system shall comply with the current edition of I.S. 10101.

13.3 **Existing System Survey and Compatibility**

Prior to commencing work or ordering equipment, the specialist Fire Alarm Contractor shall carry out

a detailed survey of the existing fire alarm installation.

The survey shall establish, as a minimum:

- Manufacturer and model of the existing control and indicating equipment.
- Existing system protocol.
- Software and firmware versions.
- Number and type of existing loops.
- Existing loop loading and available device capacity.
- Available loop current capacity.
- Existing sounder and alarm-device loading.
- Power supply capacity.
- Existing standby battery capacity.
- Existing zones and device addresses.
- Existing short-circuit isolator arrangement.
- Existing interfaces and cause-and-effect programming.
- Existing remote monitoring arrangements.
- Condition and suitability of the existing installation for extension.

All new equipment shall be fully compatible with the existing fire alarm system and protocol.

New detectors, manual call points, sounders, interfaces and other addressable devices shall generally be of the same manufacturer and compatible product range as the existing system.

Alternative equipment shall not be used unless its compatibility and connectability with the existing installation has been confirmed by the fire alarm system manufacturer and complies with the applicable requirements of I.S. EN 54-13.

Should insufficient loop, panel, power supply or battery capacity be identified, the Contractor shall immediately advise the Engineer before proceeding.

13.4 **Existing System Condition**

Prior to commencement of the modification works, the specialist Fire Alarm Contractor shall test the existing system sufficiently to establish its operational condition and identify any pre-existing faults.

Existing faults, damaged equipment or non-compliances unrelated to the new works shall be recorded and reported to the Engineer before modification works commence.

The Contractor shall not become responsible for pre-existing defects that have been identified and formally recorded prior to commencement of the works.

The works shall not adversely affect the operation, certification or performance of the existing system.

13.5 **Specialist Fire Alarm Contractor**

All modifications and extensions shall be undertaken by a competent specialist Fire Alarm Contractor

having appropriate experience with the existing fire alarm system manufacturer and protocol.

The specialist shall be responsible for:

- Surveying the existing installation.
- Confirming system compatibility and capacity.
- Preparing working drawings.
- Confirming device locations.
- Programming addresses and device text.
- Updating the existing cause-and-effect strategy.
- Testing all new devices.
- Testing affected existing devices and interfaces.
- Commissioning the modified installation.
- Updating zone plans and system records.
- Providing the applicable I.S. 3218:2024 confirmation documentation.

13.6 Working Drawings

The Fire Alarm Contractor shall prepare coordinated working drawings prior to installation.

Drawings shall indicate:

- Existing devices to be retained.
- Existing devices to be relocated or removed.
- New fire alarm devices.
- Loop numbers.
- Device addresses.
- Fire alarm zones.
- Circuit routes.
- Short-circuit isolators.
- Interface units.
- Sounders and visual alarm devices.
- Existing and new cause-and-effect interfaces.

Working drawings shall be submitted to the Engineer for review prior to installation.

13.7 1Wiring

The Contractor shall include for all wiring necessary to modify and extend the existing fire alarm system.

New wiring shall comprise LSF fire-resistant fire alarm cable of a type complying with I.S. 3218:2024 and compatible with the existing system.

Where enhanced fire-resistant cable is required by the system design or is already used on the existing installation, extensions shall be wired using cable of an equivalent or higher performance classification.

Cable conductor size shall comply with the fire alarm manufacturer's requirements and voltage-drop calculations and shall generally be not less than 1.5 mm² unless otherwise approved.

Fire alarm wiring shall be segregated from other electrical and communications services in accordance

with I.S. 3218.

Where installed within common containment, suitable metallic segregation shall be provided.

All exposed fire alarm cabling shall be supported using appropriately spaced metallic fire-resistant supports. Plastic cable clips or cable ties shall not be relied upon as the means of cable support.

Where fire alarm cables are installed in conduit or trunking, containment shall be metallic and appropriately identified.

Outgoing and return sections of addressable loops shall be installed in accordance with I.S. 3218 and the manufacturer's requirements so that a single cable fault does not unnecessarily compromise the complete loop.

Junction boxes shall be avoided. Where unavoidable and specifically approved, junction boxes shall be metallic, accessible and permanently labelled:

- **FIRE ALARM – [LOOP/CIRCUIT REFERENCE]**

All penetrations through fire-rated construction shall be appropriately fire stopped following installation.

13.8 **Existing Fire Alarm Control Panel**

The existing fire alarm control panel shall be retained unless otherwise indicated.

The Contractor shall provide all additional loop cards, interface cards, network cards, power supplies, batteries or other equipment required to accommodate the extension where indicated or approved.

Prior to connecting additional devices, the specialist Fire Alarm Contractor shall confirm:

- Available address capacity
- Loop current capacity
- Panel processing capacity
- Sounder loading
- Auxiliary power capacity
- Battery standby capacity
- Compatibility of all proposed devices.

The complete system standby and alarm battery requirements shall be recalculated following the extension and batteries shall be upgraded where necessary.

All new devices shall be provided with unique addresses and clear descriptive text identifying the device location.

13.9 **Manual Call Points**

New manual call points shall be addressable units compatible with the existing system and shall comply with I.S. EN 54-11.

Manual call points shall be of the resettable type unless otherwise approved.

Call points shall be installed at the locations indicated on the drawings and at additional locations required to achieve compliance with I.S. 3218.

Mounting heights, locations and travel distances shall comply with I.S. 3218.

Protective covers shall only be provided where appropriate and where permitted by the fire alarm

design.

13.10 **Smoke and Heat Detectors**

New automatic detectors shall be addressable and fully compatible with the existing system.

Smoke detectors shall generally be optical or multi-sensor type as appropriate to the application and the existing system.

Heat detectors shall be provided in locations where smoke detection would be unsuitable or could result in an unacceptable risk of false alarms.

Detector type and operating characteristics shall be selected having regard to:

- Fire risk.
- Ceiling height.
- Environmental conditions.
- Likelihood of false alarms.
- Existing detector types.
- Manufacturer's recommendations.

Each detector shall incorporate or be connected to an appropriate addressable mounting base.

Removal of a detector shall generate a fault condition at the control panel without unnecessarily interrupting operation of other devices.

Remote indicator LEDs shall be provided where detectors are concealed or where otherwise required.

13.11 **Short-Circuit Isolators**

Addressable loops shall incorporate short-circuit isolators in accordance with I.S. 3218, I.S. EN 54-17 and the system manufacturer's requirements.

The existing isolator arrangement shall be reviewed as part of the modification works and additional isolators shall be installed where necessary to maintain the required system fault tolerance.

13.12 **Interface Units**

Addressable input/output interface units shall be provided or extended where required to monitor or

control other building systems.

Interfaces may include:

- Access-controlled doors.
- Gas shut-off valves.
- Automatic opening vents.
- Smoke-control systems.
- Magnetic door hold-open devices.
- Mechanical ventilation systems.
- Motor control panels.
- Fire/smoke dampers.
- Passenger or platform lifts.
- Sprinkler systems.
- Aspirating detection systems.
- Other life-safety systems indicated on the drawings.

Interfaces shall be fail-safe where appropriate.

The Fire Alarm Contractor shall liaise with the relevant specialist contractors to establish the required interface arrangement, volt-free contacts, monitoring requirements and cause-and-effect operation.

All interfaces shall be individually tested during commissioning.

13.13 Alarm Sounders and Visual Alarm Devices

Existing fire alarm sounders shall be retained where suitable.

Additional addressable sounders or combined detector base sounders shall be provided as indicated on the drawings and where required to achieve the alarm sound levels specified by I.S. 3218.

Sounders shall be fully compatible with the existing system and shall produce the same recognised fire alarm signal as the existing installation.

The specialist Fire Alarm Contractor shall carry out sound-pressure-level measurements following completion of the works and shall provide additional sounders where required to achieve compliance.

Visual alarm devices shall be provided where required by the fire alarm design and shall comply with I.S. EN 54-23.

Sounders or visual alarm devices shall not be selected solely on nominal manufacturer output; their quantity and locations shall be determined by the performance required within the completed building.

13.14 Fire Alarm Cause and Effect

The existing building fire alarm cause-and-effect strategy shall be retained and extended to incorporate the new works, unless specifically indicated otherwise.

The Contractor shall obtain and review the existing fire alarm cause-and-effect matrix prior to programming.

Activation of new devices shall initiate the same appropriate fire alarm actions as equivalent existing devices within the relevant fire alarm zone.

The Contractor shall not alter the existing evacuation strategy, alarm sequence, delays, investigation periods or interface operation without the written approval of the Engineer and relevant fire safety designer.

A revised cause-and-effect matrix shall be prepared where the works affect existing system interfaces

or programming.

13.15 Remote Monitoring

Where the existing fire alarm system is connected to an Alarm Receiving Centre or other remote monitoring service, the existing monitoring arrangement shall be maintained.

The Contractor shall include for all modifications to the existing signalling equipment required as a consequence of the works.

Following completion, fire and fault transmission to the monitoring facility shall be fully tested and confirmation of successful signal transmission obtained.

Remote monitoring shall only be provided where required by the existing fire strategy, system design or Client requirements.

13.16 Zone Plans

Existing fire alarm zone plans shall be updated to incorporate the modifications and extensions.

A current zone plan shall be permanently mounted adjacent to:

- The main fire alarm control panel.
- Each repeat indicator panel where required.

Zone plans shall clearly indicate:

- Building layout.
- Fire alarm zones.
- "You Are Here" location.
- Main fire alarm panel.
- Repeat panels where applicable.
- Relevant floor identification.

Zone plans shall be clear, durable and readily understood by persons unfamiliar with the premises.

13.17 Maintaining Fire Alarm Protection During the Works

The Contractor shall plan the works so that disruption to the existing fire detection and alarm system is kept to an absolute minimum.

Any isolation, shutdown or impairment of the existing system shall be agreed in advance with the Client's nominated representative.

The Contractor shall:

- Identify the area and devices affected.
- Agree the shutdown period.
- Notify the Client prior to isolation.
- Implement temporary precautions where required.
- Reinstate and test the affected system immediately following completion of the works.
- Record all isolations and reinstatements in the fire alarm logbook.

No part of the existing fire alarm system shall be left isolated or disabled outside agreed working

periods without the express agreement of the Client.

13.18 **Testing and Commissioning**

Following completion, the modified and extended fire alarm installation shall be fully tested and commissioned in accordance with I.S. 3218:2024.

Testing shall include, as a minimum:

- Verification of all new device addresses and location text
- Functional testing of every new detector
- Functional testing of every new manual call point
- Functional testing of all new sounders and visual alarm devices
- Testing of short-circuit isolators
- Testing of all new and affected input/output interfaces
- Sound-pressure-level testing
- Testing of remote monitoring where applicable
- Verification of loop continuity and fault monitoring
- Verification of mains and standby power supplies
- Verification of battery capacity
- Testing of the revised cause-and-effect strategy
- Testing of affected existing devices
- Verification that existing unaffected areas continue to operate correctly
- Testing of all fire alarm interfaces affected by the works,

All existing system faults arising as a consequence of the modification works shall be rectified before completion.

13.19 **1Certification**

On completion, the specialist Fire Alarm Contractor shall provide the applicable I.S. 3218:2024 confirmation documentation for the modification, extension or alteration of the existing system.

The Contractor shall also provide all associated installation, commissioning and acceptance documentation required by I.S. 3218:2024 for the extent of the works.

No modification shall be regarded as complete until all required confirmation documentation has been

submitted and accepted.

13.20

Documentation and Handover

The Contractor shall provide the following on completion:

- Updated as-installed fire alarm drawings
- Updated loop drawings
- Updated device and address schedule
- Updated zone plans
- Updated cause-and-effect matrix
- Details of all new equipment
- Manufacturer's product literature
- System compatibility information
- Battery capacity calculations
- Sound-level test results
- Interface test records
- Remote monitoring test records where applicable
- I.S. 3218:2024 confirmation documentation
- Updated system logbook
- Details of software or programming changes
- Backup copy of the final fire alarm panel configuration where available.

The specialist Fire Alarm Contractor shall demonstrate the modified system to the Client's nominated representative and shall explain any changes to the operation, controls or fire alarm strategy.

14 **BOILER PLANT**

14.1 **Introduction**

Under this Section the Electrical Contractor shall include for the complete supply, installation, connection, testing and commissioning of all LV power and ELV/control wiring associated with the boiler plant as indicated on the drawings and schematics.

The Contractor shall also include for erecting and connecting all control panels, thermostats, sensors, actuators and miscellaneous control devices supplied free-issue by the Mechanical Contractor.

The installation shall comply with I.S. 10101 and the relevant current standards and manufacturers' requirements.

14.2 **Power Wiring**

Power wiring to boiler plant equipment shall comprise LSF single-core copper conductors installed in galvanised steel conduit and trunking.

Cable sizes and protective devices shall be as indicated on the drawings and shall be suitable for the connected load, starting current, installation method and voltage drop.

Final connections to pumps, boilers and other vibrating equipment shall be made using suitable flexible cable or flexible metallic conduit as appropriate.

14.3 **Local Isolation**

A local isolator shall be provided adjacent to each item of plant.

Isolators shall be minimum IP54, heavy-duty polycarbonate construction, rotary operated and lockable in the OFF position.

Three-phase plant shall generally be provided with TP&N isolators and single-phase plant with double-pole isolators.

Isolators shall be equivalent to MK SafetySwitch or equal approved and shall be clearly labelled with the plant item served.

14.4 **Control Wiring**

The Electrical Contractor shall provide all control wiring between mechanical control panels and field-mounted devices including:

- Thermostats and sensors
- Motorised valves
- Pumps and boilers
- Flow and pressure switches
- Gas safety equipment
- Run, fault and enable contacts.

Control wiring shall be installed in accordance with the approved mechanical controls schematics and equipment manufacturers' requirements.

ELV, analogue and communications cables shall be appropriately segregated from LV power wiring.

Screened cables shall be provided where required.

14.5 **Control Panels**

The Contractor shall include for erecting and connecting mechanical and boiler control panels supplied free-issue.

This shall include incoming supplies, local isolation, outgoing power and control wiring, earthing and labelling.

Adequate working and maintenance clearance shall be maintained around all panels.

14.6 **Boilers, Pumps and Safety Interlocks**

Boilers and pumps shall be connected in accordance with the manufacturers' requirements and the mechanical controls schematics.

The Contractor shall include for all required enable, run, fault and safety interlock wiring.

Gas detection, gas shut-off and boiler safety circuits shall be hardwired and fail-safe where required.

Where indicated, a boiler plant emergency shutdown switch shall be provided adjacent to the principal plantroom exit.

14.7 **Containment, Earthing and Labelling**

Steel conduit and trunking shall be independently supported, neatly installed and coordinated with mechanical services.

A separate circuit protective conductor shall be installed with all power circuits.

All plant isolators, control panels, junction boxes and associated equipment shall be permanently labelled to correspond with the mechanical and electrical drawings.

14.8 **Testing and Commissioning**

The complete installation shall be tested and commissioned in conjunction with the Mechanical Contractor.

Testing shall include:

- Electrical circuit testing
- Local isolator operation
- Motor rotation
- Control wiring
- Boiler and pump enable/run/fault signals
- Safety interlocks
- Gas shutdown controls
- Emergency shutdown.

Updated drawings, test records and commissioning information shall be included within the O&M manuals.

15 **GAS SERVICES WIRING**

15.1 **General**

The Contractor shall include for the complete supply, installation, wiring, connection, testing and commissioning of all electrical services associated with the gas installation as indicated on the drawings and schematics.

The installation shall include, as applicable:

- Gas detection and control panel
- Gas detectors
- Carbon monoxide detectors
- Gas pressure proving system
- Automatic gas shut-off valve
- Gas pressure sensors/switches
- Emergency gas shut-off buttons
- Boiler/appliance safety interlocks
- Ventilation interlocks
- Audible and visual alarms
- All associated power and control wiring.

The installation shall comply with I.S. 820:2019 – Non-Domestic Gas Installations, I.S. 10101 and the relevant current I.S./EN standards. Where installed within an educational establishment, the requirements of IGEM/UP/11 shall also be considered as applicable.

15.2 **Wiring**

Power wiring shall comprise LSF single-core copper conductors installed in galvanised steel conduit and trunking.

Control and detector wiring shall be of the type recommended by the gas detection/control system manufacturer and shall be suitably segregated from LV power circuits.

All wiring associated with gas safety shutdown functions shall be hardwired and fail-safe.

Cables, junction boxes and equipment shall be clearly identified as forming part of the gas safety system.

15.3 **Gas Detection System**

A complete fixed gas detection system shall be provided comprising a control panel, gas detectors, audible/visual indication, output relays and all associated equipment.

Natural gas detectors shall be suitable for methane detection and shall comply with the relevant requirements of I.S. EN 60079-29-1. Carbon monoxide detectors, where provided, shall be suitable for commercial/industrial applications and the relevant EN 45544 series.

Natural gas detectors shall generally be installed at high level, taking account of potential gas accumulation points, ventilation patterns and the manufacturer's recommendations.

Carbon monoxide detectors shall be positioned in accordance with the manufacturer's

recommendations and the gas safety design.

The control panel shall provide:

- Normal/healthy indication.
- Gas alarm indication.
- Detector fault indication.
- Gas valve status.
- Audible alarm.
- Manual reset.
- Volt-free outputs as required for associated safety interlocks.

Gas alarm setpoints shall be configured in accordance with the gas system design and manufacturer's recommendations.

On detection of an unsafe gas concentration, the system shall automatically close the gas shut-off valve and inhibit operation of the associated gas-fired plant.

Gas shall not be automatically reinstated following an alarm condition. Manual reset shall be required following investigation and clearance of the fault.

15.4 **1Gas Shut-Off Valve**

An electrically operated normally closed gas safety valve shall be provided on the incoming gas supply at the location indicated on the drawings.

The valve shall fail closed on loss of electrical power or operation of any associated gas safety device.

The gas safety valve shall close upon:

- Gas detection alarm.
- Operation of an emergency gas shut-off button.
- Failure of the gas pressure proving sequence.
- Operation of any other designated safety interlock.

Reinstatement of the gas supply shall require manual intervention following clearance of the initiating condition.

15.5 **Gas Pressure Proving System**

A gas pressure proving system shall be provided to verify the integrity of the downstream gas installation prior to opening the main automatic gas valve.

The system shall comprise a proprietary gas pressure proving controller, pressure sensor/switches, automatic gas valve and associated wiring and controls.

On initiation, the system shall carry out an automatic pressure proving sequence to establish that the downstream gas installation is gas-tight before permitting the main gas valve to open.

Should the proving sequence fail:

- The main gas valve shall remain closed.
- A visual fault indication shall be displayed.
- The associated gas appliances shall remain inhibited.
- Manual reset shall be required following investigation of the fault.
- The pressure proving equipment and sequence shall be suitable for the gas system volume, operating pressure and appliance arrangement and shall be commissioned by the gas system

specialist.

15.6 **Emergency Gas Shut-Off**

Emergency gas shut-off buttons shall be provided at the locations indicated on the drawings, including adjacent to the principal exit from the relevant plantroom or gas appliance area where required.

Emergency shut-off units shall be clearly labelled:

EMERGENCY GAS SHUT-OFF

Operation shall immediately de-energise the gas safety valve and isolate the gas supply.

The gas valve shall remain closed until the emergency device has been reset and the gas safety system manually reinstated.

15.7 **Ventilation and Appliance Interlocks**

Where mechanical ventilation is required as part of the gas safety strategy, the gas supply shall be appropriately interlocked with the ventilation system.

Failure of the required ventilation shall inhibit or isolate the gas supply where required by the gas installation design.

All gas-fired appliances shall be provided with the necessary hardwired enable and safety interlock connections.

Safety shutdown functions shall not depend solely upon software or non-safety control systems.

15.8 **Testing and Commissioning**

The gas detection and pressure proving systems shall be commissioned by competent specialist personnel in conjunction with the Mechanical Contractor and gas installer.

Testing shall include:

- Functional testing of each gas detector
- Calibration and verification of alarm setpoints
- Gas valve opening and closing
- Simulated gas alarm
- Gas pressure proving sequence
- Pressure proving failure condition
- Emergency gas shut-off operation
- Loss-of-power fail-safe operation
- Appliance and ventilation interlocks
- Audible and visual alarm indications
- Manual reset and reinstatement

Test certificates, commissioning records, manufacturers' information and final wiring diagrams shall be incorporated into the O&M manuals.

16 **VENTILATION SERVICES WIRING**

16.1 **Introduction**

Under this Section the Electrical Contractor shall include for the complete supply, installation, connection, testing and commissioning of all LV power and ELV/control wiring associated with the ventilation systems as indicated on the drawings and schematics.

The works shall include wiring associated with:

- Supply and extract fans
- Air handling and ventilation units
- Variable Speed Drives (VSDs)
- Fan speed controllers
- Motorised dampers and actuators
- Airflow and differential pressure switches
- Run, fault and enable signals
- Gas safety and pressure proving interlocks
- Fire alarm shutdown interfaces where indicated.

Control equipment supplied free-issue by the Mechanical Contractor shall be erected and connected by the Electrical Contractor.

16.2 **Wiring**

Power wiring shall comprise LSF single-core copper conductors installed in galvanised steel conduit and trunking.

Cable sizes and protective devices shall be as indicated on the drawings and suitable for the connected load, motor starting characteristics, installation method and voltage drop.

Final connections to fans and other vibrating equipment shall be made using suitable flexible cable or flexible metallic conduit.

Control and signal wiring shall be suitably segregated from LV power wiring.

16.3 **Local Isolation**

Each fan and item of ventilation plant shall be provided with a suitably rated local isolator adjacent to the equipment.

Isolators shall be minimum IP54, lockable in the OFF position and clearly labelled with the plant reference.

Three-phase equipment shall generally be provided with TP&N isolation and single-phase equipment with double-pole isolation.

16.4 **Variable Speed Drives**

VSDs shall be installed where indicated on the drawings and shall be suitably rated for the associated

motor.

The Contractor shall include for all:

- Incoming power wiring
- Motor wiring
- Local isolation
- Enable and control wiring
- Run and fault connections
- Speed reference wiring
- Earthing and EMC bonding.

Cabling between VSDs and motors shall be screened VSD-rated cable where required by the drive manufacturer, complete with suitable EMC glands and 360-degree screen termination.

VSD power and output cables shall be segregated from ELV and sensitive control wiring.

Where a motor-side local isolator is installed between the VSD and motor, it shall incorporate an auxiliary contact interlocked with the VSD so that the drive output is inhibited before the isolator opens.

VSDs shall not automatically restart following a safety shutdown unless specifically permitted by the controls and safety strategy.

16.5 Fan Speed Controllers

Where fans are not controlled by VSDs, proprietary electronic or stepped speed controllers shall be provided as indicated.

Speed controllers shall:

- Be compatible with the fan motor
- Be suitably rated for the motor current
- Provide the required adjustable speed range
- Be installed in an accessible location
- Incorporate suitable local isolation where required.

Where EC fans are provided, speed control shall generally be by the manufacturer's compatible controller or 0–10 V control signal.

16.6 Ventilation Control Wiring

The Contractor shall provide all control wiring between ventilation equipment and associated control devices including:

- Fan enable circuits
- Run and fault contacts
- Motorised dampers
- Airflow switches
- Differential pressure switches
- Temperature controls
- Speed controllers
- VSDs
- Gas safety controls.

All wiring shall be installed in accordance with the approved mechanical controls schematics and equipment manufacturers' requirements.

16.7 Gas Pressure Proving Interlock

Where ventilation is required as part of the gas safety strategy, the ventilation system shall be hardwired and interlocked with the gas pressure proving/control system.

The gas safety system shall only permit the main gas valve to open when the required ventilation system has been enabled and its satisfactory operation has been proven.

Fan operation shall be proven by an appropriate means such as:

- Airflow switch
- Differential pressure switch
- Fan run/proving contact
- Other approved independent airflow proving device.

A fan enable signal alone shall not be accepted as proof of ventilation where positive airflow proving is required.

Failure of the required ventilation during operation shall initiate the appropriate gas safety sequence and, where required by the gas safety design, close the automatic gas shut-off valve and inhibit the associated gas-fired appliances.

Reinstatement of the gas supply following a safety shutdown shall require the gas safety system to successfully complete its normal pressure proving and ventilation proving sequence.

Gas safety interlocks shall be hardwired and fail-safe.

16.8 Fire Alarm Interlock

Where required by the fire strategy, ventilation plant shall shut down upon receipt of the appropriate fire alarm signal.

The Electrical Contractor shall provide the necessary hardwired connections between the fire alarm interface and ventilation control equipment.

Any ventilation plant required to operate during a fire condition shall operate strictly in accordance with the approved fire strategy.

16.9 Earthing and Labelling

All fans, VSDs, speed controllers, isolators and metallic containment shall be earthed in accordance with I.S. 10101.

A separate circuit protective conductor shall be installed with all power circuits.

All isolators, VSDs, speed controllers, control devices and junction boxes shall be permanently labelled with the associated plant reference.

16.10 Testing and Commissioning

The ventilation electrical installation shall be tested and commissioned in conjunction with the Mechanical Contractor.

Testing shall include:

- Electrical circuit testing
- Fan rotation
- Local isolator operation
- VSD operation and speed control
- Fan speed controller operation
- Motorised damper operation
- Airflow and pressure proving devices
- Run/fault indications
- Gas pressure proving and ventilation interlocks
- Gas shutdown upon ventilation failure
- Fire alarm shutdown interfaces where applicable.

Final wiring diagrams, test records and commissioning information shall be incorporated into the O&M manuals.

17 **MINOR BUILDER'S WORKS ASSOCIATED WITH ELECTRICAL SERVICES**

17.1 **General**

The Contractor shall include for all minor builder's works necessary to complete the electrical installation.

This shall include minor openings, holes, sleeves, chases, recesses, local making good, fire stopping and sealing associated with the electrical works.

Major structural works, excavation, underground ducting, external chambers, trenching, roadworks and other civil engineering works are excluded from this Section.

17.2 **Openings, Sleeves and Recesses**

The Contractor shall include for forming minor openings, holes and recesses required for conduits, trunking, cable trays, accessories and electrical equipment.

Suitable sleeves shall be provided through walls and floors where required.

No structural member shall be drilled, cut or altered without prior approval.

17.3 **Chases and Making Good**

Minor chases required for conduits, accessory boxes and other electrical services shall be neatly formed.

Following installation, all affected surfaces shall be made good to match the surrounding construction and finishes.

Making good shall include minor plastering, filling and sealing associated with the electrical works.

17.4 **Fire Stopping**

All electrical service penetrations through fire-rated walls, floors and compartment boundaries shall be appropriately fire stopped.

Fire stopping shall:

- Maintain the required fire resistance of the construction
- Be compatible with the cables and containment installed
- Use proprietary tested fire-stopping systems
- Be installed by competent personnel
- Be appropriately labelled and recorded where required.

17.5 **Sealing of Penetrations**

Penetrations through external walls and other exposed construction shall be permanently sealed against water, draughts, vermin and the passage of gas.

Sealing materials shall be suitable for the location and compatible with the construction penetrated.

17.6 **Supports and Fixings**

The Contractor shall include for all minor brackets, supports, Unistrut, fixings and proprietary support

systems required for electrical containment and equipment.

All supports shall be fixed independently to the building structure.

Electrical services shall not be supported from pipework, ductwork or other services.

17.7 **Access Panels**

Where electrical equipment requiring future inspection or maintenance is installed above inaccessible ceilings or within enclosed construction, the Contractor shall identify the requirement for suitable access panels.

Access panels shall be coordinated with the Main Contractor and architectural finishes.

17.8 **Coordination**

Minor builder's work requirements shall be coordinated with the Main Contractor and other trades before installation.

Particular attention shall be given to service penetrations, ceiling voids, plantrooms, distribution boards, cable routes and fire compartment boundaries.

18 **HANDOVER**

18.1 **Introduction**

Under this Section the Contractor shall include for the complete handover of the Electrical Services installations and for instruction of the Employer's nominated staff in the operation and maintenance of all systems forming part of the works.

All systems shall be fully tested, commissioned, labelled and operational prior to handover.

18.2 **Pre-Handover Requirements**

Prior to Practical Completion and before requesting the Engineer to attend for demonstrations or witnessing, the Contractor shall submit, as applicable:

- Electrical installation test certificates and schedules in accordance with I.S. 10101.
- Emergency lighting test, commissioning and handover documentation in accordance with I.S. 3217.
- Fire alarm modification/extension commissioning and confirmation documentation in accordance with I.S. 3218.
- Fagerhult Organic Response lighting controls commissioning records.
- Gas detection system commissioning certificate.
- Gas pressure proving and gas safety interlock test records.
- Ventilation system electrical commissioning records, including VSDs, speed controllers and gas safety interlocks.
- Boiler plant electrical and control test records.
- Updated distribution board schedules.
- Final as-installed drawings and schematics.
- O&M manuals and manufacturers' literature.
- Schedule of outstanding defects or incomplete works.

All systems shall be pre-tested by the Contractor prior to the Engineer attending site.

The Contractor shall be liable for additional costs incurred where witnessing or demonstration cannot be completed due to incomplete installation, defective equipment or systems not having been properly commissioned.

18.3 **Practical Completion and Handover**

Prior to handover, the Contractor shall confirm in writing that:

- The installation is complete and safe to operate
- All statutory and specification testing has been completed
- All systems have been commissioned
- All defects identified during commissioning have been rectified
- All required certificates and records have been submitted
- Final drawings and O&M documentation have been provided.

The Engineer may witness tests or demonstrations of any part of the installation prior to recommending Practical Completion.

Any remaining minor defects shall be included on an agreed snagging schedule together with a

programme for completion.

18.4 **Demonstrations and Staff Training**

The Contractor shall provide demonstrations and instruction to the Employer's nominated staff covering the operation and routine maintenance of the installed systems.

Demonstrations shall include, as applicable:

- Distribution boards and electrical isolation
- Emergency lighting and central test facilities
- Fire alarm system alterations and controls
- Fagerhult Organic Response lighting controls and wireless switches
- Boiler plant electrical controls
- Ventilation controls, VSDs and speed controllers
- Gas detection and alarm system
- Gas pressure proving and emergency gas shut-off systems
- Safety interlocks and emergency shutdown arrangements.

Specialist suppliers shall attend and provide instruction where appropriate.

A handover schedule shall be submitted in advance identifying the systems to be demonstrated, proposed duration and required attendees.

18.5 **Recorded Training**

Where requested by the Employer, the formal system demonstrations and training sessions shall be digitally recorded and provided electronically as part of the handover documentation.

Recordings shall clearly demonstrate the normal operation, testing, isolation and reset procedures for the principal systems.

A completed and signed handover record shall be provided confirming that the demonstrations and training have been carried out.

19 **TESTING & COMMISSIONING**

19.1 **Introduction**

Under this section the Contractor shall include for the testing and commissioning of Electrical Services Installations shown on the drawings and specified in the documents.

19.2 **General Description**

Tests and pre-commissioning shall be carried out by the Contractor during the course of the work. The integrated systems, when complete, shall be commissioned by the Contractor to ensure that the design intent has been met.

The Contractor shall agree a programme for pre-commissioning and commissioning of all installations strictly in accordance with the details following and shall include for updating and reporting on progress throughout the Contract.

The Contractor shall ensure that sufficient time is allowed, to carry out the detailed pre-commissioning and commissioning described later.

At all stages of pre-commissioning and commissioning, the Employers representative shall reserve the right to witness part or all of the tests carried out and to have tests repeated to prove that installations or individual items of plant meet the specified performance. Accordingly, the Contractor shall give adequate notice of such tests.

The Contractor shall provide all test instruments and equipment required to carry out all tests, pre-commissioning and commissioning as detailed later. Equipment shall be approved by the Engineers as to their suitability.

The Contractor shall complete commissioning certificates which shall be made available to him. Commissioning certificates shall cover the performance and operation of the installation in order to achieve the design intent.

19.3 **Inspection and Testing**

The whole of the work shall be carried out in strict accordance with the latest Edition of the NSAI National Wiring Rules for Electrical Installations and any other relevant local, statutory or government authority.

The Engineer shall be given seven days' notice in writing to inspect any parts of the installation that shall be concealed within the building fabric. The Contractor shall at no cost to the contract and at the Engineers discretion, expose any services should the notice have not previously been given.

The Contractor shall allow the Engineer to inspect all work in progress and upon completion and shall carry out tests in the Engineer's presence as required, in order to prove that all work carried out and all materials, apparatus, equipment and systems installed are wholly satisfactory and fully meet the requirements of this Specification.

All costs and charges associated with or arising from such inspections and tests, including costs incurred by the Contractor in carrying out the prescribed tests and attending upon the Engineer whilst tests and inspections are in progress, shall be included within the Tender.

The results of each test carried out in accordance with the provisions of this Specification shall be accurately recorded on an approved form of test certificate signed by the person in charge of the testing procedure and countersigned by the Engineer witnessing the test(s). Copies of every such test certificate shall be submitted to the Engineer within 14 days of completion of the tests.

Every test certificate submitted in accordance with the preceding clause shall in addition to a fully detailed description of the tests carried out and the results obtained, bear the project name and number, the Sub-Contract reference, the name and address of the Sub-Contractor, and the manufacturer or supplier, all relevant contract order, and production numbers, the date and time of the test and the ambient conditions and include any relevant performance curves.

All labour and test instruments, materials, fuel and power, required for the efficient and safe execution of the tests required by the Engineer in accordance with this Specification shall be provided by the

Contractor at his own expense, and the costs thereof shall be deemed to have been included within the tender.

All expenses incurred by the Engineer or his authorised representatives in connection with inspections or tests resulting in the rejection of the item(s) offered for inspection or test will be charged to the Contractor or deducted from sums due to him.

No inspection or testing by the Engineer, nor the witnessing of satisfactory tests, shall in any way relieve the Contractor of any of his obligations under this Contract, nor shall it in any way limit the right of the Engineer to reject such items if they subsequently prove to be defective or unsatisfactory or unsuitable for their intended purpose.

The Engineer shall have the right to waive, at his sole discretion, the requirements relating to inspection of materials, apparatus equipment and installations and the witnessing of tests thereon. The exercise by the Engineer of this right shall not in any way relieve the Contractor of his obligations to carry out the prescribed tests and to submit test certificates.

Upon completion of the works the whole installation shall be subjected to testing and every defect shall be noted, corrected and brought to the notice of the Engineer. Prior to final acceptance of the installation all tests shall be repeated either in whole or in part as advised and witnessed by the Engineer to his full satisfaction. The Engineer shall be given at least one weeks' notice in writing of the proposed tests.

All testing and witnessing shall be executed within the program of works and the Contractor shall be wholly responsible for all programming and co-ordination of this work.

Before connection to the supply, tests shall be carried out for polarity, earthing, insulation and protection as laid down in Section 6 of the NSAI National Rules for Electrical Installations.

After the installation or part thereof has been tested, as specified above, and found to comply with the NSAI Rules, the Contractor shall sign a statement to that effect. The statement shall be in the form of a certificate, which shall be in accordance with the sample appropriate to industrial and commercial installations, shown in the NSAI Rules.

All tests shall be carried out before services are enclosed in underground ducts or ceiling voids, or service duct panels are fixed.

19.4 **Commissioning**

The Contractor shall execute the commissioning and perform any demonstration which is necessary before the installation is accepted for use.

Commissioning shall be carried out to verify the correct operation of the whole installation including equipment etc. and to ensure that this is operating in accordance with the specified conditions. This shall entail the operation of all equipment in normal working mode e.g., fire alarm systems, emergency lighting, public address, etc.

The Contractor shall prepare a full and detailed commissioning schedule detailing all systems to be witnessed, time scale and attendees, together with method statements for procedures. All this information shall be submitted in draft to allow comment by the Engineer and re-submission.

Commissioning procedures shall be sufficiently thorough and systematic so as to identify, together with normal site inspection, any obvious installation deficiencies and design errors or omissions. The Contractor shall be responsible for the rectification of defective work but any problems which result from the design of the installation shall be referred to the Engineers for their decision.

As an immediate preliminary to the setting-to-work of the installation, the Contractor shall carry out a full check and inspection to confirm that the installation and its components are in a safe and satisfactory condition. He shall verify that all statutory notices are displayed and that arrangements have been made so that installations may be safely commissioned.

When the preliminary checking and inspection of the installation has shown that it is in a safe and satisfactory condition, or after any deficiencies which have been revealed during this process have been put right, the Contractor shall proceed to set it to work and adjust and regulate it as necessary in accordance with the Contract requirements.

Commissioning shall include, where appropriate, the energising of electrical installations, the setting of machinery into motion; verifying the operation of controls, safety devices and alarms; and the setting

of controls within limits specified in the Contract documents e.g. the setting of overloads in motor starters.

The Contractor shall prepare and submit records of measurement and settings related to the installation, both as offered for acceptance and as finally commissioned.

The Employers representative, the Engineer and others who may be concerned with the maintenance and use of an installation shall be permitted to witness the commissioning procedure, testing and working demonstrations.

The Engineer's acceptance of the commissioning process and results obtained shall not in any way relieve the Contractor of the contractual and statutory obligations to ensure that all connections and adjustments are made correctly and that the installations and equipment are handed over in a completely safe and satisfactory condition.

All activities carried out by the Contractor during commissioning shall be carried out, and be continuously supervised, by a competent and experienced commissioning engineer, details of whose experience and qualifications shall be submitted to the Engineer for comment before commissioning commences.

The Contractor shall be wholly responsible for ensuring that all work on electrical circuits and equipment which have been energised are carried out in a safe manner and shall operate, and rigidly adhere to, an approved "permit-to-work" system.

Sections of the installation, equipment or system shall not be considered as being complete until the prescribed commissioning procedures have been satisfactorily carried out and the reliability run has been completed without significant incident.

20 **LABELLING AND IDENTIFICATION OF PLANT AND EQUIPMENT**

20.1 **General**

The Contractor shall provide permanent labels and identification for all electrical plant, equipment, controls and associated services forming part of the installation.

Labels shall be clear, durable, securely fixed and suitable for the environment in which they are installed.

Identification shall correspond with the references used on the drawings, schematics, schedules and O&M documentation.

20.2 **Equipment Labelling**

The following shall be labelled as applicable:

- Distribution boards and switchgear.
- Control panels.
- Local isolators.
- Boilers, pumps and ventilation equipment.
- Variable speed drives and speed controllers.
- Gas detection and gas pressure proving equipment.
- Fire alarm equipment.
- Emergency lighting test equipment.
- Lighting control equipment.
- Junction and marshalling boxes.
- Electrical panels and enclosures.
- Specialist control equipment.

Labels shall generally comprise engraved laminated traffolyte or equivalent approved material with contrasting lettering.

20.3 **Distribution Boards and Switchgear**

Each distribution board and switchgear assembly shall be identified with:

- Board reference
- Source of supply
- Voltage
- Main protective device rating
- Associated upstream distribution board or switchboard.

Each outgoing circuit shall be clearly identified using permanently printed circuit schedules.

Circuit schedules shall accurately reflect the final as-installed installation.

20.4 **Local Isolators and Control Devices**

All isolators, switches, control stations and emergency shutdown devices shall be labelled to identify

the plant or equipment controlled.

Typical labels shall include:

AHU-01 ISOLATOR
BOILER-01 ISOLATOR
GAS EMERGENCY SHUT-OFF
EMERGENCY LIGHTING TEST UNIT

Where equipment may be supplied from more than one source, suitable warning labels shall be provided.

20.5 Cable and Wiring Identification

All main and sub-main cables shall be permanently identified at both ends and at intermediate accessible locations where necessary.

Control and ELV cables shall be identified at both ends using permanent cable markers corresponding with the control schematics and terminal schedules.

Conductors within control panels shall be ferruled or otherwise permanently identified.

20.6 Containment Identification

Containment dedicated to specialist systems shall be identified where required, including:

- Fire alarm
- Emergency lighting
- Gas detection
- Controls
- Communications.

Identification shall be provided at suitable intervals and adjacent to changes in direction, penetrations and access points where necessary.

20.7 Warning Labels

Statutory and safety warning labels shall be provided as required, including:

- Electrical hazard warnings
- Multiple supply warnings
- Isolation notices.
- Emergency shutdown identification.
- Live equipment warnings.
- Warning of automatic operation or remote starting where applicable.

Labels shall comply with the relevant safety signage requirements.

21 **OPERATION & MAINTENANCE MANUALS**

21.1 **Introduction**

The Contractor shall include for provision of operation and maintenance manuals including "as-installed" drawings for issuing to the client upon completion of the works. The term operation maintenance manual shall be deemed to include all necessary maintenance and operating instructions and record drawings for the entire installation.

The manual shall be issued for approval at least one month in advance of the intended date of practical completion.

The Contractor shall hand over two hard copies and one electronic copy of the manual to the client and shall instruct the client's staff in the operation and maintenance of the various components forming the installation.

The operation and maintenance manual shall comprise one of more A4 lever arch ring binder files, endorsed with the project details and contractors name and address. Transparent cellophane envelopes / polypockets shall be provided to hold copies of the "As-installed" drawings and any other items which cannot be punched. Cardboard dividers shall be provided to separate the various sections of the manual. Each divider shall be neatly labelled.

The operations and maintenance manual shall be split into the following sections: -

- Index
- General description of the installation, equipment used and method of operation of the installation
- Handbooks, maintenance instructions, drawings and spare parts list for all components, plant and equipment used in the contract works
- Schedule of routine maintenance complete with routine grease points and recommended lubricants. Schedule of periodic and preventive maintenance
- Wiring diagrams of plant
- Manufacturer's Service Manuals for all specialised plant
- Schedules of equipment supplied giving names of manufacturers, serials numbers of plant, electrical supply and power rating, etc.
- Outline design data of plant
- Test and performance data
- Commissioning Certificates
- As-installed drawings.

21.2 **'As-installed' Drawings**

Throughout the contract the contractor shall keep on site a complete set of "up-to-date" prints marked up with "As-installed" details. These prints shall be available for use by the Architect or M&E Engineer.

As part of this contract, the contractor is requested to produce two full scale paper prints and a digitised copy presented on a compact disc (CD) of "As-installed" drawings. The digitised drawings shall be completed in the latest version of Autocad.

One paper print of all "As-installed" drawings shall be issued to the Engineer for approval of format and general content prior to the final issue. These prints for approval shall be sent to the Engineer in sufficient time to allow him 20 days for approving.

The use of Tender drawings shall not be permitted for a preparation/submission of "As-installed" drawings.

Upon completion of the contract, the contractor shall provide two sets of paper prints and a CD, containing the "As-installed" drawings, to the client as part of the overall O & M package.