DUB311

General Mechanical Specification

90% Design Stage – October 2015

Project Reference 14D\_102

Electrical Particular Specification

D311-ETH-ZZ-XX-SP-E-002

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23rd February 2022

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# Introduction

This Specification details the works associated with the Electrical building services installation for the new manufacturing facility at Unit 901 Kilshane Avenue in the North West Business Centre, Ballycoolin, Dublin for Amazon Web Services (AWS).

## Project Overview

The Amazon Web Services (AWS) project involves the construction of a new manufacturing facility at unit 901, Kilshane Avenue, North West Business Centre, Ballycoolin, Dublin.

Unit 901, also known as DUB311, is a new greenfield development. The building consists of the following.

* Ground Floor manufacture and test facility including inbound, detrash, packaging and shipping area.
* First Floor office level
* New Canteen located on First Floor

It should be noted that the building will be split in two to house two separate manufacturing vendors. The two halves of the building will be mirrors of each other with slight differences between the two halfs.

AWS will occupy a portion of the first floor offices.

Map

Description automatically generated

**Figure 1**– Site Location – Unit 901, Kilshane Avenue, North West Business Centre, Ballycoolin, Dublin

The scope of the project includes the electrical installation to both tenant and landlord areas for the total alterations to the total 206,560 sq ft building.

The document is to be read in conjunction with all other Contract Documents and relevant sections of the Mechanical & Electrical Documents as listed in the Document Issue Registers. The services design has been based on the developed architectural drawings produced by RKD Architects together with input from AWS, DKF and the rest of the design team.

Please refer to Architectural documentation and drawings for a more detailed description.

## Interpretation

This specification has been written using simple, direct language wherever possible. Imperative terms such as 'provide' and 'submit' mean that the Electrical Contractor shall 'provide' or 'submit' the relevant samples, documentation or information. If any discrepancies exist or there is any doubt about the interpretation of the Documents, obtain clarification from the Project Manager.

## Related Documents

This Specification shall be read in conjunction with all other Contract Documents and relevant sections of the Mechanical & Electrical Documents including M&E Technical Preliminaries as listed in the Document Issue Register.

## Pre Tender Requirements

Tenderers are invited to visit the site and obtain for themselves all information that may be necessary for the purposes of making a valid tender. Tenderers shall be deemed to have so visited the site before submitting a tender and to have obtained all necessary information as to risks, contingencies and circumstances which may affect or influence their tenders. If attendance to site is not possible due to current COVID 19 restrictions the tenderers are expected to raise RFI’s and issue to the Design Team to answer.

All drawings and specifications shall be read in conjunction with the Mechanical, Architectural, Civil/Structural Engineers, and Fire Consultants drawings and specifications. For clarity and to understand the clear demarcation line between the Shell & Core and fit out works the Parks Development drawings must be referenced.

This specification should be read in conjunction with the requirements set out in the Architects ‘Room Data/Layout Sheet’s’ and the Clients Performance Specification. Any discrepancies found or clarifications required should be brought to the attention of the Clients Engineer prior to tender return.

This specification shall be read in conjunction with all relevant Irish standards and codes of practice, IS 10101, Irish Building Regulations, Technical Guidance Documents to the Irish Building Regulations, and all the relevant laws of the Republic of Ireland. The requirements of these documents shall be fully adhered to by the Electrical Services Sub-Contractor in his execution of the subcontract works. In the event of there being any conflict between the requirements of this specification and any of the above-mentioned Irish Standard documents, the requirements of the Irish Standard documents shall prevail over those of this specification.

The Electrical Services Sub-Contractor shall pre-tender, giving adequate notice before taking any course of action, inform the architect or project manager of any such disagreement in the documentation. Adequate notice shall never be less than one week.

This specification shall be read in conjunction with the relevant drawings and form of tender pricing document. In the event of there being any conflict between the drawings, specifications and form of tender pricing document the Electrical Services Sub-Contractor shall allow for the most onerous option when submitting a tender.

The Electrical Services Sub-Contractor shall satisfy himself that the installation is in accordance with all codes and standards as set out in the General Electrical Specification.

All works described shall comply with:

1. Safety, Health and Welfare at Work Act, 2015.
2. Safety, Health and Welfare at Work (Construction) Regulations 2013.
3. Local Authority / County Council Bylaw’s
4. Fire Office direction or recommendations
5. National Building Regulations – Technical Guidance Documents
   * Particular reference is made to Part B and Part M.
6. IS 10101
7. IS 10101
8. I.S.3217:2013+A1:2017 Emergency lighting standard (2017 A1)
9. I.S.3218:2018+A1:2019 Fire detection and alarm standard (2019 A1)
10. I.S. EN 81 Lifts requirements
11. The ESB requirements
12. British Standards (where referenced in this document and in Fire safety report)
13. CIBSE Guides, Codes and Technical Memoranda
14. British Council for Offices Guide to Specification (latest edition)
15. Factories Act / Statutory Instruments.
16. Project Safety Protocol.
17. Project Specifications.
18. Tender Drawings.
19. Contract Preliminaries.
20. The Materials and Workmanship clauses – Electrical Services General Specification.
21. All relevant Irish, British and European Standards and Codes of Practice.

The Contractor shall familiarise himself with the above and the obligations therein.

# Engineering Services Design & Co-Ordination

## General

The Electrical sub-Contractor is responsible particularly for the detailed installation and co-ordination with other services and structures for the entire installation. The Electrical Sub-Contractor shall take the tendered design as produced by Ethos Engineering and develop the coordinated design as required to build the installation. Unless there are significant changes to the principals of the original design, the Electrical Sub-Contractor will take on board the changes that arise from client changes, architectural layout alterations etc. and incorporate them into their latest coordinated construction drawings. Ethos Engineering will not be revising/developing their tender design unless they deem it necessary and as deemed by the client.

## Design Requirements

The Electrical Sub-Contractor shall be responsible for the construction stage design necessary to complete the installation in accordance with the requirements of the Tender Drawings, Specification and Sub-Contract Documentation. Value engineering, alternative suppliers, or design changes must be costed as a variation to the base tender price (below the line). **Tender price to be based on the drawings and specifications as issued.**

Such detailed design and development shall be inclusive of, but not limited to, the following:

* Final Design & Coordination of all electrical services for installation and commissioning
* Production and Submission of all design calculations and technical submittals for review prior to ordering
* Selection of equipment and components in accordance with the requirements of the Tender Drawings and Specifications
* Checking of dimensions on site and preparation of builder’s work, installation and fabrication drawings
* Design associated with building services including secondary supplementary steelwork, access platforms and lifting equipment for maintenance purposes including loads imposed on the structure
* Design of test rigs as necessary to carry out the specified testing
* Design associated with temporary works not forming part of the final installation
* Final design of the BMS controls system will be completed by the Mechanical Sub-Contractor’s controls specialist.
* Preparation of method statements covering the whole of the Contract Works inclusive of, but not limited to off and on-site testing, inspection, installation, setting-to-work, testing and commissioning
* Preparation of Operating and Maintenance Manuals and As Built Drawings
* The supply and installation, including design, of all steelwork and plinths necessary for support of plant and services unless indicated otherwise on the Tender Drawings
* The provision and design of all necessary temporary facilities, commissioning, etc.
* The supply and installation, including design and adequate provisions for;
* Ensuring that all materials, equipment and components used, together with methods of installation, comply with Statutory Requirements.
* Making all applications, giving all notices and paying all fees required by and to comply with the provisions of the Statutory Requirements.
* Coordinating with local utility providers for the on-time installation of incoming utility services and coordinating and set-out of the final incoming services positions.
* Preparation of installation and record drawings for all of the electrical services.
* Power to mechanical equipment, refer to sprinkler and POD manufacturers details
* Engagement with ESB on incoming supply and switchgear settings to ensure discrimination between the ESB switchgear and the new LV switchgear
* Full discrimination to be achieved with final selection of switchgear. The electrical contractor shall confirm settings of each and every breaker to achieve full discrimination. Discrimination confirmation to be issued as part of a discrimination report as part of the technical submittal process.
* Containment for all cabling throughout the development
* Generator co-ordination with the building form including ventilation and flue exhaust system
* Switchboard assemblies including heat gain calculations
* Fire alarm panel battery sizing
* Lux level readings after the installation both internally and externally

## Engineering Services Co-ordination

The Electrical sub-Contractor is responsible particularly for:

1. Interpretation of Engineering System Contract Drawings.
2. Producing the drawings and information which are specified in their respective sub-contract preliminaries and obtaining Engineer's comments on the drawings.
3. Timely and adequate provision of general arrangement and installation drawings, samples, patterns and models, and setting out data, and thereafter co-ordination of the said drawings, data etc. to ensure the satisfactory placing of all Engineering Systems.
4. Day-by-day co-ordination of the site setting out and the sequence of operations to comply with the design requirements of the contract drawings.
5. Resolution of points or queries raised by the Architect or obtaining further instruction from the Architect or Project Supervisor where the point or query necessitates such reference being made.
6. Reporting on Engineering Systems works and progress at all meetings attended by the Architect, Consulting Services Engineers or any other representative of the Employers.
7. Ensuring the Engineering Systems are not damaged from premature installation and thereafter checking on the adequacy of measures to protect the works until approved.
8. Co-ordination of inspection, testing and commissioning of Engineering Systems with builder’s work to avoid damage to systems and to ensure that tests and commissioning are not abortive. A fully detailed installation and commissioning programme shall be provided in order that representative of the Employers, the Consulting Engineers, the Insurance Company can arrange to witness tests and commissioning as appropriate.
9. Ensuring that all Engineering Systems are properly tested, proven and signed off in accordance with the sub-contract preliminaries and specifications, prior to offering them for inspection by the Employers representative(s). The charge for time incurred by the Employers representative(s) in attending abortive tests will be made in accordance with the latest recommendation of the Institution of Engineers of Ireland.
10. Ensuring that record drawings, instruction manuals and test certificates are properly and promptly prepared in accordance with the requirements of their respective Engineering Systems preliminaries. This includes monitoring of the ongoing preparation of record drawings throughout the contract.
11. Co-ordination with the Works of other Contractors and attendance at meetings as may be required.
12. Provide schedule of coordinated drawings for approval by the design team.
    1. Co-ordination and Builder’s Work Drawings

The Electrical sub-Contractor shall include for producing dimensioned multi-disciplinary services layout and cross-sections for all areas of the building showing not only his plant and components but also builders work and other services relevant to or influenced by the electrical installations.

* + 1. Meetings

The Electrical sub-Contractor will attend Scheduled Service Progress Meetings and will provide at an early stage the following for approval:

* Schedule of Builders Work Requirements
* Schedule of Builders Work Drawings
* Schedule of Service Layout Drawings and Sections
* Schedule of Co-ordinated Drawings and Approvals
* Schedule, samples & benchmarking of “Visible Fittings” for Approval
  + 1. Lead Co-ordinator

The Electrical sub-Contractor will be required to issue all necessary information to the lead co-ordinator in sufficient time to allow him carry out his function efficiently.

* + 1. Issue of Drawings

Co-ordinated drawings shall be issued in duplicate format to the Architects, Quantity Surveyors, Services Engineer, Structural Engineer, for their comments and approval, at least six calendar weeks prior to the programmed formation on-site. Co-ordination drawings shall be issued as “For Construction” only upon receipt of comments by the above mentioned.

* + 1. Builder’s Work Drawings

The Electrical sub-Contractor shall prepare, in accordance with the agreed Construction programme, complete Builders Work Drawings associated with the installation of the services as indicated on the Consulting Engineers Drawings. Builders Work Drawings shall be detailed to the extent that the Main Contractor can accurately position form and trim all openings in the structure necessary for the installation of the Electrical Services.

* + 1. Drawing Scale and Schedule

Drawings provided by the Electrical sub-Contractor shall be drawn to a minimum scale of 1:50. The Electrical sub-Contractor shall submit a drawing schedule for review by the Engineers.

* + 1. Design Team Comments on Electrical sub-Contractor’s Drawings

Builders Work Drawings shall be issued in duplicate format to the Architect, Quantity Surveyor, Services Engineers and Structural Engineers for their review, (at least six calendar weeks) prior to forming opes on site. Builders Work Drawings shall not be issued to the Main Contractor unless formally commented on by the Design Team members as indicated above. Remedial of unnecessary formed openings resulting from same shall be at the expense of the Electrical sub-Contractor. Refer to M&E Preliminaries for submittals process.

* + 1. Co-ordination Costs

The Electrical sub-Contractor is deemed to have included all costs associated with co-ordination of each service and the building fabric. These costs shall be deemed to include all necessary containment offsets, re-routing, etc., and all containment offsets, etc. No claims for additional costs shall be accepted after receipt of tenders.

* + 1. Revision of Drawings

The Electrical sub-Contractor shall include for the on-going revision of co-ordination and builders work drawings for the duration of the contract. The Electrical sub-Contractor shall update their drawings within a week of a change occurring for the duration of the Contract.

* + 1. Mark Out of Opes

The Electrical sub-Contractor will Mark out opes and holes on all floor and wall surfaces as required to the satisfaction of Services Engineer, Structural Engineer and Main Contractor in sufficient time to allow the Main Contractor to complete his works to programme.

## Spare Parts

Spare parts shall be direct replacements of the same manufacture and quality as the original component, properly protected in the Manufacturer's original packing.

Spares and replacement consumables shall be clearly identified by a reference cross-indexed to a spares list within the Operation and Maintenance Instructions, identifying the equipment to which the spare refers.

The Electrical Services Installer shall provide a schedule of additional spare parts recommended by the manufacturers, together with their individual prices.

## Commissioning

### Inspection

Every installation shall, during erection and/or on completion and before being put into service, be inspected and tested to verify that all requirements have been met. Certification to IS requirements will be required for each phase of the works.

The following items should be covered by the inspection work. These include:

* Electrical connections
* Identification of conductors
* Safe routing of cables
* Conductors are selected in accordance with the design
* That single pole devices are connected in the phase conductor
* Correct connection of sockets
* Presence of fire barriers
* Appropriate insulation of conductors
* Presence of protective conductors
* Appropriate installation of conductors
* Danger notices and labelling of circuits
* Access to switchgear adequate
* Fuse links should be checked to ensure they are of the correct rating to protect the circuit cables that they control.

### Testing

Certification to show that the following tests have been performed will form part of the final documentation.

The tests will comprise of the following:

* Continuity of protective conductors (including main and supplementary equipotential bonding conductors).
* Continuity of ring final circuit conductors including protective conductors.
* Insulation resistance (between live conductors and between each live conductor and earth).
* Polarity, this includes checks that single pole control and protective devices are connected in the phase conductor only.
* Earth fault loop impedance.
* Earth electrode resistance.
* Functional testing (including RCDs).

All electrical circuits shall be tested in accordance with the ETCI National Wiring Rules.

The fire alarm shall be tested in accordance with IS 3218:2018.

The emergency lighting shall be tested in accordance with IS 3217:2013.

The earth electrode system shall be tested and the impedance to earth of the main earth bar in the LV switch rooms measured.

### Labelling

All distribution boards will be suitably labelled with a 100mm x 60mm trafolyte labels. The label (red label black text) will indicate:

* Distribution board drawing reference e.g. DB/G/1.
* The voltage rating of the distribution board.
* The size of the feeder cable to the boards and the origin of the feeder cables.

All cables will be labelled at its origin and its final termination point. The cable label will include the following information – the size and type of the cable, the cables distribution board reference and the final destination for the cable. The label will be attracted to the cable with cable ties. All protective devices shall be clearly labelled so that the circuit being protected may be easily recognised. The main switchboard will also be clearly labelled. The label will consist of a 100 x 60mm white trafolyte with black text. The label will clearly indicate the purpose of the switchgear units.

All isolators shall be clearly labelled to indicate their specific purpose. The voltage rating of each isolator will also be indicated.

## Post-Occupancy Maintenance

Contractor is to allow for a 12 Months Post Occupancy Maintenance for all M&E systems installed. This shall be highlighted in the tender returns. The ‘12 months shall start from day of handover.

## Operation and Maintenance Manuals

All operation and maintenance manuals along with their associated record drawings shall be prepared in accordance with the requirements of BSRIA document AG1/87 Operating and Maintenance Manuals for Building Services Installations.

3No. hard copies and 3No. soft copies (memory sticks) of the final approved O&M documentation will be required.

* 1. BCAR Compliance

The main contractor shall nominate a dedicated BCAR Coordinator as part of their team.

The individual’s CV shall be submitted and shall demonstrate that the individual has performed this duty on other comparative size projects and has received appropriate training and has the required knowledge to perform this role.

The BCAR coordinator shall have responsibility for performing the following duties;

* Liaise regularly and throughout the duration of the project with the Assigned Certifier.
* Attend all main Site Progress Meetings which may be conducted each week or at two-week intervals at the requirement of the contract administrator.
* Attend monthly dedicated BCAR coordination meeting which will be convened and chaired by the Assigned Certifier.
* Produce and maintain regularly the following BCAR documentation trackers and records.

**Ancillary Certification (Main and Sub-Contractor) Tracker**

This will track the Main Contractor and all Sub-Contractor Ancillary Certification required.

The BCAR coordinator shall be responsible for drafting up relevant proforma Ancillary Certification for all specialist and non-specialist sub-contractors and have these attached to each relevant subcontractor’s contract.

The BCAR coordinator shall procure, at the appropriate time, the relevant Ancillary Certification from each subcontractor.

**Ancillary Certifier (Main and Sub-Contractor) Live Inspection Reports Tracker**

This will track all Main Contractor and Sub-Contractor Inspections and Inspection Reports.

The BCAR coordinator shall be responsible for procuring Inspections Plans from the Main Contractor and all Specialist Subcontractors. For avoidance of doubt Specialist Subcontractors are those lists of subcontractors that are required to provide and execute co-lateral warranties/agreements as set out in the contract.

The BCAR coordinator shall be responsible for ensuring the main contractor and all specialist subcontractors carry out their inspections as set out and planned on their respective Inspections Plans.

An Inspection Report shall be prepared following each inspection by the main contractor or specialist subcontractor and issued to the BCAR coordinator.

**Main contractor and specialist subcontractor site inspections – Contractor Actions Trackers**

The BCAR coordinator shall be responsible for maintaining this tracker. This tracker will record all **‘contractor actions’** as highlighted in all**main contractor and specialist subcontractor** inspection reports. The **main contractor and specialist subcontractor** will be instructed by the assigned certifier to highlight clearly in their respective inspection reports those items that require action by them or the main contractor- **‘contractor actions’**. All other matters noted in the inspection’s reports may be regarded by the main contractor as commentary on progress.

Contractor actions are extracted from the main contractor and specialist subcontractor inspection reports and placed on this tracker for action by the BCAR coordinator. The BCAR coordinator will be responsible for ensuring that such contractor actions are attended to and closed out in a timely manner and recorded as such.

**Design team site inspections – Contractor Actions Trackers**

The BCAR coordinator shall be responsible for maintaining this tracker. This tracker will record all **‘contractor actions’** as highlighted in all **design team** inspection reports. The design team will be instructed by the assigned certifier to highlight clearly in their respective inspection reports those items that require action by the main contractor -**‘contractor actions’**. All other matters noted in the inspection’s reports may be regarded by the main contractor as commentary on progress.

Contractor actions are extracted from the design team inspection reports and placed on this tracker for action by the BCAR coordinator. The BCAR coordinator will be responsible for ensuring that such contractor actions are attended to and closed out in a timely manner and recorded as such.

**Materials Certification Tracker**

This Tracker to be maintained by the BCAR coordinator and will track and record all Specific Product certification including CE, or equivalent certification and DOP where available all as per Part D of the Building Regulations which are to be obtained for all materials used on the project.

Consideration will be given to this being undertaken as appropriate by both the main contractor and each subcontractor and supervised and reviewed by the BCAR coordinator.

The BCAR coordinator shall be responsible for ensuring that a CE cert / DOP should be the first part of any main contractor and subcontractor Technical Submission.

**Testing and Commissioning Tracker**

The BCAR coordinator shall be responsible for assembling and maintaining this tracker. The BCAR coordinator shall examine all design team performance specifications and extract any testing and commissioning requirement and insert same into the above tracker and identify an appropriate time for the carrying out of any testing or commissioning and give timely notification of any testing or commissioning to the relevant designer ahead of the testing or commissioning taking place.

This tracker shall record the results and outcomes of all testing and commissioning.

***Proforma versions of all the above referenced trackers shall be submitted with the Main Contractors Tender.***

# Operation & Maintenance Manuals

All operation & maintenance manuals along with their associated record drawings shall be prepared in accordance with the requirements of BSRIA document 1/2007 Handover, O&M Manuals,and Project Feedback for Building Services Installations.

The electrical Contractor shall include for 3No. hard copies and 6No. memory disks/soft copies of the final approved O&M documentation including all drawings in an AutoCAD and pdf Format. The contractor shall also allow for issuing all information to an online O&M Management system should one be employed for this project.

The Contractor shall provide complete record drawings and O&M Manuals in sufficient detail to enable the Employer to carry out proper maintenance. To facilitate submission of record drawings, the Contractor shall keep on site a complete set of all drawings used on the Contract Works, on which he shall mark alterations to the designs shown thereon as such alterations are carried out.

THIS PROCEDURE SHALL BE STRICTLY ADHERED TO.

The manuals must therefore contain all necessary technical information on each item of equipment and the associated components which have been used to assemble and construct the system(s).

In addition, manuals for each system must contain information on the design intent of the system, commissioning and testing results and reports of how the components of the system are adjusted to achieve the design intent, line diagrams to show how the system is arranged in the building giving the location of all equipment and components, its control system, how the system must be set in the normal operating mode and in the event of any emergency, routine check that must be made and a list of spares which should be kept and a list of any special tools which may be required.

The manuals must be prepared in such a way that an Engineer without any previous knowledge of the Project may use them to operate and maintain the system.

## Contents of Manual

The Operating and Maintenance Manual shall be specific in respect of the complete Contract Works and shall include the following sections.

* Section 1 Description
* Section 2 Plant and Engineering Systems
* Section 3 Building Management System
* Section 4 Operating and Maintenance Procedures
* Section 5 Commissioning and Testing

#### Section 1 – Description

This section shall comprise of:

1. A detailed description of each building services system.
2. General description of all equipment.
3. A detailed description of the control system.
4. Design data for the system and for each item of equipment.

#### Section 2 - Plant and Engineering Systems.

This section shall comprise of:

1. Detailed technical information as published.
2. Manufacturers drawings (where applicable) showing all components of the equipment with each component number in accordance with the parts list.
3. Parts list for each piece of equipment.
4. Name plate details for each plant item e.g. generator.
5. Manufacturer’s addresses and telephone numbers.
6. Complete instructions for ordering replacement parts in a manner that will prevent errors or misunderstanding.
7. Installation instructions as provided by manufacturer.
8. Details of cabling and power distribution materials (LV & ELV).
9. Colour coding identification schedule for each building services system.
10. Electrical schematics for whole system including installed equipment ratings

#### Section 3 – Building Management System

This section shall comprise of:

1. Wiring diagrams of control panels and external wiring from panel to control etc.
2. A line diagram showing positions of all equipment.
3. Parts list for each different type of control device.
4. Manufacturer’s addresses and telephone numbers.
5. Complete instructions for ordering replacement parts in a manner that will prevent errors or misunderstanding, including order number for each component item.
6. Installation instructions as provided by manufacturers.

#### Section 4 - Operating & Maintenance Procedures

This section shall comprise of:

1. A step-by-step method of starting, operating and shutting down a system and how this affects other systems. The procedure for an emergency shut-down.
2. A list of routine checks that should be made and the frequency of the checks.
3. A comprehensive schedule of routine maintenance based on Manufacturer’s recommendations for items of plant etc. This program should state clearly what work should be done each day, week, month, and year or given number of hours.
4. A list of tools and keys which will be required in the operation and maintenance of the systems.
5. Fault Finding procedures noted for logical diagnosis and correction of faults.

#### Section 5 - Commissioning & Testing Report

The report for each system shall contain a record of all the parameters which affect the performance of the system at the time of commissioning. A similar report shall be prepared for tests which have been made. The report shall be comprehensive and shall contain a record of the settings of all controls and any other adjustable components so that the system may be reset to the commissioned state by reference to the report.

# LEED Requirements

LEED certification is not sought for this project.

# Installation

## Design Philosophy

The design philosophy is to provide engineering solutions for the mechanical and electrical services engineering installations, which ensure the various spaces are adequately serviced in line with specific client requirements, CIBSE guidelines, building regulations and national and European standards and to provide an ease of maintenance and simplicity in operation.

There is an equal commitment in providing design solutions to reduce the overall energy consumption of the building. Energy efficient design will be incorporated as part of the mechanical and electrical engineering services installations.

The mechanical and electrical engineering services shall be fully integrated with the architectural and structural design and layouts and other specialist installations.

### Leadership in Energy & Environmental (LEED)

The office building is targeting a platinum standard under LEED v4 (Office). The electrical contractor shall refer to the LEED list of targeted credits and include for any items required. Main items will be included within this specification include metering, light pollution. However, the contractor shall be explicitly aware of all the requirements for each credit, and produce records where necessary to release the credits i.e. as builds / commissioning results etc. Compliance with ASHRAE 90.1 is required for some credits. The electrical contractor shall be required to assign a ‘LEED Champion’ within their team to manage and track the credits being targeted as well as gathering the relevant credit evidence requirements.

### Description of Works and Phasing

The works to be completed as part of this contract is summarised as but not limited to the following:

* Installation of a new indoor ESB substation
* New MV distribution switchgear
* New cast resin transformers
* New main LV switchgear
* New authority and house metering
* New tenant generator
* New electrical containment systems as indicated on the electrical containment drawings.
* New installation of general services as indicated on the electrical general services & power drawings
* New electric vehicle charging points
* New e-bike charging points
* New artificial lighting installation, internal and external fittings
* New computer based central addressable DALI Lighting Control system for all light fittings, internal and external
* New self-contained addressable emergency lighting system.
* New addressable fire alarm system
* New disabled toilet alarm system
* New disabled refuge alarm system
* New lightning protection, earthing and equipotential bonding.

## Electrical Supply

### ESB supply

The electrical contractor is responsible for liasing with the ESB for installation of a new ESB substation. The electrical contractor is responsible for all correspondence, liaising, meetings, co-ordination, phasing, materials etc that is required for making live of the permanent substation on site. The incoming supply shall be underground from the network in the street.

### MV & LV Supplies

The power supply to the development will be as follows:

External Works and EV Charging – LV Connection from ESB Substation

Vendor 1 – MV Connection from ESB Substation

Vendor 2 – MV Connection from ESB Substation

The MV connections will be terminated into new client transformer rooms located on ground and first floor of the building. The southern half of the building shall be supplied with power from the First Floor electrical room and the northern half of the building shall be supplied from the Ground Floor. This supply shall be metered at MV and supply all internal areas. The electrical contractor is responsible for all co-ordination required with ESB metering of the landlord MV supply.

The LV supply for the external areas and EV charging shall be metered at the main LV panel located in the consumer LV room next to the ESB substation.

The electrical contractor is responsible for all co-ordination required with ESB metering of the LV supply.

### Sub Distribution Boards

The Electrical Sub-Contractor shall supply, install, test & commission the all sub-distribution boards as indicated on the drawings. All sub-distribution boards are to be in accordance with I.S.EN 61439 and of metal construction.

The new main LV Switchboards will house the main landlord and tenant power supplies. These switchboards will be designed as Form 4 construction. The main LV distribution boards will incorporate the MV/LV transformer and shall be divided into sections for the UPS and Generator supplies, as detailed on the schematic diagrams.

The approved suppliers of the distribution boards are:

* Davenham Switchgear
* M&L Manufacturing

### Essential – Non Essential Change-Over Panel

The change-over shall form part of the main LV switchboard.

In the event of mains failure within the building, this change over panel shall switch the supply feeding the essential services sub-distribution panel over to the backup generator.

### RTU Distribution Units

The RTU distribution units shall be provided in accordance with the AWS requirements for the system detailed in Appendix 6 of this document.

### Power Meters

### Scope

Provide labour, material, equipment, related services, and supervision required, including, but not limited to, manufacturing, fabrication, erection, and installation for power meter devices in energy cost management applications as required for the complete performance of the work, and as shown on the drawings and as herein specified. The power meters shall be wired to the BMS system to the information can be recorded and logged on the BMS system to obtain information such as MIC, Voltage, Amps, Power Factor, kVar, kW, kVA, phases etc.

### Applicable products

The present specification applies to power meter devices from 110V to 690V direct connect or up to 1MV with potential transformers in different system configurations from single phase to three phase AC (50Hz).

The power meters shall be included as part of this project and identified on the single-line drawings shall be capable of the below:

* CTs with Accuracy Class 1 where CTs are employed as part of the power metering
* Monitoring with the features to include B2 plus serial and dual Ethernet communication, 8-rate multi tariff, up to 63rd Individual harmonics, 4 digital inputs, 2 solid state outputs, 52 alarms events, 4 current transformer inputs and on-board logging memory.

The contractor shall refer to the requirements with regards to meter capability as required by the LEED specification.

### Surge Protection System

### General

A Surge Protection System shall be installed to protect the installation from the effects of lightning surges and transient over voltage surges.

The system shall be graded from the main switchboard to the distribution boards so as to limit the let through energy to a suitable level for the equipment to be protected. The clamping voltage of the devices shall be matched to suit the equipment to be protected.

To provide coordinated overvoltage suppression, all switchboards & panelboards (landlord & tenant) shall have SPDs installed.

At main switchboards (MSB) incorporating a MEN, surge currents may be conducted to earth.

Main distribution and downstream distribution boards (DB) shall install Silicon Avalanche Suppressor Diodes (SASD) with conduction to Neutral.

Wire the fault alarm outputs to the power monitoring system (PMS).

### Selection of Approriate Devices

In keeping with the assessed and identified risks and based strictly on the risk assessment procedures as outlined within I.S. EN 62305-2, the following SPD types will be necessary for this project, to ensure that the calculated risks are protected against and final certification to I.S. EN 62305:2012 is achieved. Please refer to IEC 61643-12 which confirms the need for the following:

The SPD types determined necessary to achieve the required “R1” and “R2” (to include “R1”-“Rd” , “R1”-“Ri” & “R2”-“Rd”, “R2”-“Ri”) protection to the LV distribution system should be confirmed to be enhanced, full and differential mode (enhanced low let-through voltage in all modes of protection), Class I, II & III, with a manufacturer certified maximum of 600v let-through (“Up” <600v) in all modes of protection. The SPD’s should also include remote monitoring contacts for BMS interface where required.

### SPD TYPES AND LOCATIONS:

1. MDB location - ESP E415M2, with LED indication showing protection status in all modes.

1. SDB's and MCC's - ESP E415D1, with LED indication showing protection status in all modes.
2. Single Phase Consumer Units and SDB’s (where required) – ESP 240D1, with LED indication showing protection status in all modes.
3. Roof mounted AHU's etc - ESP E415D1, with LED indication showing protection status in all modes.
4. For any additional unlisted services, the installation of “enhanced ESP units” , with performance characteristics to be matched to actual site installed conductive services such as, Satellite equipment, Field control devices, BMS system lines, Network cable services etc, will ensure that the required protection is achieved.

These ELV surge protectors need to be selected as “enhanced ESP units” and matched to the actual characteristics of the ELV by the specialist.

The above SPD units will ensure that the appropriate and safe protection levels required by I.S. EN 62305:2012 & NSAI I.S. 10101:2020 are achieved and certified upon completion of the installation.

### Standards and Regulations

The following standards shall apply:

|  |  |
| --- | --- |
| IS EN 62305 | Protection against Lightning. |
| IS EN 61439 | Surge Protective Devices Connected To Low-Voltage Power Distribution Systems |
| IEC 61643-11 | Surge Protective Devices Connected to Low-Voltage Power Distribution Systems, Part 11: Performance Requirements And Testing Methods |
| IEEE C62.41 | Recommended Practice For Surge Voltages in LV AC Power Circuits. |
| IEEE C62.45 | Guide On Surge Testing For Equipment Connected To LV AC Power Circuits. |
| UL 1449 | Fire and safety for TVSS (SPD) Surge Protection Devices. |
|  |  |

### Overload Protection

**Short-circuit protective devices and isolators:** In line overload protection to each SPD with a 63A at main switchboard or a 20A at distribution boards, using a suitably fault-rated circuit breaker or fuse isolator.

**Cables:** Maximum length between main circuit supply active and associated fuse, isolator, arrestor, neutral and earth conductor connections including MEN link: 1m.

**Installation:** Keep cables as short and straight as practicable. Line and Load side separated 300mm apart. Segregate from 400V/230V wiring by a minimum distance of 50mm and in corrugated conduit.

**Minimum cable size:** 10mm2 copper for 20A SASD SPD and 25mm2 copper for 63A SASD SPD.

### Performance Parameters Tested

SASD SPD shall be tested to the following performance parameters:

* Maximum continuous operating voltage shall be 280VAC Line to Neutral.

Voltage Protection Level (Up) shall not exceed 850V when tested to Class II at 5kA per IEC 61643-11

* Voltage Protection Level (Up) shall not exceed 800V when tested to Class III at 5kA
* Uoc = 10kV when tested to IEC61643-11 and during Class III tests
* Longwave 10/1000 s at 250A as per IEEE C62.41.2 and C62.45.

Provide suitable surge diverters, to all switchboards, on each phase of the switchboards, incorporating the following features:

* SPD shall be annunciated via front mechanical or LED indicator, visible on the front of the switchboard
* fitted with voltage free contacts for transmission of remote alarm. Alarm relay with contacts rated to at least 230VAC and 0.5A
* Marking shall be consistent with IEC 61643-1.
* Manufacturer: Transtector or equal approved.

Installation shall be in accordance with the manufacturers requirements.

### Spare Ways and Spare Space

30% spare capacity shall be included in all assemblies (even when not indicated on schematic drawings). Spare ways shall be fully fitted out complete with functional units and all equipment necessary to bring the spare way into service.

For planning purposes, the cable sizes for spare ways shall be assumed to be equal to the largest size cable indicated for functional units of the same rating in the assembly or the next larger size cable to that cable size required to carry the full current of the functional unit concerned whichever is larger.

Where spare space for additional functional units is specified, it should be understood that space only for future installation of apparatus is required. However, modification to existing functional units, busbars, cables etc. should not be required. Where Class 3 assemblies with spare space are specified, the relevant sub-sections shall be fitted with doors, partitions and busbars tap-off units incoming and outgoing socket connections and guide rails shall be fitted. Sub-sections designated spare space shall have live connections fully shrouded to IP20.

All switches shall be fitted with suitably inscribed laminated plates. All switch operating handles shall be fixed to equipment to avoid loss of handles when doors are opened etc.

### PLC Control System

It is a requirement of this contract that a PLC control system shall be included in the Assembly Line distribution boards as well as in the R&S distribution board.

The PLC control system shall communicate over an RS485 network.

The purpose of the control system is to disconnect circuit breaker in the event of the demand on the system being more than the capability of the system.

The thresholds for the settings will be provided to the successful bidder.

The manufacturer of the distribution boards shall allow for all required power supplies, fuses, relays and contactors to allow for the successful operation of the system.

The manufacturer shall provide to the engineer a complete programming philosophy in Ladder Logic or other EN/IEC mandated programming language for approval prior to commissioning of the system.

### Factory Testing

All major main switchboards shall be tested in accordance with the applicable parts of IS EN 61439, and NSAI Code of Practice for low voltage switchgear. All instrumentation and controls functions shall be tested to prove their correct operation. The set points for adjustable devices, such as sensing relays, shall be recorded on test results and additionally marked within the switchboard, with adjustment points sealed to prevent movement and unauthorised tampering. Calibrated instruments shall be used for all tests.

Results of all tests including dielectric strength, and the instruments used to conduct tests, shall be recorded and a copy provided within the operation and maintenance manual. Where initial tests are unsuccessful, the results of these tests together with the corrective measures taken shall also be provided. All test results shall be signed and dated.

Upon completion of construction of the main switchboard and Authority inspections, where required, and prior to the switchboard being shipped to site, arrange for pre-delivery inspections of the switchboard at the factory.

Proposed commissioning test schedules and protocols shall be submitted for approval in conjunction with shop drawings. Protocols shall be fully detailed and include, but not be limited to, schedules in tabulated format covering:

* proposed calibrated and where permissible non calibrated, instruments to be used and the tests for which each shall be used
* functioning of all switchgear to confirm correct and uninhibited operations over all phases
* injection tests for all meters with 0%, 50% and 100% of full scale readings
* confirmation of all derived metered values, such as hours run, kWh, Power Factor, kVA, etc
* set points for all adjustable devices such as sensing relays, timers and the like
* function of all control circuits with all inputs and outputs for simulation listed, detailing the specified response and with space for recording the actual response
* functioning of all monitoring points provided either for immediate or future connection to internal or external systems
* other functional requirements where specified
* space on each page for signature and date of witness tests

Factory testing of controls shall be accomplished using a purpose made and labelled test panel with all required inputs simulated by the operation of switches, and all required outputs indicated by lamps, or an equal arrangement as approved.

Factory testing shall include the demonstration of monitoring systems specified as part of this contract, in conjunction with metering, controls and function testing detailed above.

Once testing has been completed, factory test results shall be verified and submitted for approval. Following that approval a witness test shall be arranged with the Engineer. One weeks notice should be allowed for the arrangement of witness testing.

### Site Testing

Upon completion of the installation, complete testing of all switchboard controls with all internal and external interfaces and controls connected and operational to confirm their functionality. Retest any functions requiring rewiring adjustment or modification.

Co-ordinate with other trades and arrange for all trades to be present to verify the operations of all external controls and monitoring.

Submit signed test results in an approved format confirming the completion of these test, prior to arranging witness testing by the Engineer.

### Thermographic Survey

Arrange for a thermographic survey of all busbar, equipment and cable joints and connections within the major purpose switchboards by an approved independent thermographic survey company prior to practical completion and also prior to the expiry of the defects liability period.

The dates of the survey shall be agreed and shall be conducted when electrical supply and loads are connected, i.e., during normal operation periods of the building with all available and building load connected and whilst under maximum load.

Record the results of each survey and submit a detailed report including ambient temperature, loads, photographs and thermograms for each item being surveyed.

Rectify all joints and connections indicated as requiring attention and undertake new thermograms to prove the effectiveness of the remedial work prior to submitting final results.

## Backup Generator

Two new backup diesel generators of 3000kW each will be provided complete with a proprietary base bunded oil storage tank to operate the generator. The generator shall be provided in a walk in containerised enclosure with diesel belly tank. The generator shall back up the entire power supply to the building. The belly tank shall be sufficient for 48 hours continuous operation at 75% load.

A new twin wall stainless steel flue is to be routed to parapet level and shall be supported off the canopy. A separate flue structure will not be provided.

The generator will be alarmed on the landlord BMS system for status and common fault. A new remote alarm mimic panel is to be provided by the electrical contractor to relay the following alarms: the panel shall be located in the main reception area;

* Generator common fault
* Generator running
* Low fuel level
* High fuel level
* Leak detection

Contractor to provide confirmation that there is no impact to tripping time on protective devices based on the X”d% alternator values of the submitted genset.

### Scope

This specification covers the requirements for the following:

1. Supply, installation and commissioning of 2No. emergency diesel generators. The diesel generators shall be designed to operate under the following environmental conditions:

Ambient Temperature : +40o max. -20o min. 30o average over 24 hrs.

Relative Humidity : 50% at +30o C max.

Altitude : Below 1000m.

Location : External between Unit 901 and Unit 900

### Standards and codes

The diesel generator shall comply with the latest editions of the following standards:

* + - * EU directives 89/392/EU, 91/368/EU and 93/44/EU .
      * National Standards Authority of Ireland (NSAI) Standards.
      * Safety, Health and Welfare at Work Regulations 1993 (SI No. 44 of 1993).
      * British Standards.
      * IEC Standards.
      * Requirements of the local Fire Services Department.
      * BS 7698/ISO8528 G2.
      * EU directives 89/392/EU, 91/368/EU and 93/44/EU. .
      * Safety, Health and Welfare at Work Regulations 1993 (SI No. 44 of 1993).
      * BS 4999-0.
      * BS EN IEC 60034-5.
      * BS 4999-140.
      * BS 4999-142.
      * BS EN ISO 3046-1
      * BS ISO 8528-1 to 6.
      * BS ISO 8528 – 9 & 10.
      * BS EN IEC 60034-1.
      * BS EN IEC 60034-1.
      * BS EN IEC 60034-22.
      * ISO 12000.
      * BS EN 953.
      * BS EN12601.
      * BS EN 61000-6-3 & -4.
      * BS EN 61000-1 & -2.
      * BS EN 60204-1.
      * BS EN 60439-1.
      * BS EN60529.
      * IEC Standards.
      * Requirements of the local Fire Services Department.
      * EU Stage 2 emissions per European Community Directive 2000/14/EC

### Ratings

The generator set shall comply with the following requirements.

3000kW continuous output, at 0.8 p.f. to ISO8528 LTP.

Nominal output voltage – 400/230V.

Phases – 3 phase, 4 wire.

Frequency – 50 Hertz.

Connection – Star.

### Noise

The generator shall be supplied in a sound attenuated, walk in enclosure. The attenuators should reduce the noise to 75dBA at 1m from the enclosure while the generator is running at 100% load.

### Engine

**General**

The diesel engine shall be manufactured by **Perkins, Cummins or Caterpillar** to comply with BS5514.

**Governor**

The governor shall be of the **electronic type** and meet the accuracy requirements of class A1 to BS5514.

**Electrical System**

The engine shall be supplied with energised to run shutdown solenoid for fail safe operation. Oil pressure switches and water temperature switches. Oil pressure and water temperature senders shall be supplied.

**Cooling Radiator**

The radiator and cooling fan shall be complete with protection guards, designed to cool engine at specified output in air-on temperatures up to 40 degrees Celsius. A low coolant level alarm shall be fitted.

**Engine Filtration System**

Cartridge type dry air filters, cartridge type fuel filters and full flow lube oil filters shall be supplied.

**Exhaust System**

A heavy duty capacity exhaust silencer system shall be supplied to reduce the noise level as per specification.

**Electric System**

A 24 volt system with battery charging alternator and axial type starter motor shall be supplied. High capacity lead acid starting batteries, battery rack mounted in machine baseframe and heavy duty interconnecting cables with terminations shall be supplied.

### Alternator

**General**

The alternator shall be manufactured by FG Wilson and shall be brushless, screen protected and drip-proof, **separately excited by means of a** **separate winding or permanent magnet,** self regulating with fully interconnected damper windings and sealed-for-life bearings.

**Insulation system**

The insulation system is Class H. All windings are impregnated in either a triple dip thermo-setting moisture, oil and acid resisting polyester varnish or vacuum pressure impregnated with a special polyester resin. A heavy coat of anti-tracking varnish for additional protection against moisture or condensation shall be included.

**Electrical Characteristics**

The alternator shall be in accordance with BS5000 part 99, IEC34-1, VDE0530, UTE51100, NEMW MG-122.

**Automatic Voltage Regulator**

The fully sealed automatic voltage regulator shall monitor all **three phases** and maintain the voltage within the limits of **+/- 0.5%** from no load to full load including cold to hot variations at any power factor between 0.8 lagging and unity and inclusive of speed variation of 4.5%.

Nominal adjustment by means of a trimmer incorporated in the AVR shall be included.

**Waveform Distortion, THF and TIF Factors**

The total distortion of the voltage waveform with open circuit between phases or phase and neutral shall be in the order of 2. On a 3 phase balanced harmonic-free load the total distortion shall be in the order of 3.5%. The alternator shall be designed to have a THF better that 2% and a TIF better than 50. The alternator shall have a **2/3 pitch factor.**

**Radio Interference**

Suppression shall be in line with the provisions of BS800 and BDE class G and N.

**Motor Starting**

An overload capacity equivalent to 300% of full load impedance at zero power factor shall be sustained for 10 seconds.

### Mounting Arrangement - Safety Features

**Baseframe**

The complete generator shall be mounted, as a whole, on a heavy duty fabricated and welded steel baseframe constructed from folded channel sections. The baseframe shall incorporate specially designed crane lifting devices.

**Coupling**

The engine and alternator shall be directly coupled by means of an SAE flange so that there is no possibility of misalignment after prolonged use. The engine flywheel shall be flexibly coupled to the alternator rotor and a full torsional analysis has been carried out to guarantee no harmful vibration will occur in the assembly.

**Anti-Vibration Mounting Pads**

Anti-vibration pads shall be supplied.

### Doubled Skinned Fuel Tank

A fuel tank with a capacity for minimum of 48 hours operation at 75% load shall be provided below the walk in enclosure. Leak detection shall be provided by means of a float switch in the outer tank. The tank shall be supplied complete with high and low level contacts, contents indication, fuel fill cap with breather and strainer, fuel feed and return lines to engine and drain plug. All alarms shall be relayed to both BMS system and also to a remote alarm (location to be agreed).

### Load Banking

The generator shall be delivered to site complete a second MCCB within the room to allow for load bank connection. This MCCB shall have a shunt trip function that would be operated when the genset control panel receives a remote start signal for mains failure operation. A DCP10 / 20 module shall be utilized to accommodate the transfer to load banking function. Load bank connections shall be by means of suitably rated sockets.

### Control System

**General**

The control panel shall be for set mounting and shall contain the means of starting and stopping generator, monitoring its operation and output, and automatically shutting it down in the event of a critical condition arising such as a low oil pressure or high engine coolant temperature. A remote alarm display panel shall also be provided as part of the system. The location of this panel is to be agreed and shall display all alarms that the main panel provides including generator running and generator stand-by displays. This panel will be supplied by the generator specialist.

**Digital Automatic Start Control Panel.**

**Control panel shall contain the following:**

Shutdown and alarms Channels: - low oil pressure.

- failed to start.

- high coolant temp.

- overspeed.

Alarm channels only: - approaching low oil pressure

- approaching high coolant temp.

- low battery voltage.

- battery charger failure.

- system not in auto mode.

Fault logging: - full fault log memory.

Remote signals: - common voltage free alarm contact

- open protocol communication interface

Instrumentation: - start attempt counter

- voltmeter.

- ammeter.

- kilowatt meter

- kilovar meter

- power factor meter

- frequency meter.

- battery voltmeter.

- hours run counter.

- oil pressure gauge.

- coolant temp. gauge.

Control switches: - run-off-auto switch.

- emergency stop button.

**Remote Monitoring by means of Open Protocol Communication Interface**

The control panel shall be equipped with an open protocol communication interface **RS-422 and** **RS-485.**

Full details shall be supplied at the time of tender.

**Circuit Breaker**

A 3 pole moulded case circuit breaker shall be mounted on the generator in a vibration isolated sheet steel cubicle with adequate access for incoming and outgoing cables.

### Documentation

A full set of operation and maintenance manuals, circuit wiring diagrams, commissioning/fault finding instruction leaflets shall be supplied.

### General Arrangement

The generator shall be designed and constructed for installation in a weatherproof enclosure for outdoor location.

### Factory Tests

The generator set shall be load tested before despatch. All faults, control functions and site load conditions shall be simulated and the generator and its systems checked and proved. A test certificate shall be provided.

### Installation

The installation shall consist of the following:

It should be noted that the generator room has restricted access due to its location. The contractor shall include for all additional rigging manpower & equipment required to place the generator in the proposed location. The contractor must also prove that the generator has an access route for maintainece and replacement in the future.

**Delivery / Off-loading:**

* Delivery to site with the canopies disassembled if necessary
* Off-loading and crane hire as required.
* Assembly and setting into position within the designated generator area.
* Provision of a full tank of fuel on hand over of the project

**Ventilation:**

* Supply and install ductwork between the generator canopy and the air outlet grill to insure there is no recirculation of hot discharge air onto the canopy air inlet.

**Commissioning:**

* Supply and install:
* Lubricating oil in the engine sump.
* Anti-freeze and coolant to the engine cooling system.
* Battery acid in the starting batteries (supplied dry charged).
* Connect starting batteries.

**Testing:**

* Carrying out of a full operational check on the installation.
* Carrying out of a load test with mobile resistive load bank.
* Carrying out a comprehensive engine safety shutdown.
* Carrying out a detailed client instruction.

### Service and Warranty

* + All equipment shall be guaranteed for a period of 24 months from date of commissioning.
  + Generator supply should include for a comprehensive maintenance contract for the full warranty period.

### Approved Suppliers

* + Cummins
  + Finning

## Power Distribution & Wiring

### General

A mixture of cable ladder and tray will provide routeways for all LV and ELV cabling throughout the building. All sub main cabling from the tenant switchroom adjacent to the ESB substation will be routed through the Lower Ground and Ground floor areas as indicated on the drawings to the specified tenant electrical service riser. Vertical containment will be installed in each electrical service riser to provide routeways to each floor including the roof. High level and low level containment will be installed on each floor to cater for landlord and tenant cabling requirements. Please refer to containment drawings for sizes, quantities and location of all cable containment.

The Electrical sub-Contractor shall supply and install all distribution and wiring systems and equipment as described here and as indicated on the drawings. All cabling used on the project shall be rated at a minimum CPR Class Dca-s2,d2,a2 throughout.

Electrical distribution shall comprise of sub-distribution wiring of all general services circuits from the local floor sub distribution boards, and terminate within the floor void busbar track units.

The types, ratings, number of cores and sizes of all cables shall be as shown on the drawings. During production of working/installation drawings, the Electrical Sub-Contractor shall obtain confirmation of all mechanical and other services loads. If any changes have resulted due to final plant selections, then the Electrical Sub-Contractor shall re-assess the cable sizes. However, sizes smaller than those detailed in the documents will not be permitted.

Circuits feeding control panels, plant and equipment shall be configured as single radial circuits. Small power outlets shall be wired as ring circuits or radial circuits, depending on location and function.

Containment systems shall be laid in the floor/ceiling voids and in the service chassis to form the main containment system for the final sub-circuits on all floors. As indicated on the drawing the Electrical Sub-Contractor is responsible for sizing, supplying and installing all secondary and final containment systems needed to complete the installation.

The Electrical Sub-Contractor shall install a separate Circuit Protective Conductor (CPC) for each final circuit unless specified elsewhere. Under no circumstances shall the conduit/trunking system be used as, or form part of, a circuit protective conductor.

The Electrical Sub-Contractor shall determine the mounting heights of high level sockets, high level primary electrical containment, etc. from the schedule of mounting heights. All other mounting heights to be determined from the Architects drawings.

Cable sheath colours shall conform to the following sequence - Brown/Black/Grey for the 3 phases; Blue for Neutral and Green/Yellow for Circuit Protective Conductors and Bonding Conductors. Brown for line; Blue for neutral and Green/Yellow for CPC for single phase.

All socket outlets shall be supplied, installed and wired up as detailed on the drawings and scheduled in the panel board schedules by the Electrical Sub-Contractor. They shall comprise the number of gangs indicated and shall be of the switched type.

In those areas where general purpose socket outlets are indicated they shall be 13A, 3 rectangular pin type, complete with shutters, neon indicators where applicable, having single or double pole switches and shall be to BS 1363.

Fused connection units shall match the socket outlets and shall be with or without cord outlets to suit individual applications. Every effort shall be made to conceal all flexible cables for final connection to fixed appliances by using connection units without flex outlets and cable outlet plates located either behind the appliances or located so close to the appliance cable inlet point as to make the length of exposed flexible cable as short as possible.

Radial circuits serving socket outlets shall be protected by means of residual circuit breaker devices having tripping current setting not exceeding 30mA.

Local isolators/sockets for specific fixed equipment shall be supplied and installed at the locations shown on the relevant drawings.

Isolators shall be sized and rated as shown on the drawings and manufactured as in the preferred schedule of manufacturers.

Installation heights for electrical devices shall be as per the schedule in the appendices at the rear of the document or as per the architect’s drawings.

### Cable Tray

Cable tray shall be manufactured in accordance with EN 61537.

The appropriate corrosion protection will be determined by reference to EN ISO 12944.

In general, cable tray installed internally shall be galvanised to EN 10346. Cable trays installed externally and in internal areas of high humidity and corrosion shall be galvanised to EN ISO 1461. In highly corrosive and clean room environments stainless steel cable tray shall be installed.

Cable trays shall be medium\*/heavy\* duty with a sidewall of 35\*/60\*/85\*/105\*mm

Cable trays will be 3050mm in length (3000mm usable length).

Cable trays installed externally shall be fitted with covers.

All accessories (bends, tees, intersections, internal and external risers, offsets, and reducers etc.) shall be supplied by the manufacturer.

Cable trays shall be supported at span distances not greater than 1.5m or as specified by the manufacturer. The deflection conditions of EN 61537 must be met at all times. Additional supports will be positioned no further than 150mm from accessories. Only support brackets with load capacities tested in accordance with EN 61537 will be used.

Cable trays will have adequate space to allow for the correct installation and fixing of all cables plus 30% spare capacity for future use.

Any cuts will be treated to return the cable tray to the condition of manufacture.

Cable trays will meet the following requirements:

* Interlocking ends with self-locking couplers that do not require additional bolting.
* Electrical continuity without additional earth bonding.
* Magnetic shield insulation without cover 20dB, with cover 50dB.
* Electromagnetic compatibility to VDE 0870-1.
* Transfer impedance without cover 1.14mΩ/m, with cover 0.71mΩ/m.
* Embedded perforations in the base of the cable tray for increased ventilation and simplified connection to the support system.
* Both lengthways and crossways perforation slots in the base of the cable tray.
* Continuous side perforation slots 7 x 20mm.
* The facility to fit snap-in segregation strips into the base of the cable tray.
* Covers will be supplied with pre-installed turnbuckles.
* Sprung steel clips will be manufactured from stainless steel.

Cable trays for life safety and fire-fighting applications and those that run along and across escape routes shall be tested in accordance with DIN 4102 Pt12 and approved for function maintenance classes E30 to E90.

Fire-resistant cables shall be segregated from non-fire-resistant cables. Fire resistant cables shall be supported on a system that has an approval of equal duration to that of the cables it is supporting.

Cables that run along and across escape routes shall be supported on a system that has a stability approval equal to the duration specified for the safe evacuation of the building.

Where cable tray is indicated on the drawings to run up to equipment / distribution boards, the contractor shall allow for a vertical drop of the tray to the equipment.

### Cable Basket

Cable basket shall be manufactured in accordance with EN 61537.

The appropriate corrosion protection will be determined by reference to EN ISO 12944.

In general, cable basket installed internally shall be galvanised to EN 12329. Cable baskets installed externally and in internal areas of high humidity and corrosion shall be galvanised to EN ISO 1461. In highly corrosive and clean room environments stainless steel cable basket shall be installed.

Cable baskets shall be medium\*/heavy\* duty with a sidewall of 35\*/55\*/105\*mm.

Cable baskets will be 3000mm in length.

Cable baskets installed externally shall be fitted with covers.

Bends shall be supplied by the manufacturer. Other accessories (tees, intersections, internal and external risers, offsets, and reducers etc.) shall be manufactured according to the manufacturer’s instructions.

Cable baskets shall be supported at span distances not greater than 1.2m or as specified by the manufacturer. The deflection conditions of EN 61537 must be met at all times. Additional supports will be positioned no further than 150mm from accessories. Only support brackets with load capacities tested in accordance with EN 61537 will be used.

Cable baskets will have adequate space to allow for the correct installation and fixing of all cables plus 30% spare capacity for future use.

Any cuts will be treated to return the cable basket to the condition of manufacture.

Cable baskets will meet the following requirements:

* Interlocking ends that do not require additional bolting.
* Electrical continuity without additional earth bonding.
* Magnetic shield insulation without cover 15dB, with cover 25dB.
* Electromagnetic compatibility to VDE 0870-1.
* Transfer impedance without cover 6.17mΩ/m, with cover 5.5mΩ/m.
* Mesh grid of 50 x 100mm
* The facility to fit snap-in segregation strips into the base of the cable basket.
* Covers will be supplied with sprung steel clamps.
* Sprung steel clips will be manufactured from stainless steel.

Cable baskets for life safety and fire-fighting applications and those that run along and across escape routes shall be tested in accordance with DIN 4102 Pt12 and approved for function maintenance classes E30 to E90.

Fire-resistant cables shall be segregated from non-fire-resistant cables. Fire resistant cables shall be supported on a system that has an approval of equal duration to that of the cables it is supporting.

Cables that run along and across escape routes shall be supported on a system that has a stability approval equal to the duration specified for the safe evacuation of the building.

Where cable basket is indicated on the drawings to run up to equipment / distribution boards, the contractor shall allow for a vertical drop of the basket to the equipment.

### Cable Ladder

Cable ladder shall be manufactured in accordance with EN 61537.

The appropriate corrosion protection will be determined by reference to EN ISO 12944.

In general, cable ladder installed internally shall be galvanised to EN 10346. Cable ladders installed externally and in internal areas of high humidity and corrosion shall be galvanised to EN ISO 1461. In highly corrosive and clean room environments stainless steel cable ladder shall be installed.

Cable ladders shall be medium\*/heavy\* duty with a sidewall of 45\*/60\*/110\*/160\*/200\*mm

Cable ladders will be 3000 or 6000mm in length.

Cable ladders installed externally shall be fitted with covers.

All accessories (bends, tees, intersections, internal and external risers, offsets, and reducers etc.) shall be supplied by the manufacturer.

Cable ladders shall be supported at span distances not greater than 1.5m or as specified by the manufacturer. The deflection conditions of EN 61537 must be met at all times. Additional supports will be positioned no further than 300mm from accessories. Only support brackets with load capacities tested in accordance with EN 61537 will be used.

Cable ladders will have adequate space to allow for the correct installation and fixing of all cables plus 30% spare capacity for future use.

Vertical cable ladder systems will be used in risers. Cables will be secured with U clamps supplied by the manufacturer.

Any cuts will be treated to return the cable ladder to the condition of manufacture.

Cable ladders will meet the following requirements:

* Electrical continuity without additional earth bonding.
* Magnetic shield insulation without cover 10dB, with cover 15dB, G mesh cable basket 15dB.
* Electromagnetic compatibility to VDE 0870-1.
* Supplied folded up for ease of transport and storage (45, 60 and 110mm sidewall only).
* Continuous side perforation slots.
* The facility to fit snap-in segregation strips into the base of the cable ladder (45, 60 and 110mm sidewall only).
* Covers will be supplied with pre-installed turnbuckles.
* Sprung steel clips will be manufactured from stainless steel.

Cable ladders for life safety and fire-fighting applications and those that run along and across escape routes shall be tested in accordance with DIN 4102 Pt12 and approved for function maintenance classes E30 to E90.

Fire-resistant cables shall be segregated from non-fire-resistant cables. Fire resistant cables shall be supported on a system that has an approval of equal duration to that of the cables it is supporting.

Cables that run along and across escape routes shall be supported on a system that has a stability approval equal to the duration specified for the safe evacuation of the building.

Where cable ladder is indicated on the drawings to run up to equipment / distribution boards, the contractor shall allow for a vertical drop of the ladder to the equipment.

### Cable Trunking

Cable trunking shall be manufactured in accordance with BS EN 50085.

In general, cable trunking installed internally shall be galvanised to EN 10143. In highly corrosive and clean room environments stainless steel cable trunking shall be installed.

Trunking lids will be fitted with turnbuckles that are closed and opened with a No2 pozi screwdriver.

The gauges of steel used to manufacture cable trunking will conform to BS 4678.

Cable trunkings will conform to EN 60529 1991: IP 30.

Cable trunkings will be 3000mm in length.

All accessories (bends, tees, intersections, internal and external risers, offsets, and reducers etc.) shall be supplied by the manufacturer. All couplers and accessories will be fitted with back welded nuts and secured with M5 screws.

Cable trunkings shall be supported at span distances not greater than 1.5m or as specified by the manufacturer. The deflection conditions of EN 61537 must be met at all times. Additional supports will be positioned no further than 150mm from accessories. Only support brackets with load capacities tested in accordance with EN 61537 will be used.

Copper earth links 12.5 x 42mm will be fixed across all trunking joints and earthed as appropriate.

Cable trunkings will have adequate space to allow for the correct installation and fixing of all cables plus 40% spare capacity for future use.

Any cuts will be treated to return the cable trunking to the condition of manufacture.

Where cable trunkings pass through fire walls and floors, fire barriers with an approval equal in duration to that of the partition through which it penetrates shall be installed.

Where trunking is indicated on the drawings to run up to equipment / distribution boards, the contractor shall allow for a vertical drop of the trunking to the equipment.

The contractor shall furthermore allow for a 150 x 150mm horizontal trunking header above each distribution board for routing of circuits.

### Conduit and Final Circuit Cable Installations

Conduit and fittings shall be in accordance with IEC 62052-21:2004+AMD1:2016 CSV Consolidated version. Conduit shall be Heavy gauge, welded, Class 4, hot-dipped galvanised steel, zinc-coated screw threads and zinc bichromate outer coating to comply with BS31. Rigid steel conduit and fittings shall conform to BS4568. Cables in conduit shall be protected throughout their length by screwed welded galvanised class 4 steel conduit, terminating in cast iron or pressed steel boxes at the fittings, switches, etc. Conduit shall not be smaller than 20mm dia. or have metal tubing less than 1.8 mm. The thickness of metal shall increase in proportion to the increase in diameter

The capacity of the conduits shall be in accordance with NSAI 10101 Rules.

**NB All containment systems for any service (fire detection & alarm, emergency lighting etc) shall be provided in a closed steel system.**

C.I. oblong intersection joint ‘T’ and other necessary boxes shall be screwed full thread into which the conduit shall fit tightly. Screw cutting oil shall be used as a lubricant when screw cutting, which must be afterwards carefully removed.

Tubes are to be properly screwed, the thread fully worked and when screwed up no rings shall be noticeable on the outside of the tubes. Conduits are to be mechanically and electrically continuous across all joints and earthed in accordance with the Clause marked “Earthing” (Note: separate independent full size earthing conductors shall be installed throughout).

At junction and ceiling roses, galvanised steel junction boxes shall be used. At ganged switch positions special multiple switch boxes shall be used.

Conduit is to be concealed throughout and it shall be fixed in chases by means of suitable crampets, or concealed within stud partitions. The conduit where sunk in the walls shall have at least 15mm cover of plaster from the external surface. Chases for conduits shall be filled with sand and cement to 7mm from the finished surface. All bends shall be made as far as possible from conduit and no bends shall have a radius smaller than 2.5 times the outside diameter of the conduit. Elbows and tees shall not be used except in positions approved by the Engineers. When complete the conduit must be water tight and electricity continuous throughout.

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

Socketed and screwed brass bushes shall be used on all ends through which cables or wire are moved in either direction.

The cables shall be stranded copper conductor Class 2 to BS EN 60228:2005 with LSF insulation Type E1.5 to BS 7655.

The cables shall be LSF insulated 600 Volt grade made to comply with BS 7211 with stranded Class 2 copper conductors to BS EN 60228:2005. The cables shall be supplied with the following colours:

* Earth-Protective-Bonding - Green/Yellow
* Neutral - Blue
* First Phase - Brown
* Second Phase - Black
* Third Phase - Grey

All conductors shall be stranded and shall not be smaller than 2.5 sq. mm for lighting and 4.0 sq. mm for services sockets. Connections between cables shall be made by means of mechanical connections of approved type. Conductor sizes for services other than lighting and sockets shall be as outlined hereafter or as indicated on drawing or schedule. A separate full circuit size earth wire shall be run with all circuits taken in trunking and conduit.

Every connection shall be easily accessible and shall have resistance not greater than that of the equivalent length of the largest conductor to which the connector is fixed.

The maximum voltage drop between the sub-distribution board and the main-distribution board shall not exceed 1.5% of nominal supply voltage as follows:

* 3.45Vac (single phase)
* 6.00Vac (three phase)

The maximum voltage drop between any final circuit outlet point and the sub-distribution board shall not exceed 2.5% of nominal supply voltage as follows:

* 5.75Vac (single phase)
* 10.00Vac (three phase)

### Flexible Conduit

Flexible conduit shall be used at final connections to potentially vibrating pieces of equipment, such as motors, etc. The flexible conduit shall consist of a helically wound galvanised steel strip with an LSF outer sheath. The PVC conduit system shall be provided with manufacturer’s termination fittings to ensure an overall protection class of IP66.

The flexible conduit shall be manufactured to comply with BS EN 61383–23: 2004, and IEC 61386.

### Mains Power Cable Installations

Armoured cables shall be XLPE/LSF/SWA/LSF with CPR Class Dca-s2,d2,a2 rating as minimum. They shall be of 600/1000V grade and shall comply with BS6724. They shall have copper stranded conductors. Multi-core cables shall be single wire armoured and single core cables shall be aluminium strips armoured.

They shall be installed as outlined below. All cables shall be suitable for installation on cable tray, ladder, in ducting or buried in the ground. The cables shall be installed in strict compliance with the manufacturer’s requirements and bends in the cables shall be of the minimum radius of 8 times the overall diameter of the cable for cables large than 25mm.

All runs of cable inside the building shall be supported on cable ladder on Unistrut brackets. In all instances the spacing of supports shall comply with the manufacturer’s recommendations.

All cables shall be terminated in the manufacturer’s glands. Termination of the cable cores shall be by means of manufacturer’s compression termination lugs in accordance with the manufacturer’s instructions. The cable amounting shall be carefully made off in the manufacturer’s gland at each entry.

Bonding to the metal work for the earthing shall be by proprietary earth tags. Armour alone shall not be relied on as the earth conductor and, where necessary, a separate earth wire shall be installed alongside the armoured cable to comply with the NSAI Regulations.

Sub-mains cables shall be 4 Core Cu- XLPE/LSF/SWA/LSF with separate CPC’s for cables over 16.0 sq.mm, and 5 Core Cu- XLPE/LSF/SWA/LSF for cables of 16.0sq.mm or less. Cables shall be sized as scheduled on the electrical drawings. All cables installed within the buildings shall have a minimum CPR Class of Dca-s2,d2,a2.

In general, main cables shall be run in PVC underground ducts or on cable tray/ladder inside the building, with final design to determine the final routes and methodologies.

Sub-mains cables shall be installed in PVC ducts and fixed to cable tray. Cable tray shall be perforated type, galvanised medium gauge sheet steel.

Sub-mains cables shall be installed on cable trays at a spacing of twice the diameter of the larger adjoining cable with nylon cable ties.

Where cables are run underground externally excavation of trenches and reinstatement shall be carried out by the Building Contractor. The Electrical contractor shall include for all layouts necessary to lay the cables in position at a minimum depth of 1200 mm below ground level (to the top of the duct). It is the responsibility of the Electrical Contractor to ensure that underground cable ducting meets the performance requirements as set out in the NSAI Rules. Plastic marker tape with a repetitive inscription “Danger - Buried Electric Cables Below” shall be installed 299 mm below ground level, along the route of external cables.

The maximum permitted volt drop from the Main Distribution Board to any final outlet shall be 4% overall.

Cables shall be manufactured, tested and installed in accordance with the following specifications:

* General Specification BS 6724 (latest edition) and 5467 (latest edition)
* Conductors Stranded Class 2 Copper Conductors BS EN 60228:2005
* Insulation XLPE Insulation Type GP8 to BS 7655
* Outer Sheath Type L7SI to BS 7655
* Fire Performance I.S. EN 50575 and I.S. EN 61034-2

### Fire Resistant Power Cables

Fire resistant power cables shall be used typically to support smoke ventilation systems, etc. in accordance with BS 8519:2020. Cable shall consist of stranded copper cores with XLPE insulation, LSF inner sheath, steel wire armouring and PH120 rated fire resistant outer sheath. The cable shall be installed in strict compliance with the manufacturer’s requirements and bends in the cable shall be a minimum radius of 8 times the overall diameter of the cable.

### Segregation of Services

Cables of various voltages, functions and separate supply sources, shall be segregated from each other and spaced sufficiently far apart to eliminate interference between services. The cabling of low voltage (below 50v) emergency lighting systems may use the same main containment as that of Fire Alarm loop wiring subject to prior approval and risk assessment.

### 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, turnings, 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 systems in excess of 2500mm2 cross - sectional area 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.

Trunking covers shall be cut at both sides of walls where they pass through for ease of access to the trunking.

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.

## General Power Distribution

### General

The electrical sub-contractor shall include for the general power outlets as indicated on the drawings. The works covered under this section shall include the following:

* Under floor busbar
* Overhead Busway
* Sockets For General and Cleaning Services
* Wiring For Fixed Power Outlets
* Earthing and Equipotential Bonding.

### Socket Outlets

Socket outlets shall be installed as inidicated on the layouts. All sockets installed externally shall be IP65 minimum. All socket outlets which are accessible by members of the public, staff members etc shall have outboard rockers installed, and be installed in accordance with the requirements stated within TGD Part M: 2010.

### General Service Outlets

The electrical sub-contractor shall supply and install all general services throughout as indicated on the drawings. This shall include all cleaner’s sockets, floor grommets, under-desk slinky, over and under desk power modules, under-floor busbar and floor box outlets. The amount of services required in each floor box is indicated on the relevant drawing.

For the services to the office areas on first floor, each desk shall be provided with the following:

* Tap off unit to connect to underfloor busbar.
* 4 x socket outlets on underdesk furniture outlet power module with integrated RCS protection.
* Floor grommet to pass cable from underfloor busbar to furniture power modules. One grommet shall be provided for every 4 desks.
* 2 x sockets on above desk furniture outlet. The outlet shall clamp to a desk surface.
* Twin data outlets shall be provided to each desk.

Each desk should be provided with an under-desk furniture outlet and shall be of the CMD Rotasoc type as supplied by Core Eletrical.

There shall be a maximum of 4No twin socket outlets per circuit. The residual current devices shall have a 30mA maximum trip setting. The protection devices shall be suitable for operation in circuits supplying switch mode power supply units and frequency converters. Floor grommets shall be as CMD 210mm diameter (Product Code PCFG238) provided by Core Electrical.

Front-of-house area (i.e. reception areas, atrium, toilets, changing rooms) outlets shall be brushed stainless steel (Legrand). Exact product to be confirmed with architect and engineers.

Back-of-house area (i.e. security room, store rooms) and cleaner outlets shall be metal clad type (MK Electric). Exact product to be agreed with architect and engineers. Sockets in the manufacturing, server test and Rack & Stack area shall be of the metal clad MK type.

Lighting and data outlets to match respective areas.

### Underfloor Busbar

Power distribution for the workstations in the office areas shall be via a 63 Amp Under-floor Busbar system routed as indicated on the drawings.

Busbars shall be low profile, 63A, 230V single phase with standard earth, high conductivity copper conductors only, 10kA short circuit rating and IP40 protection.

ASTA certified and designed to comply with BS EN 60439-2:2000 and IEC 60439-2:2000 and shall be designed to conform to BS EN 61534-22.

The Busbar system is to have a High Integrity Earth Conductor to allow compliance with section 543.7.1.3 of BS7671: 2008 of the IEE wiring regulations.

It shall be supplied in standard lengths of 1.2m, 1.8m, 2.4m and 3.6m with socket positions located every 300mm. Each socket outlet shall be coded for easy recognition and safety with sliding dust covers to protect outlets.

The Under-floor Busbar system shall be supplied with all necessary accessories (manufacturers proprietary brackets, fixings and end feed units etc.) to complete the installation and fed from the local Distribution Boards as indicated. Floor busbar shall be as ‘Betatrak Underfloor Busbar’, maximum height of 47mm, provided by Core Electrical

### Floor Services Boxes

They shall be multi-compartment boxes comprising of a 4-compartment galvanised steel frame, a lid, accessory plates and cable outlet assembly.

Each outlet box shall be provided with power, voice and data outlets as required to meet the needs of the specific room or area as per the drawings.

Each outlet box is to be fitted with a recessed hinged lid suitable for accepting floor or carpet tile. The lid shall be easily removable and reversible and hinged from either of two sides. They shall be self-closing in accordance with EN 61534-22. Lids shall have a recessed handle for easy accessibility with robust cord caps.

Raised Floorboxes powered from the Under-floor Busbar Powerplan 4 compartment box, 65mm deep containing 1no 20Amp 30mA RCBO, 2no. Twin sockets, 1no 4 x RJ45 data plate (future space) and prewired with a 5M standard earth.

### Power Services to Toilets

Under this Section the Electrical Sub-Contractor shall include for the testing and certification of Power Services in Toilets as shown on all relevant drawings.

### Fused Connection Units (Spurs)

Fused Connection outlets shall be installed for the following services:-

Small Power Services, Serving fixed outlets, supplied via mains from the local distribution board.

Each spur shall be wired on a separate 3x4 sq. mm LSF cabling, in galvanised steel conduit, from a 20A 2Pole MCB (or RCBO if serving water heaters) in the distribution board.

Each spur shall be installed in galvanised sheet steel conduit boxes for flush mounting.

Fused connection units shall be installed for local isolation of equipment, including (but not limited to):

* Fire Detection and Alarm Equipment
* Intruder Detection and Alarm Equipment
* Access Control Equipment
* CCTV Equipment
* Disabled Refuge System Equipment
* Disabled Toilet Alarm System
* Fire Smoke Dampers
* Leak Detection Equipment
* Mechanical Plant (below 1kW)
* Automatic Opening Vent Control Panel
* Telephone Systems
* ICT Systems
* Automatic Doors
* Trace Heating Systems
* Water Boilers
* Sundry Equipment
* Mechanical Plant, Local fans, local controllers etc.

Fused connection units for local isolation shall be complete with neon indication, and shall be graphite plate finish with white switches.

### Isolators

All disconnectors, switch disconnectors, switches and circuit breakers shall be provided with the means to enable them to be locked in the 'off' position. When used as earthing switches they shall be capable of being locked 'on' when closed to the earth connection.

Generally, Isolator Circuits shall be cables with one outlet per circuit and as follows:

|  |  |
| --- | --- |
| 16Amp | 4sq.mm + 2.5sq.mm Earth |
| 20Amp | 4sq.mm + 2.5sq.mm Earth |
| 25Amp | 6sq.mm + 4sq.mm Earth |
| 32Amp | 10sq.mm + 6sq.mm Earth |
| 50Amp | 16sq.mm + 10sq.mm Earth |
| 63Amp | 16sq.mm + 10sq.mm Earth |

Three Phase Socket Outlets shall be Surface Mounted, interlocked as MK Commando Range or equivalent.

Cabling to 16AMP Three-Phase Sockets shall be sq. mm. cables with 2.5sq.mm earth in conduit/trunking with a separate circuit per outlet.

Cabling to 32AMP Three-Phase Sockets shall be 6sq.mm cables with 4sq.mm earth in conduit/trunking with a separate circuit per outlet.

### Audio Frequency Induction Loop System

The contractor shall include for supply and installation of an Audio Frequency Induction Loop hearing aid system (AFILS) where indicated on the drawings and specified herein, and to comply with Building Regulations Part M.

The AFILS system shall comprise 2 separate channels with speaker and microphones, to allow 2 separate users to talk discretely to the reception staff at the reception desk.

Amplifiers shall be mounted under the reception desks. The supply contract shall include for signage at the desk, and for a working demonstration to client staff at commissioning.

AFILS systems shall be provided as follows:

* + - Southern Security Area Reception – Ground Floor
    - Northern Security Area Reception – Ground Floor

Power to the AFILS amplifiers shall be provided via a dedicated unswitched fused connection unit with neon indicator mounted under the reception desk and fed from a 10A MCB on the local distribution board.

### Hand Dryers

The electrical contractor shall supply and install 2No. hand dryers per non-part M compliant toilet and changing room and 1No. handdryer per disabled toilet. All hand dryers to be Dyson Airblade 79dB. – To be installed all toilets Male, Female and Disabled

### Wiring for Miscellaneous Services

The electrical subcontractor shall include for wiring to all equipment. All final connections, terminations and testing should be included for.

All miscellaneous services such as petrol interceptor alarms, sump pumps, utility meters and 3rd party equipment shall be provided with power and data connections, as required.

In all external environments, any and all exposed flexible cabling used for the connection of plant of any kind shall be UV weather rated and suitable for use in in areas exposed to the elements.

### Power to Sanitary Ware

All wash hand basins, flush toilets & urinals within the toilet cores are to have automatic sensors, the electrical contractor shall include for all control and power cabling to both. The electrical contractor should note that not all sanitary ware power supplies are indicted on the drawings within the WC spaces due to space restrictions, the electrical contractor shall quantify from architectural backgrounds.

### Overhead Busway

Overhead busway shall be provided in the areas indicated on the drawings. The busway shall be provided with plug-in tap off boxes to provide power to the relevant services indicated on the drawing.

Busways shall be of the Schneider type or equally approved and shall have the following ratings:

Server Test Area – 400A

Server Assembly – Manual – 80A

Server Assembly – Automatic Line – 100A

The tap-off boxes to be provided shall be equipped as follows:

Server Test Area – 2x32A TP Circuit Breakers and 1 x 20A DP RCBO.

Server Assembly Area – 4 x 20A DP RCBO and 1 x 32A TP MCB.

A tap off box shall be provided for each workstation location on the assembly lines and for each equipment rack position in the server test area.

## General Lighting Installation

### General

The electrical contractor shall supply, install, connect, upgrade, test and commission the whole of the lighting installation as shown on the drawings and described in the specification.

The type of luminaire required for each location is specified on the drawings and in the luminaire schedule. The electrical sub-Contractor shall erect and install these luminaries at the locations indicated on the drawings. The exact location of each luminaire shall be determined from the Architect’s reflected ceiling plans and **NOT** by scaling any other drawings.

The electrical sub-Contractor shall supply a complete lighting installation including all cabling and accessories required to complete the installation. All cabling to be undertaken in single core copper cables in trunking and conduit throughout. All cabling shall conform to IS 10101:2020.

The electrical sub-Contractor shall include for the supply and installation of all lamps for the various types of luminaires.

Where more than one phase is switched from the multi-gang switch location, proprietary metallic phase barriers shall be provided.

No substitutions or alternative luminaires will be considered.

Ballasts shall be suitable for use with their respective lamp type.

The Electrical Contractor shall ensure that all the luminaires required for the project are placed on order at due time to ensure delivery to suit the project construction programme. However, approval of the Architect shall be obtained for final selection of the luminaires before the orders are placed.

Under no circumstances will LSF single core cables be permitted to enter any of the luminaires. Final connection to the respective luminaires shall be carried out using heat resisting flexible cables. No power cable smaller than 1.5mm2 shall be used for final connecting in the lighting installation.

No luminaires that use thermoplastic material shall be installed in this project.

### General & External Lighting Systems

Luminaires shall be robust, easily maintainable, with colour rendering selected in accordance with the requirements for the space.

Plant Room fittings should be IK 10 and IP67 rated or as otherwise specified in the schedule.

The wiring for the general lighting installation shall be taken from the dedicated section on local distribution board. The wiring shall be carried from the local distribution boards in galvanised steel trunking and in galvanised steel conduit, carried above ceilings and recessed in walls and partitions.

The wiring for the general lighting installation shall consist of 3x2.5sq.mm. LSF insulated solid copper cable, from a 10 amp MCB in the local distribution board serving the area (10amp RCBOs shall supply shower areas and wet rooms). A maximum of 10 light fittings shall be wired on each 10amp MCB circuit. A separate 2.5mm2 stranded copper earth wire shall be taken with each lighting circuit and shall be bonded onto all light fittings and light switches.

Lighting switches throughout the installation shall be rated 20 amp single pole, wide rocker switches, with graphite finish, as previously scheduled.

Switches shall comply with standards BS 3676: 1989 and EN 60669-1 and shall be suitable for use on inductive or resistive loads and rated for 20 Amps minimum. Switches shall be single-pole retractive unless otherwise indicated or approved and where located adjacent to each other they shall be grouped in a multi-gang single enclosure and share a common switch plate (maximum quantity: 2 gang).

The rocker shall be double insulated and have a quick positive action. Brass terminals shall be pillar screw type with terminal screws to facilitate ease of connection, including facility for looping in and out of the terminal with 3No. 2.5sq.mm cables in any one terminal.

Ease of fixing and alignment shall be provided by an adjustable grid, which shall cover the box aperture and an elongated fixing lug to facilitate correct alignment. The large grid shall allow wiring to be connected without fixing the cover plate and in turn allow decorating work to be completed before the final fix. All units, except architrave assemblies shall fit boxes to BS 4662: 1970 with a minimum depth of 35mm. The switch grid shall be complete with a flying earth lead for connection to the box lug.

All boxes shall be of galvanised steel and provided with earth terminals with bonding link to cover plate/switch grid. Cover plates shall be engraved as required to denote their function.

Multi-phase switch assemblies shall be complete with internal red phase warning faceplates clearly labelled '400 volts' and with vertical phase barriers in boxes.

Samples of switches to be installed shall be submitted to the Engineer and Architect for approval before any switches are placed on order. All samples shall be complete with boxes.

Pilot lights on switch plates shall be fitted with a neon lamp, limiting resistor and red lens and shall comply with the latest BS.

Switches shall be mounted at 1100mm centre from the finished floor level unless particular requirements dictate otherwise.

### Light Fittings – Selection and Types

The electrical contractor shall include for presenting all sample light fittings on site for approval, and no fittings shall be purchased without the approval of the architect and engineer.

Light fittings shall generally be LED technology and come complete with DALI dimmable ballasts throughout (internal & external). Fittings shall be prewired to a labelled terminal block sufficient to terminate 2No, 2.5sq.mm. cables, fully earthed and with labelled terminal connector for the contractor to connect earth cable. Each light fitting shall incorporate the control gear and lamps required for normal operation. All fittings shall be CE marked and shall comply with IS 10101.

Manufacturer’s data sheets for the products proposed shall be forwarded with the tender to enable the client to assess the products offered. Any alternative submissions be submitted with the required information.

The general eligibility criteria applicable to all luminaires to be supplied under the contract include:-

* Components must be CE marked as required by EU directives
* Light luminaires must have a power factor of 0.82 or greater
* The photometric data of the luminaire must have been measured in accordance with EN1302
* Light luminaires must meet the minimum efficacy criteria outlined in the table below
* Lamps and control gear must be ENEC marked or comply the relevant standards.

All luminaires shall be CE marked and labelled “distinctly and durably in accordance with IEC:60598, including the manufacturers make and model. Luminaires shall also comply NSAI Rules. The construction, marking and connection of luminaires shall comply IEC:60598-1 “Luminaires, General Requirements and Tests”.

The electrical contractor shall allow for lighting power points to the vertical lighting included within the WC joinery. The vertical lighting within the joinery is supplied and installed by the joinery contractor. It is the responsibility of the electrical contractor to (i) include for the lighting power point to these luminaires, which shall be controlled via the local PIR (ii) ensure the lighting points are in the correct location (iii) ensure there are enough power points to accommodate the vertical joinery luminaires (the electrical contractor shall refer to the architectural details for verification and (iv) complete the termination, testing and commissioning of all of these points.

### Light Fittings – Weatherproof External

External light fittings shall be weatherproof rated IP67. In the event of water damage or fault, the contractor shall return the fittings to the supplier and ensure that replacements are correctly installed in a waterproof manner.

External lighting points shall be wired from a 10 amp MCB or RCBO (if located under 2.8m AFFL) in the local distribution board. External fittings shall not be wired on the same circuit as internal fittings. Surge protection shall be provided in accordance with the requirements of the Lightning Specialists Risk Assessment.

A coordinated external lighting design shall be developed and coordinated with the Landscape design and requirements of the planning authority.

Commissioning and certification of the installation shall be undertaken by a specialist supplier. A commissioning certificate in accordance with CIBSE Code L:2003 to include a drawing indicating all measured lux levels at commissioning stage is required, to demonstrate compliance with LG2, LG7, ADBs and design specifications. This shall be a requirement for practical completion.

Lighting of the car park area shall be by means of corrosion-resistant LED fittings wired using 2.5mm² LSF cables in steel conduit and trunking with a maximum of 10 points per circuit. The car park lighting shall be controlled by means of the DALI system installed throughout the buildings.

### Public Area Lighting

Public lighting shall be installed in accordance with the General Specification for Public Lighting Design and Installation in the Fingal County Council Area.

The type of luminaires and position shall be as indicated on the relevant drawing.

Lamp Posts shall be as indicated in the luminaire schedule and shall be rooted in accordance with the FCC requirements.

### Emergency Lighting

**General**

The electrical sub-contractor shall be required to supply, install, test and commission a complete emergency lighting installation as indicated on the drawings, as listed in the Luminaire Schedule and detailed herein, and all in accordance with the latest revision of the IS 3217 standard. All general clauses in the General and Particular Lighting section shall apply to the emergency lighting clauses.

Unswitched mains supply connections to emergency equipment should be clearly identified.

All batteries shall be put through a full charge and discharge cycle upon being first energised and the Contractor shall comply fully with any other requirements of the manufacturers to ensure that the batteries operate correctly.

**System Type**

A self-contained addressable (monitored) emergency lighting system shall be provided for the whole of the building including landlord and tenant areas. All emergency fittings and controls shall be controlled by the building Lighting Control System. It shall comply fully with the requirements of EN 62034:2012.

Generally, the emergency lighting system consists of separate self-contained dedicated emergency LED light fittings supplied. Some of the normal luminaires in stairwells, parking areas and outside exit doors will also form part of the emergency lighting system. Where emergency lighting forms part of general luminaires, they shall be supplied with switched live mains for normal operation and unswitched live mains for monitoring and charging the integral batteries both supplies shall be taken from the same MCB.

Emergency lighting shall generally be provided by the following:

* Non-maintained recessed LED downlights
* Combined emergency surfaced linear fittings in plantrooms and carpark
* Combined emergency surfaced wall mounted fittings at entrance/exit doors
* Maintained exit sign on escape routes.

Emergency luminaires shall generally be suitable for 3-hour duration. The recharge period for the batteries after full discharge shall not exceed 24 hours. A full discharge/recharge test must be performed for every luminaire.

Maintained or Non-maintained external emergency luminaires shall be positioned over each emergency exit door.

The testing and monitoring of the luminaires shall be done by means of a DALI interface.

**Emergency Light Fittings**

All safety signage utilised in conjunction with the emergency lighting system shall comply with the Safety, Health and Welfare at Work (General Application) Regulations. On exit signs, the legend shall occupy a minimum of 80% of the height of the signs. The legend shall comply with EN 7010 and shall incorporate a directional arrow.

Labels, meeting the marking requirements of EN 60598-2-22 clause 22.5, shall be fixed to the luminaries and batteries. Luminaires shall have interface units fitted to comply with the addressable emergency lighting.

**Cable / Cable support**

The cable support system shall conform with all requirements of the Cable Support Systems for Lift Safety and Fire-Fighting Applications.

The internal lighting installation shall be wired in single core LSF insulated standard copper cables installed in steel conduit and trunking, as indicated on the drawings. Lighting circuits shall be derived from lighting distribution boards as indicated on the drawings and distribution board schedules.

**Batteries**

Batteries shall be high temperature Nickel Metal Hydride (NiMH) sealed type cylindrical cells. Nickel Cadmium (NiCd) batteries will not be used due to the environmental effects of Cadmium.

Battery cells may be used singly or in groups and shall be operated in conjunction with a charging circuit designed to the cell manufacturer’s specifications.

Batteries shall be compatible with the control module and be shown to have a design life of 4 years normal operation as specified in EN 60598-2-22 when located within the luminaire or remote enclosure.

**Central Test And Monitoring Unit**

The testing and monitoring shall be done by the DALI system. It shall be possible to programme specific testing times by means of the DALI interface.

The unit shall generate a diagnostics report that includes as a minimum the following parameters:

1. Communications Errors
2. Battery Faults
3. Lamp Fault
4. Charger Fault

**Certification**

An independent third party IS 3217 certified emergency lighting specialist shall be used to test and commission the installation at the end of each phase. Emergency lighting testing and commissioning will not be undertaken by the electrical contractor.

### Lighting Control System

### Introduction

The lighting control shall provide effective energy management and reporting of lighting load status throughout the installation. It shall provide convenient and intuitive manual control, supported by appropriate automatic operation to minimise energy consumption.

The lighting control system shall be modular and scalable. It shall utilise digital network technology based on the standard open DALI2 protocol for local field networks, DALI2 intelligent luminaires and Ethernet TCP/IP for the backbone infrastructure.

To ensure simplicity and reliability, it is a requirement that the system network controllers / routers handle network connections directly. Systems that utilise additional converters or similar intermediary devices are not acceptable.

System intelligence shall be distributed and reside within the lighting ballasts, LED drivers, load controllers, input devices, gateways and network routers.

The system shall be capable of processing command instructions from switches, sensors and other devices with sufficient speed that the user of the system sees the resulting action as a direct response to a switch being operated, or sensor triggered.

The installation shall be capable of forming a building wide lighting control system. Integration to BMS shall be via the Ethernet TCP/IP backbone infrastructure. The control specialist shall offer an IP driver for use with the system’s platform to facilitate seamless integration. The driver shall allow connection and communication with the system network controllers / routers and provide automatic discovery of system devices.

Changes to the system shall be made by an Operator Workstation consisting of either a desktop PC or commissioning (temporarily connected) laptop computer. However, the PC shall not be an active control component within the system. After commissioning, the control system routers and devices shall retain all configuration and programming information required for the system to operate automatically without the PC being present.

### Overview

The DALI lighting Control system is a computerised open protocol networked addressable lighting control system integrated to the project specified DALI ballast luminaire control via a DALI gateway.

The lighting control system shall be provided with a graphical user interface and this user interface to allow capable of time clock and daylight control etc. The graphical user interface shall include floor plan layouts for each level indicating luminaries/zone status, ability to switch or dim any area, scheduling and fault monitoring.

The lighting control system shall allow monitoring lamp life, energy consumption and for producing planned maintenance schedules and act as a management tool for monitoring status and historical performance of the building and load centres.

The entire lighting operation shall be monitored in real time through graphical software on the control system. All central switches and servers shall be located within the landlord comms cabinet located within the basement.

**TYPICAL LIGHTING CONTROL SCENARIOS**

**Service corridors & toilets.**

Lighting can be switched On/Off via the Lighting Control System time schedules. Override after work hours via motion detectors which will keep the lights On for a predetermined time (30min-2hours) before the lights are switched Off automatically.

**Lift Lobbies**

Luminaires ramp to 100% once the lighting zone to which this luminaire belongs to is activated via the motion sensor. Once the motion sensor has expired one luminaire be dimmed to 50% adjacent to the entry point of the outside working hours.

**Ground Floor Reception/Specialist Lighting**

Controlled via time scheduling allowing for at least 4 different scenes with local control at reception desk.

**Day to day functionality Typical Scenario**

From a cold start, i.e. Persons entering the floor for the first time that day.

All lighting would be switched off from sensors being enabled to automatic mode and no presence sensed.

The only lighting that would be on will be any 24hr lighting and in stairs and the lighting in main lift lobbies which would be resting at 50% brightness.

**During Business Hours**

During “Business Hours” which will be activated via the Lighting Control System time schedule all lighting in Front of House areas (i.e. ground floor reception area, toilets and corridors) will be switched On.

Back of house areas (store rooms, plant rooms and stairs will switched via motion detectors based on area occupancy.

**Outside Business Hours**

Once “Business Hours” is over a message will be sent to the floor via the Lighting Control system and the control sensors will revert back to auto mode.

The system shall be formed of local networks connected to routers. The routers themselves shall inter-connect and communicate via a backbone Ethernet network using TCP/IP.

It is a requirement that the lighting control system is capable of being installed as a completely separate system to other building services. However, the IP addressing of the devices shall allow sufficient range and flexibility for the system to utilise the owner’s building data network and structured cabling system if required.

DALI networks shall utilise a suitable two-core data cable (which should be screened in electrically noisy environments). The installing contractor shall ensure that any network cable used within modular wiring or power-track type wiring systems is suitable for DALI use. To this end the contractor shall ensure that the cable type and wiring method is approved by the controls specialist.

RS485 and DMX networks shall use two twisted pairs overall screened cable specified for wide bandwidth RS485 use. The contractor shall ensure that the cable type and wiring method is approved by the controls specialist.

The Ethernet backbone cabling shall be of not lower specification than CAT 6 data cable terminated with RJ45 type connectors.

The system shall be designed in such a way that typically each floor of the building is provided with one or more local networks. These local networks shall then be connected together via the router devices to allow the passing of messages between different areas within the building, and also for communication to and from the Operator Workstation.

For reasons of data integrity, speed and reliability, mains borne signalling or R.F. networking methods are not considered an acceptable substitute for the hard wired data cable which forms the backbone of the system. However, wireless devices may be connected to the system to allow additional functions and flexibility. For example the use of a wireless networked laptop computer for commissioning.

All devices connected to the system shall be fully compliant with the Open Protocol Standards. Any enhancements, devices, commands, or functionality provided by the controls specialist, in addition to those covered by the DALI Standard, shall not cause any detrimental effect to the standard devices or the local communication network.

All DALI networks and devices shall utilise full DALI addressing, reporting and feedback. The use of non-addressed DALI broadcast messages will not be accepted as meeting the requirements of this specification.

The local DALI networks shall accommodate all luminaires including those with emergency fittings and control input devices. Sensors, manual control panels and other local control devices shall connect directly to the local DALI network. Systems requiring a separate data bus for control devices are not acceptable.

Generally, all local control devices and interface modules shall derive their power from the DALI network and require no other external power source. Where conventional switches or specialist sensors have been specified in areas controlled by the system, these may be connected to the DALI networks by suitable DALI input interfaces.

Devices requiring external power supplies and/or controllers may only be utilised in exceptional circumstances. For example devices with high power consumption, such as long range microwave sensors.

Control shall be via the logical grouping of devices. Load interfaces that are to be controlled simultaneously shall be identified collectively as a “group”. There shall be no limit to the number of load interfaces that can be included within a group. To allow freedom in respect of installation and configuration, there shall be no restrictions on how loads are functionally grouped for control with respect to their physical location or connection to the system.

A control input shall manipulate a “group”. Points of control shall include, but not be limited to:

* daylight harvesting devices
* occupancy sensors
* timer controlled scheduled events (with or without astronomic correction based on the local longitude and latitude)
* manual control panels
* wireless input devices
* switch inputs
* voltage or current inputs
* RS232 serial interface
* TCP and UDP control commands via Ethernet
* BMS / BAS

Programming access, status monitoring, system and error reporting shall be by software application(s). Connection to the system shall be via Ethernet. Connection of multiple PCs or browsers shall be allowed to facilitate, for example, multiple point monitoring. The system shall not require the connection of a P.C. for normal operation.

A system’s programming shall be able to be saved to a computer file. It is expected that this shall be a feature of the programming application. Conversely, a saved file shall be able to be restored to a system.

### Lighting Management System Product/Equipment

**System description and operation**

The project shall be equipped with an addressable lighting management system providing flexible and efficient control and management of lighting. The system shall control lighting throughout the landlord’s shell and core areas as well as within the tenant office areas. The system shall be manufactured by Delmatic. **The preferred supplier of the system is Core Electrical.**

The system shall provide DALI control of lighting and shall combine presence detection and daylight-linking with automatic calendar scheduling, management and monitoring through graphical software. The Delmatic system shall provide total flexibility through individual DALI addressing of each office / workspace luminaire and DALI channel control of core area lighting.

The system shall ensure energy efficiency using presence and absence detection throughout the building as well as daylight-linked control within perimeter and daylit areas. The lighting management system detectors shall monitor occupation of areas, and this real-time knowledge shall be used to ensure that lighting is only lit in occupied areas. To maximise energy efficiency and to optimise the overall sustainability of the building, the lighting management system shall share real-time data on building occupancy with the BMS so that HVAC as well as lighting is related to occupancy.

The complete system operation including switching and dimming arrangements, groupings, sensor time-out periods and daylight-linking thresholds shall be configured, managed and adapted through graphical software without the need to access equipment or carry-out changes to the wiring installation. Any system device shall be software-configurable without having to access the device locally, and the system shall permit any output (luminaire) to be configured to operate in response to any input (switch, sensor etc) irrespective of which module the inputs or outputs connect to.

The system shall incorporate the facility for Biodynamic White Tuning control of lighting. The system shall enable control of DALI Type 8 drivers without the need to change any hardware and shall achieve Biodynamic control solely through software upgrade and configuration. Biodynamic control shall include biodynamic scenes and routines assigned to defined zones of a building so that the lighting intensity and colour relates to activities within the area, as well as biodynamic algorithms which replicate the dynamic variation of daylight and sunlight.

The system shall provide DALI emergency light testing and monitoring as part of the building-wide lighting management system. Emergency luminaires shall be fitted with Dali inverter packs (EmPros or similar supplied by others) and the lighting management system shall monitor the DALI inverters and DALI ballasts/drivers to obtain available battery, lamp and ballast/driver failure information. Emergency monitoring software shall initiate tests of emergency lighting and provide event logs and performance reports including information on the date and time of any failures, the device address, area/location and luminaire pass or fail status. DALI emergency testing and monitoring shall be applied to all areas of the building including plant areas which are not controlled by the lighting management system.

The system shall be commissioned and integrate with other services as detailed in this specification but shall provide full automatic control and local control self-contained within the lighting management system.

To avoid reliance on a single vendor and to enable connected operation, the lighting management system shall utilise the international ISO protocols of LON, DALI and BACnet. The ISO 14908 LON protocol shall be used for communication between all the lighting control modules and the routers and the DALI IEC 60929 protocol for communication with DALI ballasts, drivers, emergency devices as well as DALI local control devices. BACnet ISO 16484 protocol shall be used for sharing information between the lighting management system and the BMS. Under no circumstances will a proprietary communication protocol be acceptable for use within any portion of the system or part of the project.

The entire Delmatic system shall be monitored in real-time. Graphical software shall provide a “window” into the installation enabling the user to manage and monitor the system, provide real-time feedback and display the active status of lighting against project-specific layout screens.

Automatic commands shall be generated using a calendar software scheduling programme which enables different regimes to be allocated for individual tenant areas of the building and for different times of the day or year. The system shall provide integrated control of corridor, circulation, staircase and exit lighting such that exit lighting is secured while office and working areas are occupied. The system shall enable lighting levels in circulation routes to be adjusted during out-out-hours periods and shall enable lighting in stairwells to be configured such that lighting is energised ahead of the individual such that a lit path forward is created when going up or down the stairs.

The system shall be decentralised and incorporate distributed intelligence such that every lighting control module contains built-in intelligence to ensure that local operation of a unit can continue in the event of head-end PC failure. To ensure distributed intelligence, each control module shall contain a Lon neuron together with non-volatile memory which stores operational parameters for that module.

Reliable and high speed communication is of the utmost importance, and the system shall utilise a transmission speed of not less than 78,000 bps on a dedicated bus between the lighting control modules and the routers. The system shall utilise handshake acknowledgements of signals and confirmed receipt of messages between items of hardware. The communication between system hardware will include embedded authentication for secure signal transmission.

Integrity of operation is paramount and all lighting control modules and routers shall be powered by mains power sources. No modules shall derive their operating power from the buswire or any central/field bus power supplies as these represent single points of failure. Systems which use power supply units to power control modules via the bus shall not be acceptable.

The system shall integrate with the fire alarm system to automatically activate exit lighting in the event of alert: integration shall be directly between the fire alarm and the lighting management system routers.

The system shall control water solenoid valves within the toilets such that the presence detectors activate lighting based upon occupancy as well as regulating the water supply based upon occupancy.

The system shall enable incoming tenants to enhance the system within their domain through the incorporation of a wide range of features including scene-setting, access-control and room-booking integration, Bluetooth asset-tracking and wayfinding, user control devices such as Touchpanels and Touchpads, lighting control from web-browser, IP phones, mobiles and Apps as well as integration with other services such as AV, window blinds and black-out blinds.

**System equipment**

The system shall comprise the following:

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| ***Network PC and Delmatic Lightscape software*** | Image result for DELL pc |
| The network PC shall host the operating system and Delmatic lighting management Lightscape software and shall be supplied to the following minimum specification.   * Latest Intel processor. * 4Gb RAM and 500Gb Hard Drive * Integral CD-ROM drive with read-write facility . (CDRW Drive) * Integral modem * Keyboard, Mouse and 23” TFT Monitor * Windows 10, LNS operating system and LNS network card. |
| ***Delmatic Lightscape project graphics*** | C:\Users\Stephen\Desktop\Brochure and Technical Guides\Technical Guide 2016\components\monitor.jpg |
| Project-specific graphics shall display the active status of each luminaire against background building layouts and shall enable authorised users to manage lighting, alter automatic times, and reconfigure grouping arrangements.  Software shall provide the following: |
| * project specific graphic displays detailing the position of every luminaire against background building layouts * monitor and display the active status of each addressed output (DALI channel and DALI luminaire) * full active monitoring of DALI drivers for lamp and ballast failure * virtual wiring reprogramming and reconfiguration achieved through drag and drop graphics * white tuning of DALI 8 drivers * hierarchy of access levels (individual and on a role basis) * log the run-time of each addressed output * test and monitor DALI emergency devices * software-configurable presence detection and absence detection with software adjustable time-out periods * software-configurable daylight-linking thresholds and operating parameters * calendar timing schedule with multiple regimes for different areas and tenants * astronomical time clock software * secure access with multiple levels of password and access rights. * real-time monitoring and diagnostics of system hardware, module, sensor and network operation. * scheduled backups of system data * for maintenance and future-proofing it shall be possible to remotely upgrade on-board software on all system hardware from any point on the network. | |
| ***Delmatic Network Router - Delmatic Lon Router*** |  |
| Lon Routers (as detailed on the project schematic) shall optimise the data flow and routing of information between the network PC and the Lighting Control Modules.  The Lon Routers shall form part of the building-wide lighting management system architecture, ensure open and seamless communication across the horizontal and vertical networks and optimise the transmission of data. | N:\Marketing\2 - Product Images\1 - Product images\Lon-Router- small    - (106D1).jpg |
| Code protected controls shall provide user access to master on and off functions, emergency test and loadshed routines. The Router shall incorporate four volt free inputs for direct digital master on and off control, loadshedding, emergency-test, fire alarm functions etc. The router shall also provide four digital (relay) outputs.  The router shall allow the connection of a lap-top for configuring and monitoring the network, and shall incorporate integral selectable network termination resistors. The router shall use the ANSI/EIA 709.1-A-1999 international protocol for communication via integral FTT-10A transceiver. The router shall also provide system monitoring status indication including Lon transmit and receive activity, vertical and horizontal bus transmission and emergency test status.   * router optimises data routing and transmission * seamlessly connects vertical and horizontal networks * includes integral code-protected master control overrides * master command functions for e-test, load shed, global on/off * incorporates four volt free inputs for direct commands from other systems * provides four digital (relay) outputs * allows connection of lap-top for configuring and monitoring the network * uses Lon ANSI/EIA 709.1-A-1999 international protocol * monitors system activity including vertical and horizontal bus transmission * incorporates integral network termination resistors * supports up to 64 lighting control modules * three digital inputs plus four digital outputs * 500m maximum network cable length (free topology) * 1500m maximum network cable length (bus topology)   dimensions - 380 (w) x 150 (h) x 70 (d) | |

**Lighting Control Modules**

The lighting management system shall include various types of DALI lighting control modules as specified below and as detailed on the lighting layout drawings.

Modules shall be applied to specific areas of the building as follows:

Core areas – lift lobbies Delmatic DALI Broadcast Module

Core areas – toilets Delmatic DALI Broadcast Module

Core areas – carpark Delmatic DALI Broadcast Module

Core areas – staircases Delmatic DALI Buswire Module One

Office areas Delmatic DALI Plug-in Module (areas with false ceilings)

Delmatic DALI Buswire Module One / Three (areas with suspended luminaires)

Modules shall be as described on the following pages:

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| ***Delmatic DALI Plug-in Modules*** |  |
| DALI Plug-in One Ten ZP Modules shall provide individual addressing, switching, dimming and monitoring of DALI luminaire drivers, and shall provide total flexibility of control.  The module shall contain pre-addressed DALI ports and will not require the addressing of any DALI driver either on-site or prior to delivery. Should a DALI driver within a fitting require replacement at any time, the replacement driver shall not require addressing to function as part of the system. | N:\Marketing\2 - Product Images\1 - Product images\One-Ten-Six--30d_small.jpg |
| The DALI plug-in approach has been selected to avoid the requirement to address each DALI driver after installation and to avoid the need to address drivers when replaced as part of on-going maintenance. Systems or approaches which require the DALI drivers to be addressed shall not be acceptable.  The DALI Plug-in One Ten ZP Module shall provide individual addressable switching, dimming and monitoring of up to ten individually connected light sources. The module shall be equipped with ten six-pin ports/sockets on the module lid which shall provide switched Live, Earth and Neutral feed to the luminaire, maintained live (for self-contained emergency luminaires) and the DALI + and DALI – signal to the DALI driver.  The module shall be fed by a lighting sub-circuit from the DB protected by a 10A MCB. This circuit will feed the connected luminaires and power the module electronics, and connect to the module via a three-pin plug-in socket on the lid. The module shall not derive operating power from the buswire or any central/field bus power supply.  The module shall be equipped with ten addressable switching relays (plus a separate emergency test relay) providing ten individually addressed switched outputs associated with the DALI dimming outputs. The relays will provide DALI Zero Power functionality and turn off the 230V power to each luminaire when the DALI output is set digitally to 0%. This will avoid the waste of energy by DALI drivers remaining energised in standby mode.  The module shall provide individual monitoring of each DALI port/luminaire and shall highlight lamp/driver failure for each individual port. The module shall also provide individual monitoring of DALI emergency monitoring devices (such as EmPros) connected to each port.  The module shall accept the direct connection of local control devices and shall be equipped with sockets for the plug-in connection of local wall switches, presence detectors and multi sensors, and the plug-in connection of the polarity-insensitive unscreened twisted pair buswire.  The module shall use plug-in electronics for ease of maintenance, operate at a communication speed of not less than 78,000 baud, and be equipped with a plug-in LonWorks intelligence capsule and plug-in DALI dimming capsule.  dimensions: 345 (w) x 210 (h) x 55 (d) | |

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| ***Delmatic DALI Broadcast Modules*** |  |
| DALI Broadcast modules shall be utilized for control of DALI lighting in fixed areas as detailed in the specification, drawings, schematics and schedules. These modules shall be located within the Electrical Room / DB cupboard and will digitally switch and dim hard-wired DALI lighting outputs.  The DALI broadcast module shall contain pre-addressed DALI outputs and will not require the addressing of any DALI ballast either on-site or prior to delivery. Should a DALI ballast within a fitting require replacement at any time, the replacement ballast shall not require addressing to function as part of the system. | N:\Marketing\2 - Product Images\1 - Product images\DALI-Broadcast-small -   (204A1).jpg |
| The DALI broadcast approach has been selected to avoid the requirement to address each DALI ballast after installation and to avoid the need to address drivers when replaced as part of on-going maintenance. Systems or approaches which require the DALI drivers or drivers to be addressed shall not be acceptable.  The DALI Broadcast Module shall control luminaires fitted with DALI drivers or drivers and shall broadcast DALI commands to multiple drivers on a single DALI channel. A module shall connect to a maximum of 480 DALI devices comprising twelve DALI channels of up to 40 DALI drivers/drivers per channel. A single twisted pair cable shall be wired from the module to the DALI drivers/drivers on each channel.  The module shall broadcast switching and dimming commands to each DALI channel and monitor and highlight lamp failures along each channel. The module shall enable individual addressing and monitoring of DALI emergency devices along the DALI broadcast channel.  The module shall allow the connection of other DALI devices such as DALI switches and DALI sensors along each channel buswire. The module shall not require a separate buswire for the connection of local control devices to operate the channels of lighting.  The lighting circuit (or circuits) powering the luminaires shall be wired directly from the distribution board to the luminaires. A 230V supply (from the lighting circuit or other circuit) protected by a 10A MCB will provide power to the module. The module shall not derive operating power from the buswire or any central/field bus power supply.  The DALI broadcast module shall contain a plug-in LonWorks intelligence capsule for ease of maintenance and shall operate at a communication speed of not less than 78,000 baud.  dimensions: 330 (w) x 190 (h) x 70 (d) | |

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| ***Delmatic DALI Buswire modules – DALI Buswire One*** |  |
| DALI Buswire One modules shall be used as detailed on the lighting layout drawings, schematics and schedules to provide individual addressing of DALI drivers connected to a common buswire, and shall provide addressing along a single DALI bus.  These modules shall be located within the Electrical Room / DB cupboard or ceiling void as appropriate and shall switch, dim and monitor luminaires equipped with DALI drivers, LEDs with DALI drivers and DALI relays controlling non-DALI compatible fixtures. | **N:\Marketing\2 - Product Images\1 - Product images\DALI-Buswire-One-30d_small -   (205A1).jpg** |
| The DALI Buswire One module shall accept the connection of up to 64 DALI drivers or emergency devices plus up to 16 DALI local control devices such as DALI presence/absence detectors, DALI multisensors and DALI switches: the drivers and local control devices shall be connected to a common twisted pair buswire wired from each Module. The use of additional or separate DALI pairs or other buswires to connect sensors or emergency devices shall not be permitted.  The module shall provide total flexibility of control with individual addressing and monitoring of each DALI ballast or driver and the ability to group lighting into 16 DALI groups and to regroup through software without the need to access fittings or controllers in the area.  The module shall provide individual addressing and monitoring of each ballast and driver and shall monitor individual DALI lamp failures and drivers. The module shall also enable individual addressing and monitoring of DALI emergency devices (such as EmPros) along the buswire.  When they are delivered to site all DALI luminaires are the same and unaddressed so DALI luminaires connected to a DALI buswire module require to be addressed on site prior to configuring and grouping. The DALI short-address address of each luminaire ballast or driver shall be assigned post-installation through software via a hand-held programming device such as a laptop or tablet: addressing shall be carried out without disturbing the lighting control module, luminaire, detectors or ceiling.  The lighting circuit (or circuits) powering the luminaires shall be wired directly from the distribution board to the luminaires. A 230V supply (from the lighting circuit or other circuit) protected by a 10A MCB will provide power to the module. The module shall not derive operating power from the buswire or any central/field bus power supply.  The module shall use plug-in electronics for ease of maintenance, operate at a communication speed of not less than 78,000 baud, and be equipped with a plug-in LonWorks intelligence capsule and plug-in DALI dimming capsule.  dimensions: 225 (w) x 133 (h) x 66 (d) | |

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| ***Delmatic DALI Buswire modules – DALI Buswire Three*** |  |
| DALI Buswire Three modules shall be used as detailed on the lighting layout drawings, schematics and schedules to provide individual addressing of DALI drivers connected to a common buswire, and shall provide addressing and grouping control along three DALI bus universes.  These modules shall be located within the Electrical Room / DB cupboard or ceiling void as appropriate and shall switch, dim and monitor luminaires equipped with DALI drivers, LEDs with DALI drivers and DALI relays controlling non-DALI compatible fixtures. | **C:\Users\Stephen\Desktop\TG17 - 41 - Dali Buswire Modules rev 1..jpg** |
| The DALI Buswire One module shall accept the connection of up to 192 DALI drivers or emergency devices across three DALI universes plus up to 48 (16 x 3) DALI local control devices such as DALI presence/absence detectors, DALI multisensors and DALI switches across the three universes: the drivers and local control devices shall be connected to a common twisted pair buswire wired from each Module to each of the three DALI universes. The use of additional or separate DALI pairs or other buswires to connect sensors or emergency devices shall not be permitted.  The module shall provide total flexibility of control with individual addressing and monitoring of each DALI ballast or driver and the ability to group lighting into 48 DALI groups and to regroup through software without the need to access fittings or controllers in the area.  The module shall provide individual addressing and monitoring of each ballast and driver and shall monitor individual DALI lamp failures and drivers. The module shall also enable individual addressing and monitoring of DALI emergency devices (such as EmPros) along the buswire.  When they are delivered to site all DALI luminaires are the same and unaddressed so DALI luminaires connected to a DALI buswire module require to be addressed on site prior to configuring and grouping. The DALI short-address address of each luminaire ballast or driver shall be assigned post-installation through software via a hand-held programming device such as a laptop or tablet: addressing shall be carried out without disturbing the lighting control module, luminaire, detectors or ceiling.  The lighting circuit (or circuits) powering the luminaires shall be wired directly from the distribution board to the luminaires. A 230V supply (from the lighting circuit or other circuit) protected by a 10A MCB will provide power to the module. The module shall not derive operating power from the buswire or any central/field bus power supply.  The module shall use plug-in electronics for ease of maintenance, operate at a communication speed of not less than 78,000 baud, and be equipped with a plug-in LonWorks intelligence capsule and plug-in DALI dimming capsule.  dimensions: 335 (w) x 130 (h) x 140 (d) | |

**Local Control Devices**

The system shall include local control devices as follows.

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| ***Delmatic DALI Presence Detectors***  Passive infra-red presence detectors shall relate lighting to occupancy and switch lighting on when motion in an area is detected and extinguish lighting after a software programmable time delay following vacation of areas.  The operational parameters and the software time-out period of each detector shall be configurable through the head-end graphical software. The operation of the detector shall be software configurable as Presence (on and off operation) or Absence (off only operation with manual on operation from another local device eg. switch)  The detector shall be designed for ceiling mounting and shall provide a detection field diameter of twice the mounting height such that a sensor mounted at approximately 2.5 m from floor level provides an area of coverage of 5m diameter. The detector shall include LED trigger/transmit indication.  dimensions - depth: 35 mm, bezel diameter: 49 mm, cut-out diameter: 40 mm | N:\Marketing\2 - Product Images\1 - Product images\DALI PIR Presence - Absence detector_small    -   (163B1).jpg |

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| --- | --- |
| ***Delmatic DALI Multisensors*** |  |
| Multi-sensors shall combine absence/presence detectors with daylight linking / photocell control.  The passive infra-red absence/presence detector shall relate lighting to occupancy and shall extinguish lighting after a programmed delay following vacation of individual areas. The photocell sensor shall measure the lighting level and dim lighting to compensate for the contribution of natural daylight.  The operational parameters and the software time-out period of each detector shall be configurable through the head-end graphical software. The operation of the detector shall be software configurable as Presence (on and off operation) or Absence (off only operation with manual on operation from another local device eg. switch). The sensitivity and configuration properties of the photocell shall also be fully configurable through the system software.  The detector shall be designed for ceiling mounting and shall provide a detection field diameter of twice the mounting height such that a sensor mounted at approximately 2.5 m from floor level provides an area of coverage of 5m diameter. The detector shall include LED trigger/transmit indication.  dimensions - depth: 35 mm, bezel diameter: 49 mm, cut-out diameter: 40 mm | N:\Marketing\2 - Product Images\1 - Product images\DALI PIR Presence - Absence detector_small    -   (163B1).jpg |

**DALI Emergency Lighting Testing and Monitoring**

The system shall provide DALI Emergency Lighting Testing and Monitoring.

It shall be commissioned by Core Electrical – Built Enviro Ltd

Self-contained emergency fittings shall be equipped with DALI drivers and DALI emergency gear such that the system can monitor all aspects of the emergency luminaire operation as part of the shell and core integrated network. Any emergency luminaires without DALI based monitoring shall be clearly identified and subject to a separate regime of manual testing procedures.

The self-contained emergency luminaires shall be equipped with two individual DALI devices – a DALI ballast for the normal gear and a DALI emergency monitoring device for the emergency battery/changeover unit. The system shall continuously monitor the normal gear (DALI ballast) for lamp failure to enable pre-emptive emergency lamp replacement without the need for a duration or function tests. The system shall also continuously monitor all DALI emergency devices for inverter circuit or battery failure without the need to interrupt lighting by conducting a duration or function test.

Tests of the DALI emergency luminaires shall be carried out automatically by the system based upon the intervals and time durations specified within EN 50172: tests may be scheduled to take place on specific days (such as weekends) or other out of hours periods and may also be manually initiated from the head-end graphical software.

Setting up and verification of the DALI emergency lighting testing and monitoring feature requires all the emergency packs in an area to be installed and commissioned while testing is subject to recharging-periods (typically twenty-four hours) which prevent repeat testing and witnessing during a single twenty-four hour period. Such timescales are not always compatible with the need to complete areas against the tight and variable deadlines leading up to initial project completion. Therefore, in some instances conventional manual testing and witnessing of the emergency lighting may be employed and, thereafter, a further period of time shall be allowed to rectify any issues highlighted as the system conducts automatic tests of the DALI devices.

**System Interfaces**

The lighting management system shall interface with other building services systems as follows:-

***Fire Alarms***

The lighting management system shall interface with the fire alarm system. On a fire alarm condition, all designated lighting (typically circulation and exit lighting) shall be turned on.

***BMS for connected presence-related control of interoperable HVAC***

The lighting management system shall integrate with the BMS system such that HVAC is related to occupancy measured by the lighting management system presence detectors. The lighting management system presence detectors, absence detectors and multisensors shall monitor occupation and presence within each area and pass this data to the BMS via BACnet integration at the Router.

***Security integration***

The lighting management system shall interface with the security system such that lighting in exit and corridor routes can be activated during a security alert. Integration shall also permit lighting within circulation routes and office areas to be automatically energised upon access by known individuals.

**Network cabling**

***Vertical backbone buswire cabling***

The lighting management system vertical Lon data buswire shall connect the network PC to the Lon Routers: the cable shall be run in a serial manner and shall comprise an unscreened, twisted pair run on the comms cable tray.

The cable shall be unscreened twisted pair as Firefighter type 4001P2044-BW-20AWG.

The cable length shall be a maximum of 1000m.

***Horizontal buswire cabling***

The lighting management system horizontal Lon data buswire shall connect the Lighting Control Modules to the Router as detailed on the system schematic: the cable shall be run in a serial manner looping in and out of each module. The Lon cable shall comprise an unscreened, twisted pair run on the comms cable tray.

The cable shall be unscreened twisted pair as Firefighter type 4001P2044-BW-20AWG.

The cable length shall be a maximum of 1000m.

***DALI cabling***

The DALI buswire shall connect the DALI drivers, DALI emergency devices, DALI sensors and DALI switches to the lighting control modules: the cable shall be run in a serial manner looping in and out of each device. The DALI cable shall comprise an unscreened, twisted pair run on the comms cable tray or alongside mains cables.

The cable shall be unscreened twisted pair as Firefighter type 4001P1444-14AWG.

The cable length shall be a maximum of 300m.

**Tenant Options**

|  |  |
| --- | --- |
| The system shall enable incoming tenants to enhance the system within their domain through the incorporation of a range of local user control devices such as scene-set panels, Touchpanels and Touchpads as well as integration with other services such as AV and window blinds.  ***DALI Switch Interface***  Lighting management system switches shall comprise standard push button momentary-action, two-way-and-off retractive switches (sourced by the contractor to match other electrical accessories) equipped with a DALI interface (supplied by the lighting management system supplier) to convert the switch activation into a DALI signal. The DALI Switch shall be connected to the switch and to the DALI bus that connects the DALI module and the DALI luminaires and shall mount within the switch back-box.  The switch interface shall be programmed through software to operate the relevant lights and shall be configurable as switching or dimming operation. A short switch press will turn lights on and off: a press and hold action will dim lighting up and down.  dimensions: 46 x 32 x 14 (d) mm | N:\Marketing\2 - Product Images\1 - Product images\DALI switch interface -     (119A1).jpg |

|  |  |
| --- | --- |
| ***Touch Scene Set Panels*** |  |
| Touch scene set panels shall provide powerful touch control of six lighting scenes, six blind and solar shading scenes as well as six Biodynamic lighting scenes: master raise and lower buttons shall enable the global level of the selected scene to be increased or decreased and the colour temperature to be adjusted while a selector button shall enable the desired function to be chosen.  The panel shall include proximity detection activation, shall contain nine touch-activated zones, and shall enable the colour of the status LEDs to be adjusted from up to 32 user-preferred colours.  Scenes shall be fully configurable through the graphical software and may be actioned locally from the scene set panel or automatically based upon timed schedule or daylight levels. The scene set panel shall include status indication of which of the scene is activated irrespective of whether this has been selected locally or automatically.  dimensions: 86 x 86 mm |  |

|  |  |
| --- | --- |
| ***Touchpanel*** |  |
| Wall-mounted touchpanels shall provide user control of lighting as well as other connected services.  The touchpanel shall comprise a 7” optically-bonded glass touchscreen with precision aluminium bezel and frame and shall fit into a standard two-gang back-box.  The touchpanel shall provide high-resolution graphics while backlighting shall ensure images are sharp, vivid and bright. Custom-configured menus shall enable users to select the relevant functions, controlling lighting scenes as well as other integrated services such as blinds, and temperature setpoint as specified.  The touchpanel shall connect to the lighting management network and transmit user commands via the DALI network or via Lon to other interoperable building services devices: an IP Ethernet connection shall enable the Touchpanel software and graphics to be centrally updated and amended, while an integral power supply shall provide the unit with operating power.  dimensions (mm): 202 x 160 x 12 (deep) | N:\Marketing\2 - Product Images\1 - Product images\Touchpanel with graphic.jpg |

|  |  |
| --- | --- |
| ***Touchpad*** |  |
| Desktop touchpads shall provide user control of lighting as well as other integrated services.  The table-top device shall comprise a 7” optically-bonded glass touchscreen, precision aluminium bezel and frame, and integral USB power port.  Custom-configured menus shall enable users to select relevant functions, controlling lighting scenes as well as other integrated services (as detailed later) such as blinds, and temperature setpoint.  The touchpad shall transmit infra-red data to a ceiling-mounted multisensor which shall also provide software-configurable presence or absence detection and photocell daylight-linking within the area. | N:\Marketing\2 - Product Images\1 - Product images\Touchpad with graphic.jpg |

**System configuration and testing**

The electrical contractor will purchase the lighting management hardware and software from the system supplier and will install the hardware, cabling and buswires as part of the electrical installation.

The system will be supplied to site such that the electrical contractor can validate the power and bus wiring during installation, prior to making the system available for commissioning by the controls supplier.

As part of the installation, the contractor will record the control module addresses and the luminaire/lamp connections on the drawings to enable preparation of the lighting management databases by the supplier/commissioner.

### Quality Assurance

#### Proven competence

The controls manufacturer shall have a minimum of ten years proven record in the design, manufacture and world-wide support of professional lighting control equipment.

#### Processes

The manufacturer shall have a recognised quality system for the design, engineering and manufacturing processes registered to ISO 9001:2008.The manufacturer shall have a recognised environmental management system for the design, engineering and manufacturing processes registered to ISO 14001:2004.

The manufacturer shall be able to demonstrate commitment to the Waste Electrical and Electronic Equipment regulations 2006 (WEEE Directive 2002/96/EC).

#### Certification

All equipment shall carry CE and shall fully comply with the Restriction of Hazardous Substances regulations (RoHS Directive 2002/95/EC), proof of compliance shall be available from the manufacturer upon request.

Equipment safety shall be by the application of EN 60950-1:2006. Alternative safety standards shall only be accepted where the manufacturer can demonstrate equivalence.

Insulation electrical safety testing shall be at not less than 4 kV RMS.

All equipment shall be specified for operation to Pollution Degree 2. The working ambient temperature range shall be 0 to 40 deg oC and to 90%, non-condensing, relative humidity.

Mains powered load interface units shall be rated for installation category (over voltage category) II.

Electromagnetic compatibility shall be demonstrated by the application of EN 61000-6-3:2007 emission standard and EN 61547:2009 immunity standard. Alternative standards shall only be accepted where the manufacturer can demonstrate equivalence.

Electrostatic discharge immunity shall be tested by the application of IEC 6000-4-2:2009. Surge immunity simulating the effects of lightning strikes shall be tested by IEC 6000-4-5:2006.

#### Warranty

All equipment shall carry a minimum of two years warranty under normal use and service to be free from defects in materials and manufacture. The warranty shall include programming and commissioning carried out by the manufacturer.

During the warranty period the manufacturer shall bear the costs of replacement or repair necessitated by equipment failure the cause of which being attributable to the manufacturer.

The warranty period shall commence from when the equipment is first energised after installation.

The manufacturer shall offer repair or make available new, refurbished units or replacement alternatives to ensure maintenance of functional operation of the installed equipment for a period of six years from the commencement of warranty.

## Electrical Services Associated with Lifts

### General

The supplies are 400volts, 3 phase, 4 wire, 50 cycles, 230 volts between phase and neutral. A supply will be provided by an Electrical Contractor in an agreed position and terminated in 3 phase and neutral iron clad isolator switch. The Lift Contractor shall be responsible for all necessary electrical wiring for plant and controls, together with all control equipment from the isolating switches to the various components in the panels. The Non-Fire Lifts shall have a single supply of 400V 50 cycle 3 phase. The Fire Lifts shall have a dual supply of 400V 50 cycle 3 phase fire rated cables to BS 8519:2020 rated for 120mins. The lifts shall be designated as fire fighting lifts and supplied from the life safety side of landlord distribution panel (see schematic).

Please refer to Lift Specification for overview on the lift installation.

### Wiring Rules

Wiring to the provision of this specification the General Rules for wiring for the supply of electric energy as specified in the NSAI I.S. 10101 and directives issued by the Electricity Supply Board shall be strictly adhered to by the Contractor.

The General Rules for wiring herein referred to are the National Rules for Electrical Installations of the NSAI I.S. 10101:2020 (all relevant parts). Sub-System certification shall be provided for each lift installation in accordance with Commission for Energy Regulation requirements.

### System of Wiring: Cable in conduit

Where cables in conduit are specified they shall be protected throughout their length by screwed welded galvanised steel conduit, terminating in cast iron or pressed steel boxes at the fittings, switches etc. Conduit shall be Class B. to B.S.S. 4568 1970 and no tubing shall be smaller than the 20 mm. dia. or have metal less than 15 s.w.g. The thickness of metal shall increase in proportion to the increase in diameter.

The capacity of the conduits shall be in accordance with the Institution of Electrical Engineers Rules Table 12 A-D (Regulations for Electrical Equipment in Buildings) 15th edition.

C.I. oblong intersection joint "T" and other necessary boxes shall be screwed full thread into which the conduit must fit tightly. Screw cutting oil shall be used as a lubricant when screw cutting, which must be afterwards carefully removed.

Tubes are to be properly screwed, the thread fully worked and when screwed up no rings shall be noticeable on the outside of the tubes. Conduits are to be mechanically and electrically continuous across all joints and earthed in accordance with the Clause marked "Earthing".

Surface conduit shall be run either vertically or horizontally so as to avoid unsightliness and to conform to the architectural features of the building. The conduit shall be to the Engineers approval and fixings to walls and steelwork shall be adequate in number and in mechanical strength to support the conduit rigidly. All fixings shall be by means of spacer bar saddles using either slotted or keyhole pattern to permit the retaining screws. The conduit shall be laid out for the loop in system of wiring and no joints shall be permitted in the wiring, except at outlet boxes.

All bends shall be made as far as possible from conduit and no bend shall have a radius smaller than 2.5 times the outside diameter of the conduit. Elbows and tees shall not be used except in positions approved by the Engineers. When complete the conduit must be water tight and electrically continuous throughout.

No cables are to be inserted until the conduit and boxes are fixed and the plastering complete and no pull greater than 15 KG shall be exerted. Talc powder shall be plentifully used.

Socketed and screwed brass bushes shall be used on all ends through which cables or wire is moved in either direction.

Conductors shall be tinned high conductively copper LSF insulated, 600 volt grade to comply with B.S.S. 6004 1995 600/1000 volt grade. Red covering shall be supplied on all switch wires and black on all neutral wire.

All conductors shall be stranded and shall not be smaller than 1.5 sq. mm. Connectors between cables shall be made by means of mechanical connections of approved type. Conductors sizes for services other than lighting and sockets shall be as outlined hereafter or as indicated on drawing or schedule.

Early connection shall be easily accessible and shall have a resistance not greater than that of the equivalent length of the largest conductor to which the connector is fixed. The maximum voltage drop between any point where the circuit leaves a fuseboard and any outlet point shall not exceed five volts. The conduits shall be as manufactured by Messrs. Tube Rollers Ltd. or similar to approval.

Cable insulation shall have a minimum CPR Rating of Dca-s2,d2,a2.

### System of Wiring: Cable Trunking

Where specified, cable trunking shall be manufactured from 1.2 mm. galvanised sheet steel in nominal length of 3.5 m. similar to Messrs. Electrofast Ltd. or equal and approved. Trunking shall be complete with all the necessary couplings, blank ends, attachment assemblies, suspension brackets etc. The trunking and suspension brackets shall be of a design to allow the trunking lid to be removed without disturbing the suspension bracket. Cable retainers shall be installed at 600 mm. intervals. Cable trunking lid shall be galvanised steel with side returns and shall be held with locking bar with slotted stud.

### System of Wiring: Final Connections

Wiring shall be enclosed throughout (except trailing cables) in trunking and conduit. Where flexible final connections are required they shall be in flexible conduit Anaconda "Sealite" plastic covered type or equal and approved properly glanded at each end. The use of flexible cords for final connections is prohibited.

### Earthing

All conduit, motor, switchgear, doors and frames, etc. or any metalwork whatsoever adjacent to the electrical equipment shall be earthed to the main earthing system in the Building. The earthing to be by means of conductor of high conductivity copper and its sectional area shall not be less than 2.5 sq. mm.

The conductor shall be protected in conduit or copper sheathed throughout its length. Flexible steel tubing shall not be considered to be effective for earthing and an earth wire shall be run through the tubing.

### Electrical Distribution & Circuit Protection

The Design & Build Contractor to include for distribution and circuit protection associated with lift drive and lift lighting / socket requirements. The Contractor shall provide wiring details of all Lift proposals in their submission.

### Electrical Testing

The Design & Build Contractor shall test the installation to comply fully with the requirements of the NSAI as set out in the National Rules for Electrical Installation I.S. 10101:2020 & Amendments, and Commission for Energy Regulation requirements.

## Electrical Vehicle Charging

### General

The Electrical Vehicle (EV) charging system shall be provided to 10% of the parking spaces. The system shall have the capacity to expand to 100% of the parking spaces and shall have the ability to me managed locally by the building management or remotely via the local authority vending system.

The location of the chargers shall be as indicated on the drawings. Chargers shall generally be mounted on external columns in the positions indicated on the drawing.

The system shall be an intelligent system allowing for load management of the connected chargers. The system shall be supplied complete with required management software.

Power supplies to the chargers shall be in accordance with Section 722 of IS 10101:2020. Charging equipment shall be provided with integral RCD or d.c. earth leakage detection.

Equipment shall comply with IS EN 61851 and the criteria set out in Directive 2014/94/EU.

The preferred system shall be the Zaptech Pro system as supplied by Core Electrical.

### Charging Stations

Charging station shall be suitable for mounting on a wall or on a floor mounted column. Generally, a single charger shall be installed to serve two parking spaces.

Chargers shall be supplied complete with mounting equipment and sundries.

### Columns

Colums shall be mounted in accordance with manufacturers instructions. Typically a single mount column shall be utilised in the position indicated on the drawings. Where twin chargers are indicated on the drawings, the columns shall be of the twin column types. Colums shall be suitable for the mounting of the charger units.

## Electrical Bicycle Charging Facilities

Charging facilities shall be provided for electrical bicycles in the bicycle parking areas in the positions indicated. The charging facility shall be turvec system and shall be mounted in accordance with the manufacturer’s specification.

## Electrical Scooter Charging Facilities

Charging facilities shall be provided for electrical scooters by means of an electric scooter docking system as supplied by Turvec. Each docking station shall be provided with 5No IP66 rated sockets.

## Electrical Services to Mechanical Plant

### General

The Electrical sub-contractor shall supply, install, connect, test and commission all power and control wiring associated with the mechanical installation. The operation of control devices, control panels and mechanical plant shall be the responsibility of others and shall not form a part of this Contract.

The Electrical sub-contractor shall refer to the Electrical and Mechanical Services drawings and specifications to ascertain the location of the mechanical plant control devices and equipment that require electrical services. Please refer to the electrical power to mechanical plant drawings for full quantity and locations.

All control wiring shall be carried out in a minimum of 4 core 0.75sqmm screened cable such as Belden 8723 or equal and approved. The Electrical contractor shall install all cabling in conduit or trunking. The Electrical contractor shall liasise with the mechanical contractor for all cable sizes, specifications, final connection points and routes.

All power wiring shall be carried out using Dca-s2,d2,a2 rated cables.

Electrical supplies for trace heating of pipework, where required, shall be provided by installing switched fused connection units located adjacent to the point where the tracing heating tape starts. They shall be complete with neon indicators, match other accessories installed in the project and shall be located in prominent positions. They shall be engraved with the following wording in red letters: **"TRACE HEATING - DO NOT SWITCH OFF"**.

The Electrical sub-contractor shall supply and install all isolators, emergency lock stop push buttons and switched fused spur outlets as necessary for the correct completion of the installation. These shall be appropriately rated for the environment in which they are to be installed.

The Electrical Sub-Contractor shall be responsible for the main power supply and wiring and installation of control devices as listed on the schedule. Control devices shall be supplied by the Mechanical Sub-Contractor to all mechanical services plant and equipment.

The cabling shall be as follows:

* Power cabling - as per points schedule
* Control cabling - as per points schedule
* Exposed control cabling – as per schedule but screened Belden with additional PVC outer sheath suitable for exposed conditions installed within conduits.

The following details the extent of Controls System included in both the Electrical Sub-Contractor’s and mechanical Sub-Contractor’s scope of works.

The general responsibilities shall be that the DDC hardware, software, field equipment, co-ordination drawings and commissioning shall be the responsibility of the Mechanical Sub-Contractor, whereas the supply, installation and termination of all field cabling (power and controls) and isolators shall be the responsibility of the Electrical Sub-Contractor. (see points schedule within the appendix of this document)

### Mechanical Contractor’s Scope of Works

**General**

The following clauses outline the scope of works to be included in the Mechanical Contract. However, unless works are specifically included under the "Electrical Sub-Contractor’s Scope of Works", any works required to make the entire system operate in a safe and efficient manner, to the intent of this Specification, shall be deemed to be included in the Mechanical Sub-Contractor’s scope of works.

**Specific Requirements**

All fuses including spare fuses, up to Practical Completion shall be replaced by the Mechanical Contractor.

All control instruments shall be installed so that there is adequate clearance for removal of any such item without dismantling any other item of equipment and that all wiring connections can be visibly inspected without removing the item.

The following shall be supplied and fitted; pockets adjacent to all pipe work thermostats and temperature detectors, suitable for mercury in glass thermometers; pressure tapings complete with stop cocks across all ports of control valves for each hydraulic tube connection; access panels adjacent to all ductwork mounted temperature, humidity and air flow detectors; welded bosses or screwed tees for water flow switches, with an oversize branch connection bushed down.

All controls items, equipment and plant including valves and dampers associated with the control system shall be provided with an engraved ‘Formica’ label with the appropriate identification as detailed on the Controller and Regulator Schedules.

### Electrical Contractor’s Scope of Works for Mechanical Installation

**General**

All electrical works shall be in accordance with the requirements of the Electrical Specification.

**Installation**

The Electrical Sub-Contractor shall be responsible for the supply, installation and termination of controls cabling and power cabling to all mechanical services loads and controls devices as indicated on the mechanical drawings, inclusive of all cable trays, ladders and baskets that may be required between the MCC panels and the mechanical equipment. The contractor shall allow in his pricing for the design procurement and installation of the containment, based on the equipment in the MCC schedule.

The Electrical Sub-Contractor shall not supply or install any controls cables or power cables until full field cabling diagrams and schedules are produced by the Mechanical Contractor and approved by the Architect.

The Electrical Sub-Contractor shall inform the main Contractor, within three weeks of awarding the contract, when these drawings are required to be supplied.

The Electrical Sub-Contractor shall liaise with the Mechanical Sub-Contractor to establish the exact location of each field devices.

The Electrical Contractor shall agree a system of cable labelling with the mechanical contractor, which shall meet with the approval of the design team.

Room mounted temperature sensors or other such devices, which require a wall box to be installed, shall involve supplying the wall box (or similar device) to the Electrical Sub-Contractor who will fit it into the wall. Termination of all sensors shall be by the Electrical Sub-Contractor.

All room or wall mounted sensors shall be cabled within galvanised steel conduit which, on finished plaster surfaces shall be concealed. Liaison with the Mechanical Sub-Contractor is essential to determine if any special fittings are required to be installed by the Electrical Sub-Contractor (e.g. wall box).

All detecting devices and control actuators shall have final terminations in flexible form, long enough to permit the removal of the devices without disconnection. This flexible connection shall be left tie wrapped in a neat manner where it cannot be damaged by the day-to-day workings of the device it connects to.

All cabling shall be run within galvanised steel conduit or trunking, as per the Specification.

Unless otherwise specified all controls cabling shall be 0.75mm² Belden screened twisted pair for controllers (with the letter ‘C’ in their reference code) and 0.75 mm² Belden double twisted pair with overall screen for regulators (with ‘R’ in their reference code).

The Electrical Sub-Contractor must obtain final confirmation on precise wiring specification for each device from the mechanical contractor prior to ordering cables.

Full and prompt co-operation with the mechanical contractor required.

## Disabled Alarm Systems

### General

A full disabled refuge system shall be installed as per fire certificate requirements. Please refer to the fire alarm drawings for quantity and location for each disabled refuge point. Each building shall be provided with a separate system.

### Disabled Refuge Intercom Specification

The system shall be specifically designed for use within buildings containing refuge areas, and or fire stairwells, and or disabled toilets and shall be compliant with BS9999:2017, BS5839 part 9 and BS8300:2009. The system shall be battery backed for 24 hours in quiescent mode then 3 hours in full power. The system shall be fully monitored and faults reported back to the master control panel, located in the Reception Area. The system shall be able to control 256 remote units on a network system. The system shall be able to communicate with disabled refuge remotes, emergency/stewards telephone, roaming telephones and disabled toilet alarms from the master control panel.

The EVC system shall have the following features:

* Fully monitored and battery-backed (24 hours quiescent and three hours functional).
* Fully compliant to BS5839-9:2011.
* Assists companies with compliance to BS9999:2017.
* Fully networkable.
* Outstations shall be connected to the control panel and network expansion panels in a radial configuration using fire rated two-core cable.
* Control panels and network expansion panels shall be networked using two 2-core cables in a loop configuration. In the event of a break in the loop, the system shall continue to function.
* An optional link to fire detection system shall prevent hoax disabled refuge calls (C2CFPE required). Firefighter, roaming telephones and toilet alarms shall remain active.
* Speech steered; disabled refuge outstations.
* Full duplex speech; Firefighter and emergency/steward telephones.
* Any combination of the following outstations should be able to be installed on a single system:
* Disabled refuge remotes (Type B outstations).
* Firefighter telephones (Type A outstations).
* Emergency telephones (Type A outstations).
* Roaming telephones.
* Disabled toilet alarms.
* All outstations shall be powered from the line, including the roaming telephone enclosure and disabled toilet alarms.

### Master Control Panel

The control panel shall have a bright and clear LCD screen and operation shall be via a rotary encoder. Any combination of the outstations shall have the capability to be connected to the panel.

#### Master Control Panel shall have the following features:

* Black or brushed stainless steel finish.
* 4 way control panel – expandable to 16 way.
* Optional 4 way expansion kit shall be available. Up to three shall be fitted per panel, enabling 8, 12 or 16 way control. (Not factory fitted.)
* Clear LCD screen with rotary encoder/control.
* Rugged red handset with hearing aid compatible earpiece.
* The handset shall be mounted in a lockable compartment to prevent misuse.
* System programming and set up shall be via the front panel or by connection of a laptop to the Ethernet port.
* Fault relay for indicator at fire panel.
* Full system monitoring.
* Indicators for ‘power’, ‘incoming call’, ‘refuge areas active’, ‘system healthy’, ‘processor restart’, ‘common fault’, ‘processor fault’.
* Housing shall include integral batteries to enable continuation of system use during mains power failure (24 hours in standby and three hours operational).
* The unit shall be surface mount with an optional flush mount bezel available.
* Optional fire panel interface shall be available.

Each building shall be provided with it’s own Master Control Panel located at the Reception area of the building. The provision for the amount of ways are as indicated on the schematic diagrams.

#### Fire panel interface card & Ethernet:

* A module shall be available that allows connection to the fire panel which fits in the control panel.
* Outstations are permanently ‘active’ (including DRS).
* When fitted, disabled refuge outstations will only be active when the fire panel has been activated.
* emergency/stewards telephones and disabled toilet alarm units shall remain permanently active when the device is connected to the fire panel.
* This module also provides a socket for a permanent Ethernet connection.

#### Control panel 4-way expansion kit:

* The master and NEP units shall be supplied as 4 way units. It shall be possible to expand these to 16 way by fitting 4 way expansion modules.
* Each module enables the addition of four outstations.
* Add these modules to the control panel(s) and/or NEPs as required.
* Up to three modules can be added per panel/NEP.

#### System expansion:

It shall be possible to have two control units on a network system. One shall act as the ‘master’ with the other being a ‘slave’ unit.

* As an option, two panels shall be installed on a networked system. (A network expansion card is required for each panel.)
* The master panel will typically be placed in a manned control room. The second panel will act as a ‘slave’ unit, unless activated as the ‘master’ (generally for emergency use only).
* The master and slave panel can communicate with each other (initiated by the master panel).
* Expansion is also possible by installing ‘network expansion’ panels.
* Up to 16 outstations can be connected to each panel (or network expansion panel) The ‘master’ control panel will operate all outstations on a networked system.

#### Network expansion:

The EVC system shall have network capabilities and for system expansion NEPs shall be connected.

* With the NEP very large EVC systems shall be catered for.
* Up to fifteen NEPs shall be fitted on one system (or fourteen if installing two ‘control’ panels).
* Each NEP is supplied with a 4-way line card for connection to four outstations (for more, the 4-way expansion kits can be fitted as per the control panel).
* Systems with up to 256 outstations shall be possible with the NEP.
* The unit shall be surface mount with an optional flush mount bezel available.
* Black or brushed stainless steel finish.
* For initial system set-up and local testing prior to connection to the network, it shall be possible to connect a ‘roaming telephone handset’ to an internal socket.
* At each NEP, the status of local outstations can be viewed by using the rotary encoder and LCD screen.
* Enclosure includes integral battery backup.

#### Network card :

* A network card shall be added to each control panel for inclusion on a networked system. These shall be fitted as standard in NEPs.

### Disabled Refuge Remote

The disabled refuge remote shall provide clear, hands-free, two-way communication between person(s) in a refuge area and building control (or fire officers) during an evacuation event. The unit supplied shall be of Type B outstation as defined in BS5839-9 - for use by the public and disabled persons requiring assistance. The disabled refuge outstations on the system shall remain permanently ‘active’, however, by fitting an optional module they can remain in ‘standby’ mode until activated by the fire panel.

#### Disabled Refuge Remote Units shall have the following features:

* Green finish.
* Induction loop output to feed external amplifier.
* Surface mountable (optional flush mount bezel available).
* Calls shall be reset at the control panel.
* Hands free operation.
* Speech steered.
* Powered from the line.
* One remote unit shall be installed per refuge area.

### Disabled Toilet Alarm

### General

A disabled toilet alarm system is required for each disabled toilet in the building. This shall allow a person in distress within the toilet to raise an alarm to summon for assistance, there shall be a local alarm sounder located above the outside of the toilet door, and also a link to the reception desk to ensure that the response to the alarm is reacted to in a efficient manner. Each building shall be provided with a separate system.

**Disabled Toilet Alarm Units shall have the following features:**

* Fit directly to the main control panel (or NEP).
* Be fully compliant to BS8300
* Up to two toilet alarm kits shall be able to connect to one line (and indicated at a single point on the panel).
* As an alternative, it shall be possible to connect an additional ceiling pull – to enable connection of two ceiling pulls to each reset and overdoor light (allowing the ability to use for rooms with two points of call).
* The toilet alarm system shall be powered from the line and not require local power.
* The components shall be available with a choice of either a white or brushed stainless steel finish.

Each kit shall comprise:

* 1 x ceiling mounted pull switch (with two ‘G’ pulls).
* 1 x reset button with LED and sounder.
* 1 x overdoor triangular lens with integral sounder.
* Components shall be available separately enabling a combination of white and brushed stainless steel finish to be fitted.
* When the ceiling mounted cord is pulled, the overdoor light/sounder shall operate. The alarm shall be raised at the control panel, where the call shall be accepted/ acknowledged. When the call is accepted at the panel, the caller shall be reassured that help is on the way due to the change in rate of the sounder.
* Monitored battery backup – from main system
* Powerful LEDs and sounder
* Plug on terminals to ease installation
* Twin G pulls on the ceiling pull switch
* Reset point with re-assurance LED
* Over door light with sounder
* A disabled WC door sign shall be included

**General Information**

* There shall be three main components - the control/slave panels, network expansion panels and the remote units.
* Remote units shall be wired in a radial (star-wired) configuration. Control/NEP panels are loop wired on the network.
* Any number of jack sockets (for the roaming telephone) shall be daisy chained (up to 500m). One handset shall be operational per line at any one time.
* Back boxes are required for the jack sockets and toilet alarm items. All other outstations (and the control panel) shall be surface mounted or flush mounted with bezel.
* The control panel shall be typically wall mounted in a central control room.
* Remote units are wall mounted in locations such as refuge areas, stairwells, fallback positions, corridors and other ‘gathering’ points, at a height easily reached by users.
* All outstations shall be powered from the line, including the roaming telephone enclosure and disabled toilet alarms.
* The system shall be configured via the encoder on the control panel or by connecting a laptop to the Ethernet port in the panel (cable supplied).
* It shall be possible to connect disabled refug and disabled toilet alarms to one panel.
* It shall be possible to fit up to two disabled toilet alarms to one line. (Or one toilet alarm with two ceiling pulls.) These units shall be directly powered from the line.

### Cabling Requirements

* Disabled refuge - two core, fire resisting, enhanced.
* Disabled toilet alarms - two core, fire resisting, enhanced.
* Network loop - 2 x two-core fire resisting, enhanced.
* Up to 500m cable run between each remote unit and the control/NEP panel.
* Up to 500m cable run between each control/NEP panel.
* Maximum overall length of the network is 5Km (i.e. network ring length + cable length to the furthest outstation = <5Km).

### Demonstration and Training

In addition to attendances and brief system training at a client handover seminar the contractor will allow training to be given to personnel nominated by the client at a time to be agreed with the client. The contractor shall provide for 2 No. 2 hour training sessions at the agreed time. The training is to include basic system operations and procedures including use of the logbook.

## Earthing and Bonding

### General

The Electrical sub-Contractor shall supply, install, test and commission the complete earthing and bonding system for the entire complex. The entire system shall conform to the requirements of the NSAI. Clean earth bars c/w insulated mounts are required in the comms room which shall be wired using a dedicated 25 sq. mm. conductor from each bar out to a dedicated array of external copper underground driven rods. The earth bars will also be linked back to the main building earth via a wall mounted earth bar located in the main switchroom. From the clean earth bar a dedicated 16sq mm earth conductor shall be run to each comms cabinet and terminated onto the cabinet earth stud with lugs.

Raised access floors and ceiling grids shall be bonded via 4mm². Circuit earths shall be in accordance with the particular specification (2.5mm² and 4mm² for lighting and GS respectively). For mechanical equipment cabling, refer to the mechanical plant schedule fore required protective earth sizes. Refer to the main SLDs for required protective earth sizes. All local equipotential bonding shall be in accordance with NSAI, with earth sizes used capable of conducting fault levels that may be present from adjacent plant.

All metal / flow forge in all risers, ducts, plant rooms and generally on all floors and levels shall be bonded to to ensure continuity to the system earth.

The contractor shall refer to the earthing schematic for specific bonding cable sizes.

### Site Earthing Conditions

The site earthing conditions are detailed in Appendix 5 of this document.

### Earthing Equipment

All components supplied and installed shall be from one system vendor as Furse or equal and approved.

### Installation and Testing

The entire system shall be installed to the manufacturer’s recommendations and the electrical sub-Contractor shall co-ordinate with the Main Contractor and Mechanical sub-contractor for routing and connection with earth and bonding contractors. Earth cabling shall be LSF insulted green/yellow copper cable. The Electrical sub-Contractor shall test the whole of the earthing and bonding system.

### Commissioning

The Electrical sub-Contractor shall submit a completed Certificate for the entire system to comply with the NSAI regulations for the new installation.

## Lightning Protection System

### General

The Contractor shall include for the complete supply installation, testing and re-commissioning of the Lightning Protection Installation as specified herein, in compliance with IS EN 62305-3-2006.

An LPL category IV system shall be provided as a minimum.

The Air Terminals shall be copper taper-pointed Air Rods, of 500mm length and 15mm diameter, complete with flat saddle for support on flat surfaces, or ridge saddle for support on ridges. The flat and ridge saddle to be complete with a four-way pass-through tape joint and Four No. Fixing Points, 100mm separate and 90o displaced from each other.

Conductive Tape on roof shall be of high-conductivity PVC coated, annealed copper, measuring 25mm wide x 3mm thick. PVC cover shall be provided to all horizontal conductors on Main Roof.

Conductive Tapes shall be fixed to the roof structure and wall structures with non-metallic clips, suitable for copper tape and complete with screw fixing.

Down conductors shall be tape or circular PVC covered copper as proposed for the roof and external to structure were possible.

Test clamps shall be provided prior to connection to the earth rods.

Square Tape Clamps for forming straight through, cross or tee joints shall be provided where required.

Test Connectors shall be provided, as indicated on the Drawings.

Equipment Earthing Points shall be as indicated on the Drawings and shall be manufactured from copper and cast into the concrete structure for parts being newly constructed.

They shall be bonded to the Structural Steel Members, which shall be used as the down-conductor, by means of 70sq.mm. bare copper cable, clamped to the steel and ‘Cad-Welded’ to the earthing point.

Earths, wherever possible, shall be copper clad steel rods driven into soft ground.

Earth inspection pits shall be concrete or plastic.

Earth Rods shall be molecular bonded 99.99% pure electrolytic copper, with a minimum thickness of .25mm onto a carbon steel core. Rod couplings shall be counter-bored and made from silicone aluminium bronze.

All metal protrusions from the Building and their associated services shall be bonded to the Lightning Protection System.

PVC Wrapping Tape of similar colour as the PVC covered tape shall be wrapped around all joints.

Denso Tape shall be wrapped around all underground tape and joints.

The whole of the system shall be in compliance with BSEN 62305, The Protection of Structures against Lightning.

Upon completion of the installation, the whole of each system shall be tested and all results duly recorded.

The Installation shall not be deemed to be complete until a satisfactory Test Certificate is issued.

All windows between Building corners and down conductors shall be bonded to the down conductors.

The combined earth loop impedance shall not exceed 1.0 ohm. The resistance of earth continuity conductors should be measured to ensure that the resistance is no greater than 0.5 ohm.

The lightning protection vendor shall note that a metal brie soleil window system is proposed for this project. The contractor shall bond to this system throughout the installation.

### Installation

A prepared IS EN 62305 Risk Assessment, based on confirmed local thunderstorm days per year, must be provided by the proposed lightning protection engineering specialist, at time of submission of tender.

Structures to be provided with comprehensive and coordinated lightning protection & equipotential bonding SPD system in strict accordance with IS EN 62305. The finished lightning protection installation must be such that the risk to the structure is within the “Rt” or tolerable risk, determined by a prepared complete and comprehensive IS EN 62305 Risk Assessment.

Enhanced Service Entry SPD’s and coordinated SPD’s must therefore form an integral part of the installation proposal and must be in keeping with the determined

LPL protection level and risk assessed kA ratings and must provide a maximum “Up” of 600v Class III protection at the sub distribution panel coordinated SPD locations, to cater for the equipment withstand voltage – I.S. 10101, Category I, impulse-withstand-voltage.

Submitted tenders based only on selective or part lightning protection proposals and which do not include for full “R1” and “R2” IS EN 62305, Parts 1 to 4, will not be considered.

Supportive documentation must be included with tender submissions, confirming that;

* The lightning protection specialist installers are annually trained and certified to design/supply/install test and certify in strict accordance with IS EN 62305-Parts 1 to 4.
* The lightning protection specialist installers employed for the installation of the internal/external lightning protection systems are competent electrically qualified tradesmen with current trade union membership.

All lightning protection components used should be pre-certified by one manufacturer, to IS EN 62561 Manufacturer’s component certification, confirming compliance with IS EN 62561 will be required at time of submission of tender proposals. Where RSJ or metalwork connections are concealed within the building fabric, permanent “B” Bond connections will be used, as opposed to inaccessible clamp-on or grub screw type connectionsMixing of different manufacturer’s components will not be permitted.

All Lightning conductors to be HC 25mm X 3mm flat conductor (75 sq. mm) and conductive oxide inhibiting compound will be used on all connections.

An on-going site log of earth electrode resistance readings must be maintained and updated upon installation of each of the earth electrodes. These earth electrodes will be re-tested upon completion of the installation and the results of which will be included within the IS EN 62305-PART 1 TO 4 completion certificate.

In accordance with IS EN 62305, where roof Faraday cage conductors are installed, consideration must be given to the need for “isolation” or “bonding” of roof mounted equipment. In this regard, the specialist installer must apply the appropriate IS EN 62305, formula calculation, based on risk assessed lightning currents and separation distance “s”, documented calculations will be required. This will determine the appropriate air terminal and roof conductor requirements.

All metalwork, flues, gutters, RWP’s, mechanical plant, vents, safety harness latching systems, etc., to be considered (in compliance with IS EN 62305 bonding or isolation requirements) for inclusion within the lightning protection system.

The spacing of the lightning protection “down conductors” will be determined by the risk assessment LPL for this project. The arrangement and frequency of the Faraday grid roof conductor system will be determined by the risk assessment LPL for this project.

Any provided lightning protection design layouts or implied protection methods for this structure should be taken as guide line only and the appointed lightning protection specialist is expected to expressly apply the IS EN 62305 standard to its fullest, thereby resulting in a fully compliant, coordinated lightning protection system.

The specialist lightning protection engineering company will be responsible for the integrity of the finished design/installation and it’s compliance with ALL aspects of IS EN 62305-Parts 1 to 4 inclusive and I.S. 10101 final circuit withstand voltages.

### Earth Electrodes:

A type “A” earthing system, in keeping with IS EN 62305, will be installed. Earth electrodes (steel cored, copper bonded, minimum 16mm dia) will be deep driven at the determined LPL dictated spacing, around the perimeter of the structure to be protected.

Where deep driven earth electrodes cannot be installed or where considered unsuitable due to soil conditions, or building LEMP requirements etc., a type “B” earthing system will be employed.

In the event that driven earth electrodes are not practical or achievable, due to prevailing rock or shale, alternative arrangements, by way of a combination of conductive aggregate and earth electrodes installed within provided (provided by others) core drilled holes, will be installed.

The earth electrode termination system will be incorporated within heavy duty earth inspection pit boxes, designed specifically for this purpose and capable of withstanding 5000 Kg point load.

In keeping with the new IS EN 62305 standards, earth electrodes will be installed, based on the methods specified for avoiding “step voltages”, by ensuring that the earth electrode is isolated from the top 500mm below finished ground level.

External metal RWP’s will be integrated into the earth electrode system and will require individual consideration when installing earth electrodes.

Where reinforcing steel within structural concrete support columns is used as “down conductors” or requires bonding to, the newly required “dual” connection method to the re-bar, must be included and dedicated re-bar “dual” clamping between floor levels will be required.

All earth electrode connections and re-bar connections will include oxide inhibiting, conductive paste, as an integral part of the electrical connection and will be wrapped in moisture repellent wrap, to ensure continued performance for the life of the installation.

### Testing and Certification:

The lightning protection engineering specialist will be responsible for ongoing soil evaluation, by way of soil resistivity tests and these tests will be carried out by way of a 4 pole test meter, using the Wenner principal.

A current and up to date calibration certificate must be provided for the test instrument, by the lightning protection specialist, with serial number, model number and manufacturers name. This will be required to accompany all provided test readings.

The completion certificate shall be fully compliant with IS EN 62305-PARTS 1 to 4 and shall include details of site conditions, prevailing weather and precise date of testing and signature of testing engineer.

The final certificate shall show individually obtained earth electrode test readings for each of the earth electrodes, their location on the “as installed” lightning protection drawing and the overall “System” reading obtained from the finished installation.

The Certificate must also detail the Service Entry and Coordinated SPD’s installed and confirm their functionality in protecting against “R1”, Risk to Loss of Human Life and “R2”, risk to loss of services, from the calculated Direct & Indirect lightning strike risks.

**Note.** In the event that the final IS EN 62305 test certificate is not provided in the above described detail or in keeping with IS EN 62305 PARTS 1 TO 4 INCLUSIVE, a third party lightning protection specialist will be brought in, at the discretion of the Consulting Engineer, for the purpose of carrying out a complete lightning protection system inspection, testing and certification.

The costs of this will be deducted, as seen appropriate, from the original contractor’s payment.

#### Essential documentation to be provided at time of submission of tender proposals is as follows:

* Project specific, IS EN 62305 Risk Assessment software printout in full.
* Manufacturer’s certification for each of the proposed lightning protection components.
* Identified Service Entries and Coordinated SPD types and classifications for same.
* Confirmation of proposed earthing system type and method.
* Confirmation of proposed lightning conductor size and type.
* Confirmation that mixed manufacturers components will not be employed (IS EN 62561).
* Confirmation that the completed installation will be fully compliant with all aspects of IS EN 62305-Parts 1 to 4.
* Confirmation that the completed installation will be fully compliant with all aspects of IS EN 62305, including installation of the required Class I, II & III Co-Ordinated, Full Seven Mode, Enhanced SPD’s, with maximum 600V let-through voltage between all Line, Neutral and Earth conductors.
* Supportive documentation as described in item 3 above, with regard to Qualification & Training Certificates and electrical qualifications of the lightning protection installation engineers.
* Confirmation that the lightning protection tender proposal incorporates all of the necessary SPD’s required to comply with the latest Edition of the National Rules for Electrical Installations I.S. 10101 (specifically relating to the Category I, impulse-withstand-voltage of final circuit equipment).

## MV Switchgear

### Scope of Works

The scope of works related to the MV switchgear includes the supply, delivery to site, rigging into position, installation, testing and commissioning of a new MV switch consisting of an incoming circuit breaker and two feeder circuit breakers, as indicated on the MV schematic diagram. The MV switchgear in the ESB substation shall be supplied and installed by the ESB. The Switchgear in the consumer MV switchroom shall form part of this contract.

### Standards

The Medium Voltage Switchgear shall be designed and manufactured in accordance with the relevant Irish Standards (or IEC Standards where an Irish equivalent does not exist) and in particular with:

|  |  |
| --- | --- |
| IEC 60265 | High Voltage Switches for rated voltages above 1 kV and up to and including 52 kV |
| IEC 62271 | Common specifications for high-voltage switchgear and control gear standards (All Parts) |
| IS EN 61936 | Power installations exceeding 1 kV a.c |
| IEC 62445 | Use of IEC 61850 for the Communication Between Control Centers and Substations |
| IEC 60427 | Specification for High-voltage alternating current circuit-breakers. |
| IS EN 60129 | Specification for alternating current disconnectors and Earthing Switches |
| I.S. 10101:2020 | Electrical Installations |
| IEC 60044-1 | Instrument transformers – Current Transformers |
| IEC 60044-2 | Instrument transformers – Voltage Transformers |
| EN/IEC 60529 | Degrees of protection provided by enclosures (IP Code) |
| IEC 60255 | Electrical Relays (all parts) |
| IS EN 60947 | Low-voltage switchgear and control gear (all parts) |
| IEC 60073 | Basic and safety principles for man-machine interface, marking and identification - Coding principles for indicators and actuators |
| IEC 60282 | High voltage fuses (for rated voltages exceeding 1000 V) |
| IEC 60137 | Bushings for alternating voltages above 1000 V |
| IEC 60502 | Power cables with extruded insulation and their accessories for rated voltages from 1 kV (Um = 1,2 kV) up to 30 kV (Um = 36 kV) |
| IEC 60060 | High voltage test techniques |
| IEC 60060 | High voltage test techniques |
| The Safety, Health and Welfare | Safety, Health And Welfare At Work 2005, and Safety Health and Welfare Act (Construction) Regulations 2013 |
| Supply Authority Network Standards | ESB Network Standards, including Conditions Governing Connection to the Distribution System and Distribution Code |
| Supply Authority Network Standards | ESB Network Standard, National Code Of Practice for Customer Interface |

### Service Conditions

The Medium Voltage switchgear shall be suitable for installation and continuous operation into a naturally or forced ventilated indoor environment.

All MV switchgear shall be designed to operate under the service conditions detailed in the schedules, and as defined in IS EN 60694.

### Manufacturing/Shop drawings

Submit drawings of all assemblies as noted in this specification for their acceptance and approval.

Submit a schedule/register of drawings and update.

Drawings shall be in the format specified herein and show the following information:

* manufacturer's name and type of any standard equipment
* the general arrangement of equipment
* full details of cabinet construction and dimensions
* the method of supporting busbars and equipment
* a description of all materials to be used
* clearances between live parts, and live parts and earth
* busbar dimensions and ratings
* internal wiring sizes and ratings
* the size and wording of labels
* wiring diagrams and schematics of instrument protection and control circuits
* front elevation
* vertical section through each compartment
* sheet metal details
* finishing process details
* weights of assemblies heavier than 500 kg for structural co-ordination purposes
* details of:
* maximum fault withstand ability
* IP rating to EN/IEC 60529.

### MV Switchgear Panel Construction

MV Switchgear panels shall be of the modular, factory built metal enclosed type. The equipment to be supplied shall consist of separate panels which shall be extendable, safe and easy to operate and low maintenance. Each panel shall have separate compartments for:

* Switchgear
* Busbar
* MV cable connection
* LV + ELV compartment, accessible with MV cables and busbars energised
* Fuse compartment (as applicable)

Panels shall be operated from the front with each panel provided with identification labels indicating functions and electrical characteristics as well as a simple mimic operating diagram.

Panels shall be constructed to provide total protection of personnel under fault conditions.

Panels shall be floor mounted cubicles suitable for bottom entry cabling and constructed with arc propagation barriers; tested to confirm their capability to withstand internal arcing at rated prospective fault level.

Footprint of switchgear shall not exceed 696 width, 1906 height, 751 depth.

Panels shall generally be equipped with the following:

* HDHC fully insulated or air insulated copper busbars.
* Fixed operating device (circuit breaker/switch).
* Local/Remote Control Selector Switch (Circuit Breakers)
* Mechanical and illuminated (LED cluster type) on/off indicators.
* Cable earthing (3 position switch).
* Spring charged indicators.
* Open/close push button.
* Air filled rear cable box (if applicable).
* Mechanical operation counter.
* Phase connected/live indicators.
* Comprehensive mechanical interlocks.
* Padlocking facilities for doors, operating buttons and levers.
* Thermostatically controlled anti condensation heaters.
* Auxiliary contacts to monitor device status on/off/earth.
* Motor charged spring closing mechanism (circuit breakers)
* 48V DC motor drive for remote operation with shunt trip release
* Protection Relays
* Test Blocks
* Current transformers, voltage transformers and meters

### Switchboard Enclosure

The Switchboards shall be fully assembled and tested before leaving the factory.

### Access Arrangements

* The enclosure shall have full segregation between all low voltage and Medium voltage compartments.
* It shall not be possible to access any MV compartment from a LV + ELV compartment, under any operating conditions.
* Access to any live parts of the system shall be prevented at all times, including under fault conditions, by means of design or use of interlocking devices.
* It shall not be possible to bypass interlocks that prevent access to live parts.
* Any feature that allows bypassing of the interlocks shall be subject to approval in writing.
* Entry for control and instrumentation cables to each low voltage compartment shall be possible via segregated and fully enclosed cable ducts from underneath each separate unit.
* To minimise the effects of electro-magnetic interference, adequate clearance shall be maintained between:
* power cables, control cables and communication cables; and
* power cables and control cable trays;

### Control Switches

Provide push buttons and control switches for the following:

* Remote Automatic/Remote Manual/Local Manual
* Open and close

### Busbars

* Busbars shall be hard-drawn, high-conductivity (HDHC), electrolytic or superior grade copper of adequate cross section and supported by post insulators.
* The main busbars shall have the same current rating throughout the length of the switchboard.
* Horizontal and vertical busbars shall have epoxy moulded insulation or air insulated.
* Busbars and connections shall be so arranged and supported such that under no circumstances, including short-circuit conditions, can the clearance between:
* live metal and earth or earthed metal work; or
* the live conductors of different phases,
* be less than the minimum clearances specified in relevant applicable Irish and International Standards.
* Busbars and feeder connections shall be provided with phase colour coding at all connections and ends to identify the phase. Phase identification shall be using non-flammable material.
* Busbars shall be rated for the higher of:
* maximum possible power flow on any feeder connected to busbar;
* nominal rating of circuit breaker; or
* nominal rating of cable switch.
* All feeder connections shall be rated for the higher of:
* maximum possible power flow on the feeder;
* nominal rating of circuit breaker;
* nominal rating of cable switch; or
* nominal rating of cable.
* The busbars and connections to equipment shall maintain adequate flexibility to allow for thermal expansion and contraction.
* All sections of each busbar shall be of an equivalent rating.
* Busbars shall be connected to the elements of the high voltage system by means of branches.
* All busbar contacts and connections shall be electro-tinned or silver plated.
* Sliding or rolling surfaces other than stainless or hardened components shall be zinc electro-plated and passivated.
* Busbars shall allow the addition of panel/s to be added at a future date.

### Earthing

* The earthing bars for each of the panels making up the switchboard shall be interconnected by a set of copper bars and shall be connectable outside the switchboard and extend over its full width.
* The cross section of the busbars shall be sufficient to withstand the rated short circuit current of the switchgear.
* All metallic parts of each panel shall be connected to the main earth bar.
* The earthing bar shall be arranged to provide connection to the main earthing bar of the substation without dismantling any of the bars.
* The earthing bar shall be suitable for connection to a substation earth bar at least at two independent points.
* The earthing of cables shall only be possible when the switch is open.
* Earthing switches shall be capable of operating with a short circuit making capacity to withstand the fault level applicable at that location.
* Provide details of mechanical interlocking function to ensure the earth switch cannot be closed without the switch being open.
* Provide a pad locking system to lock the earthing switch in the open or closed position.
* All earthing devices must either be capable of being viewed so that visible indication of earthing is given or indicating devices must be positively linked to earth switch operating mechanism.
* Provide facilities for earthing of busbars.

### Circuit Breakers

The Circuit Breakers shall:

* use vacuum/air insulated for current interruption;
* require only minimum maintenance and shall provide a high level of electrical endurance;
* be interlocked with the power circuit disconnector so that the disconnector cannot be open unless the circuit breaker is open;
* The position of the circuit breaker contacts shall be clearly indicated by the operating mechanism.
* The mechanical and electrical endurance shall exceed 10,000 operations.
* Non-resettable operations counter
* Circuit breakers shall have the following positions:
* Service position
* Test position
* Disconnected position
* Removed position
* Earthed position
* Circuit breaker shall be suitable for operation at the nominated control voltage.
* The operating mechanisms shall be of the trip free type so that the circuit breaker is free to open during the closing operation and the operation shall ensure anti-pumping whereby repeat closing is entirely prevented. It shall be possible to lock the circuit breaker in the isolated position
* A motor charged spring closing mechanism shall be fitted. A manual spring charging facility shall be provided.
* Electrical shunt trip and spring release (remote close) coils shall be fitted. An alarm for failure of spring charge shall be provided.
* A mechanical push to trip button shall be fitted to allow manual operation.
* Mechanical indicators shall show the circuit breaker condition:
* Open/Trip/Closed
* Earth Switch Open/Closed
* Spring charged/discharged
* Each primary disconnect contact shall comprise of opposed sets of spring loaded, self aligning contact fingers fitted to the circuit breaker. The fixed contact shall have plain silver-plated coating
* Circuit breakers shall be provided with a means of operational testing when in the test or part withdrawn isolated position. The local switchboard mounted tripping device and closing device shall be operable in the test position. All other remote and automatic control circuits shall be inoperable in the test position.
* The spout bushing for the primary disconnect fixed contacts shall be covered by earthed metal shutters. The shutters shall be independently positively driven open and closed by two independent means as the circuit breaker is moved to and from the service location. Shutters shall be openable for testing purposes. Shutters shall also have the ability to be padlocked closed.

### Earthing Switches

All Earthing Switches shall:

* have a rated short-circuit making current equal to the rated peak withstand current;
* be designed and so placed that the operation of earth switches does not pose any risk to operator safety;
* The earth switch mechanisms shall be designed so that, in the event of failure of the operating mechanism, the earth arms shall not swing from the open position into the closed position under the action of counterweights or springs and similarly if the device is closed it shall not swing into the open position;
* be of identical performance and characteristics;
* be closed and opened from the front of the MV Switchboard;
* be provided with an inspection window to check the physical contacts of the earth switch to ascertain its position; and
* have mechanical indicating devices positively linked to the earth switch operating mechanism.
* The earthing blade shall be fitted with a means of directly connecting to the substation earthing grid via a dedicated, fully rated earth connection. The earth switch shall connect the earthed equipment to this earth blade.
* The manual operating mechanism shall not be located higher than 1200 mm above ground level.

### Switch Interlocks

The Switch Interlocks shall be provided as follows:

* the switch can only be closed if the earthing switch is open;
* the earthing switch can be closed only if the switch is open;
* the access panel for connection can be opened only if the earthing switch is closed;
* the device can only be closed if the earthing switch associated with the circuit is open;
* the switch is locked in the open position when the access panel is removed. The earthing switch may be operated for tests
* padlock facilities as follows:
* doors closed
* switching device is in open position
* earthing switch closed

### Circuit Breaker Interlocks

The Circuit Breaker Interlocks shall be provided as follows:

* as a minimum provision would be provided to padlock the following:
* doors closed
* switching device is in disconnected position
* safety shutters closed, separate facility for busbar and circuit shutters
* earthing switches closed
* switching device control circuit local/remote selector switches, if applicable, in all positions
* The transformer enclosure can be opened only if the earthing switch is closed (key interlock).
* the circuit breaker can only be closed if the earthing switch is open;
* earthing switch can only be closed when the circuit breaker is in the open;
* the access panel for connection can be opened only if the earthing switch is closed;
* if the trip circuit associated with the circuit breaker is faulty;
* if closing spring is not charged;
* the device can only be closed if the earthing switch associated with the circuit and the bus earth switch (if bus earth switch is provided) is open;

### Earth Switches Interlocks

The Earth Switch operation shall be interlocked such that:

* an earth switch can only be closed when the associated cable switch/ circuit breaker is open;
* an earth switch shall be prevented from being closed onto a live bus;
* an earth switch shall be prevented from being closed if the associated cable switch/ circuit breaker is NOT open; and
* the access panel for the MV cable termination compartment can be opened only if the earthing switch is closed

### Cable Termination

* Power cable terminations shall be from the bottom via a trench
* Control cable terminations shall be from the top.
* All cable terminations shall:
* be rated for the nominal and peak impulse voltages and short time fault rating; and
* be rated for the nominal current of the relevant functional device as a minimum.
* Cable termination shall be by plug in, elbow type, connections manufactured by Richs or approved equal
* Cable boxes shall be air insulated type and suitable for connecting the cables which rise vertically from the base of the unit;
* Panels shall be selected to allow termination of cable sizes as nominated on the associated drawings;
* The cable compartment shall be type tested to withstand internal arc faults;
* It shall not be possible to close the circuit main switch with the cable compartment cover removed.
* Where plug in type surge arrestors are used, provision shall be made for the inclusion of surge arrestors within the cable termination.
* Cable terminations shall be provided with a means of supporting cables which enter/ exit the switchboard.
* Cable terminations provided shall be sized to allow adequate space for trifurcation of three-core cables within the switchboard enclosure.

### DC Control Circuits

* All DC Control Circuits shall be arranged to facilitate external connections and to provide appropriate isolating points for circuit checking and fault finding. Isolations shall be possible in the form of slide-disconnect link terminals.
* Each slide-disconnect link terminal shall have a specific designation and shall be easily identified for the designated purpose.
* All DC supplies shall be brought to a common terminal group in each local control panel. The terminals shall be easily and safely accessible from floor level.
* Provide individual MCBs for each functional unit (circuit breakers and cable switches) to provide all DC power required by the components of the functional unit.
* Auxiliary contacts shall be provided on MCBs.

### Auxiliary Equipment

* Relays and controls shall be mounted at the front of the switchgear, in the top compartment together with protection relays.
* Control wiring shall be PVC insulated having a minimum cross sectional area of 1.5 mm², except for bus wiring and CT secondary wiring which will have a minimum area of 2.5 mm². The cable shall be rated at 105°C.
* Not more than two wires shall be connected to any one terminal, one wire at each side.
* Wiring across door hinges shall be protected against mechanical damage. Main and auxiliary circuit cables within an enclosure shall be segregated.

### Instrument Transformers

* Instrument transformers, namely current transformers (CT) and voltage transformers (VT) are required for both protection schemes and operational measurement within the MV electrical power network.
* Instrument transformers provided shall be suitable for their application in a main electricity distribution environment. The instrument transformers are to conform to the latest applicable IS/EN Standards:
* IEC 60044-1 Current Transformers; and
* IEC 60044-2 Voltage Transformers.
* Current transformers (CTs) and voltage transformers (VTs) shall be as follows:
* ring type CTs shall be bushing mounted and comply with IEC 60185. CTs shall be accessible safely without de-energising the main busbars
* CTs shall be provided as shown on the single line diagram.
* protection class of CTs shall be as shown below or other to be checked with engineer for approval and shall have a rated burden suitable for operation of the self-powered protection relay.

### Insulation

* Instrument transformers shall have necessary insulation as per the above Standards and in no case less than the highest voltages expected in the specific application.
* Instrument transformers shall be cast resin insulated, completely sealed, solid insulated type.
* Oil insulated instrument transformers will not be accepted.

### Principles of Operation

* Instrument transformers other than those working on inductive technology may be used only if they are proven to be more reliable and have less operation, maintenance and whole of life costs.
* Any instrument transformer proposed shall be based on a design that has been in “commercial service” for at least three years in an electricity power distribution industry in Ireland/Europe. Where a technology has not been in commercial service for three years, it shall not be offered.
* It will be at Engineer’s discretion to accept any technology that has not been proven for more than three years. All offers shall be supported with relevant references, details of installation and all necessary test reports and performance certificates.

### General Requirements

* Multiple ratios shall be achieved by reconnection of secondary windings taps only. Ratio changes shall not be achieved by reconnection of primary windings.
* Where multiple ratio, multi tap, multi core instrument transformers are provided, all testing associated with the instrument transformers shall be undertaken for each core, winding and tap.
* The instrument transformers shall be provided with necessary number of cores and windings with performances and classes of precision suited to the functional requirements of the devices connected to them.
* The specified performance of the instrument transformers shall be obtained without recourse to compensation devices or ancillaries for calibration.
* The instrument transformers shall have same short circuit withstand capability as that of any other high voltage elements at the point of connection of the instrument transformer.
* Polarity markings shall be provided on primary and secondary terminals of all instrument transformers and fixed on the instrument transformers so that it may be easily read without requiring disconnection of the instrument transformer.
* Secondary terminal markings shall be provided for each tap and each secondary winding. Each secondary tap including any test taps shall have their own individual terminal marking.
* All secondary terminations including connections from all taps, cores and test taps shall be brought out in the corresponding switchgear low voltage compartment. The termination of the instrument transformers shall, as a minimum, be in the low voltage compartment where the secondary devices are located and shall be arranged to be easily accessible from floor level.
* All secondary connections shall use slide-disconnect link test terminals to enable testing of protection and metering devices without removing any wires from terminals. The CT links should be arranged to fall to closed and the VT links should be arranged to fall to open.
* All MV instrument transformers, applied to a MV switchboard, shall be of identical technology in terms of insulation and principle of operation.
* All instrument transformers shall be arranged so that it is possible to conduct primary injection of the instrument transformers without requiring removal of the transformers. Connections for conducting primary injection testing shall be suitable for testing of instrument transformers to their full rating. All such provisions shall be clearly identified and instructions for testing shall be provided.

### Current Transformers

* CTs for all feeders (incoming or outgoing) shall be located on the cable side of the associated circuit breakers and on the circuit breaker side of the associated earth-switch.
* CTs for all feeders shall be arranged to allow access for maintenance and repairs without requiring a busbar outage.
* The minimum rated burden shall be 15 VA at any tap, for each CT core and windings. Rated burden of 5 VA shall be allowed for CTs with ratios at and below 100/1 Amps, subject to fulfilling the criteria as stated below.
* The minimum rated burden for each CT core and winding shall allow for the burden of connected secondary circuits and devices, plus an additional device, with similar burden.

### CT Primary Circuit Requirements

* The continuous thermal rating of the primary of the current transformer shall be greater than 120 % of the primary current at highest ratio connection of the current transformer.
* Where multi-core CTs are provided, the design shall be such that a burden change on any one core does not affect the performance of the other cores.
* Each CT shall have the necessary number of cores as required from the intended applications. As a minimum, the number of cores and their performance shall meet the requirements as below.
* For all CT cores applied to MV busbar protection, the specifications and ratios of CT cores in incomer feeder, outgoing feeder and bus-coupler shall be identical.
* Arrangement and order of the cores shall be based on the principle of overlapping protection zones.
* Primary terminals shall have polarity markings P1 and P2.
* The polarity markings for various circuits shall be arranged as below:
* For incoming feeder to a MV busbar, P1 located adjacent the MV circuit breaker;
* For outgoing feeder from a MV busbar, P1 located adjacent the MV circuit breaker;
* For bus-coupler, P1 terminal located adjacent the MV busbar, with P2 terminal located adjacent the bus-coupler circuit breaker; and
* For transformer neutral, P1 terminal located remote from the transformer bushing for externally mounted neutral current transformers.
* Cores shall be numbered sequentially according to their location relative to primary polarity P1 and P2 with the core closest to P1 identified as Core 1.

### CT Secondary Circuit Requirements

* The nominal secondary rating of all current transformers shall be 1 Amp unless otherwise indicated.
* The thermal rating current of the secondary circuit of the current transformer shall be 2 Amps in any connection configuration.
* The secondary short-time withstand capability shall be at least equivalent to that of the primary.
* The actual CT ratio for connection shall be confirmed with Engineer before commissioning. All pre-commissioning and commissioning tests shall be based on this selected ratio. Testing on all actual and derived ratios and shall be performed during factory acceptance testing and shall be performed for each CT provided.
* Secondary circuit shall have polarity marking and shall use xS1, xS2, xS3 and xS4. Where utilised, test taps shall have polarity markings xT1, xT2. ‘x’ represents the core number.
* CT secondary circuits for each three phase CT combination shall be normally connected in a star configuration. The common star point shall be formed on terminal blocks in each low voltage compartment. For the protection CTs, the secondary terminals that are towards the device to be protected shall be connected as the star point. For the metering CTs, the S1 terminals shall be connected as the star point.
* Each CT secondary circuit shall be earthed at only one point in each associated low voltage compartment. Where multiple CTs are connected in parallel in a protection scheme, the secondary circuit will be earthed at only one point adjacent the protection device.

### Voltage Transformers

### General Requirements

* To minimise spares requirements, all VTs provided for one switchboard shall be identical.
* Optional price shall be provided for high voltage fuses for VT’s.
* All VTs shall be provided with low voltage MCBs.
* Fuses and MCBs shall be graded to provide discrimination with all downstream protection devices and allow for a supply of secondary burdens to the limit of VT rated burden.
* VTs are to be equipped with dual secondary windings.
* The minimum rated burden shall be 50 VA for each VT secondary winding, subject to meeting the criteria listed below.
* The minimum rated burden for each VT secondary winding shall allow for the sum of:
* Burden of connected secondary circuits and devices. While calculating the secondary circuit burden all possible circuits that are required to be connected to the VT winding shall be considered, for e.g. connection of all VT loads on the busbar (due to failure of the main VT); and the additional burden due to protection and metering devices associated with any spare feeders. While considering the additional protection and metering circuit, the circuit with maximum burden shall be considered.

### VT Primary Circuit Requirements

* The continuous voltage withstand capability of the voltage transformer shall be at least 120% of the primary circuit’s nominal voltage.
* VT windings shall be such that a change in burden of one winding does not affect the accuracy and performance of the other winding.
* Primary circuit shall have polarity markings A1 and N.
* The neutral terminal of the primary winding shall be insulated for at least 2 kV for 1 minute. The neutral end of the primary winding is to be directly connected to earth adjacent to the VT.

### VT Secondary Circuit Requirements

* The nominal phase-phase secondary rating of all voltage transformers shall be 110 V ac.
* Secondary circuits of the voltage transformers shall normally be connected in star configuration. The star point shall be formed on terminal blocks in the associated low voltage compartment. It shall be possible to wire the secondary of the VT to open delta configuration by changes in wiring on the terminal blocks in the associated low voltage compartment, without the addition of any new terminals.
* Voltage connections (phase-phase or phase-earth) to the protection relays and metering circuits shall allow all functionality of the protection and metering equipment to be used without any limitation. Use of any specific function, e.g. directional power within the protection relay, shall not require changes to wiring and connections to the protection.
* Each VT incoming circuit shall be protected using three-phase lockable MCBs. Separate locks with minimum two keys shall be provided with each of these MCBs.
* All secondary circuits shall be protected by their own independent MCB. Where the same VT winding is used for more than one secondary circuit, a VT bus shall be formed within the switchboard and each individual secondary circuit shall be fed from this bus. A fault in any one secondary circuit shall not cause tripping of the complete VT supply.
* Coordination of fuses and MCBs shall be performed.
* The secondary short time withstand capability shall be at least be equivalent to that of the primary.
* Each VT shall have dual secondary windings. High quality assurance procedures should be followed taking into consideration that any failure of one single VT winding does not cause the loss of metering and protection devices connected to the other winding. Where dual secondary winding VTs are required, the design shall be ensure that burden changes on either winding will not affect the performance of the other winding.

### Wiring

All low voltage and ELV circuits of each functional unit shall be factory wired. Inter-cubicle wiring shall be by the switchgear manufacturer.

Only the LV and inter-cubicle connections arriving from outside the MV switchgear shall be wired on site. Outside cables may enter at either end of the switchgear. Wiring shall be identified by codes which comply with the indications given in the wiring diagrams from the manufacturer.

All wiring shall be carried out in a neat and orderly manner and securely fastened to appropriate mounting points within the switchgear.

### Labelling

Provide labels for every panel, pilot lamp, push button, switch, relay and all indicating equipment. Labels shall be as follows:

* circuit title labels shall be of the plastic laminate type with black letters on a white background
* standard instruction and identification labels shall be either aluminium, plastic laminate or stove enamelled screen printed type with black letters on a white background
* warning labels of the permanent self-adhesive type shall be attached to all removable covers behind, which are situated live high voltage connections and where such connections are the main busbars, an additional label inscribed “busbars” shall be fitted.
* for each complete assembly, a purchaser’s nameplate should be included giving the following information:
* Project name
* Order number
* Manufacturer’s name
* Item tag number
* Year of manufacture
* Short circuit rating
* IP rating
* identification labels shall be attached to each removable cover/door of the switchboard to identify an internal CT/VT turns ratio, class and rating

### Low Voltage Equipment

The requirements of these clauses, where appropriate apply to switchgear and control components mounted in the low voltage compartments or remote from an assembly.

### Miniature Circuit Breakers

All miniature circuit breakers outlined herein shall be of the same manufacture throughout the installation. They shall be selected to fully discriminate and cascade and offer fault current limiting features in the range.

### Anti-condensation Heaters

Thermostatically controlled anti condensation heaters shall be provided to the switchgear panels. Heaters shall be powered by 230V single phase 50Hz supply.

Remote monitoring or indication of heater operation/failure shall be provided.

Anti condensation heaters shall be accessible and easily replaced without the need for dismantling of switchgear.

### Indication

### Indicator Lights

All miniature Panel mounted indicator lights shall:

* comply with IEC 60073
* be ultra bright cluster type light emitting diode (LED) type with a minimum design life of 50,000 hours equal to Telemecanique ZB series or higher range
* have Fresnel patterned coloured lenses of 19 mm diameter minimum
* be capable of being replaced from the front without having to remove the lamp holder assembly except where minimum design life of at least 100,000 hours is offered.

Installations having in excess of three indicator lamps on the one switchboard shall be fitted with a push to test button to verify the operation of the lamps powered from a common voltage supply.

Indicating lights shall indicate as follows:

* Functional device Open – Green
* Functional device Closed – Red
* Functional device Trip – Orange/Amber
* Trip circuit healthy – White
* Provide a lamp test button.

### Digital Power Meters

Allow to supply and install to the requirements below:

Power meters shall:

* Class 0.5s or better for power
* be of flush mounted type with door cut out, or DIN rail mounted with door cut out to allow the display to be visible with the door closed
* be suitable for continuous duty
* have digital liquid crystal display
* have RS232 serial or RS485 modbus/bacnet output suitable for a connection to a BMS or energy monitoring computer

The following maximum demand functions shall be stored and displayed with manual re-setting facility:

* active power
* apparent power
* current for each phase, including neutral where recorded.

Metering and display of the following instantaneous functions shall be registered on a single panel mounted digital instrument.

* kilowatt and kilowatt/hour
* true RMS volts, phase to phase and phase to neutral
* true RMS current for each phase
* power factor
* apparent power
* frequency
* true RMS current for neutral
* include THDV, THDI recording per phase and neutral
* be capable of displaying harmonic content up to 50
* include the facility, with vendor software, to record user programmable events and to record waveforms at the time of any defined trigger event

### Voltage Indicators

Each switchgear panel shall be provided with voltage indicators for each phase.

### Tools and Appliances

Provide necessary tools and appliances required to carry out routine operation and maintenance.

Tools and appliances shall be packed separately from the equipment and shall be marked as appropriate. All tags shall be of non-ferrous metal or plastic, with punched lettering. It is desirable that all tools and appliances be sent in the one shipment with the first delivery of the equipment. Small items of tools and appliances shall be supplied in transparent, moisture proof packages.

Each package shall contain identical components or sub-assemblies.

### Protection Relays

The Protection and Control equipment shall be provided as per requirements identified below:

### General Requirements

Each functional device (circuit breaker, isolator, etc...) shall be equipped with an electronic protection relay unit with adjustable protection settings nominated. The protection functions shall be provided as detailed in the schedules.

Protection relays shall be mounted in the associated Low Voltage compartment of each functional device.

Minimum requirements for protection and control systems are listed below:

* The protection and control equipment shall be capable of reliable operation within a frequency range of 44.5 Hz to 52 Hz for the MV System and shall be designed for operation at a system frequency of 50 Hz.
* All new protection and control devices or schemes shall make use of proven microprocessor technology.
* The protection and control devices shall have self-diagnostic features in the form of “internal device failure”.
* All processes within any protection and control devices shall be continuously supervised and alarms for non-healthiness of the units shall be connected to a terminal strip.
* On the detection of an internal malfunction within a device, the device shall block itself to prevent mal-operation or a circuit breaker trip.
* The self-diagnostic outputs shall use hard-wired fail-safe contacts to indicate unit failure and problems.
* All protection relays shall be wired via test blocks.
* Provide trip circuit monitoring and supervision.

Protection relays shall have suitable terminals for the connection of the following wiring:

* Current Transformers, Voltage Transformers and other input protection devices (light sensing, temperature, etc...)
* Functional device open/trip and close coils
* Communication and inter-trip to other protection relays
* Power supply
* BMS alarms and status
* Other control and monitoring points required within the switchgear

All wiring shall be via terminal blocks to allow for easy wiring during replacement/upgrade of protection relays. Terminal block shall have spare capacity for future wiring for other additional protection functions.

### Protection Scheme Philosophy

The key performance criteria for the protection schemes are:

* To be selective by ensuring that only the faulted part of the power network is removed from service in the least possible time under all system conditions.
* To ensure that a maximum portion of the healthy part of the power network remains available following the removal of the faulted part of the network due to a protection operation.
* To ensure reliable operation at any time for the entire period that the protection scheme is installed.
* To ensure stability for faults outside the intended zone of protection, except where the scheme operates as a backup to the failure of the protection acting as the primary protection in an external zone.
* To be sensitive enough to detect the lowest level of faults within the intended zones of protection, whilst not operating for normal load conditions.

### 48V DC Charger System

### General

48V battery and charger systems shall be provided as follows:

* Two (2) 48V battery and charger systems (A & B configuration) shall be provided, for MV switchboard, housed locally within the Customer side of the ESB substation.

Final sizing of the battery system shall be sized by the MV switchgear/switchboard supplier to suit their particular switchgear load requirements.

Provide minimum capacity for 5hrs for the standing load and minimum 10 open/close operations to an end voltage of 1.8V/cell.

### Batteries

Batteries shall be sealed lead acid batteries cells having a minimum design life of 5 years.

Batteries shall be rated for an operational environment of 25oC, with 80% operating capacity being achieved at the end of rated life.

Batteries shall:

* be provided with an optically translucent container of flame retardant ABS plastic or polypropylene material and manufactured to BS 6290 Parts 1 and 4 and BS 6334
* have minimum and maximum electrolyte levels marked on the container
* where in excess of 5 kg weight per component, be provided with lifting handles
* be fitted with pressure relief vents complying allowing venting of gas pressure build up whilst not allowing sparks or flame to enter the cells
* have plates formed from lead plated solid copper separated by porous or honeycombed electrically inert material
* have lead plated copper connections both internal and external with sufficiently high connection posts to assist cleaning
* be supplied with terminal shrouds for all external connections
* have cell plates individually supported and separated to enable plate growth during ageing
* be sized to withstand the stated boost and float charge rates of the battery charger, without allowing detrimental effects to occur

Prior to installation of the battery, the terminals shall be lightly wire brushed to remove oxidation. After completion of connections all exposed metal surfaces shall be coated with petroleum jelly prior to enclosing within the terminal shroud.

All connections shall be made using stainless steel bolts.

The battery shall operate for all conditions at a voltage per cell below that of the gassing voltage. Connection shall be made using multi strand flexible cables, equal to welding flexibles, having adequate cross sectional area and minimum voltage drop.

### Battery Cabinets

Batteries shall be housed within a battery cabinet. The cabinet shall consist of electrolyte resistant paint/material. Each leg of the cabinet shall be provided with a porcelain insulator. Battery cabinet may be stepped or tiered.

### Battery Chargers

Provide an automatic constant voltage, two rate constant current unit incorporating the following features:

* double wound transformer
* automatic output current limiter to a pre-set level to suit the battery
* full wave thyristor controlled rectifier bridge
* DC output smoothing reactor
* reverse polarity protection
* be sized to cope with the standing load as well as maintain the battery in full operation status
* AC input HRC fuses
* manual booster charge facilities which will operate for a pre-set time after which the charger will automatically reset to float charge mode
* be provided with two sets of normally open clean contacts internally wired to a terminal strip for connection to a BMS system and a remote mimic panel
* provided with the following alarms:
* low or high voltage charge fail
* earth fault
* low electrolyte
* fitted with double pole circuit breakers for DC outputs
* DC voltmeter
* AC supply on LED indicator
* DC output ammeter
* DC charge output ammeter

Battery charger cubicles shall be constructed in a similar manner and finish as specified for Switchboards.

### DC Distribution Board/Cubicle Specification

Each cubicle shall be folded and welded 1.6mm sheet steel main body and 1.6mm doors. Access to the cubicle shall be by doors. These doors shall be fitted with a full length piano hinge and stiffening brace, and non-lockable latch. Two eyebolts shall be provided on top of the cubicle to facilitate overhead lifting.

A galvanised channel run plinth shall be provided at the base of the cubicle.

The control panel shall be folded 1.2mm stainless steel, satin finish and shall accommodate the escutcheon mounted instruments and controls.

Drip proof pressed louvers shall be provided on both sides of the cubicle for ventilating the cubicle.

### Diodes

Each A & B Battery charger shall supply each 48V powered device. Supply shall be paralleled at each device and appropriate diodes provided in the DC distribution boards to prevent back-feed.

### Testing

Prior to acceptance recorded capacity tests shall be undertaken in accordance with relevant Standard.

### Safety Equipment

Provide the following safety equipment:

* face shield or goggles
* cell lifting devices
* hand tools with insulated handles
* safety signs advising of restricted access and caution
* acid resistant combination overalls or dust coat
* PVC bib apron
* PVC or rubber boots
* PVC fabric gloves
* Bi carbonate of soda

### MV Switchboard Testing

### General

The switchboard and switchgear shall satisfactorily pass type and routine tests as detailed in relevant standards. Type test certification shall be submitted for type tests performed including impulse dielectric tests, temperature rise testing, and short time withstand current tests and mechanical operating tests.

Factory acceptance and site acceptance testing shall be carried out

### Type Testing

The MV switchgear assembly (including all functional devices) shall have previously undergone type testing in accordance with relevant standards.

Test certificates shall be provided.

The switchgear supplier shall present the following type of testing certificates:

* Impulse dielectric withstand test.
* Dielectric withstand at power frequency test.
* Overheating test.
* Admissible short time current withstand test.
* Mechanical operation test.
* Degree of protection check.
* Electromagnetic compatibility check (EMC test).
* Switchgear device breaking capacity check.
* Switchgear device making capacity check.

The test shall be carried out in accordance with the corresponding IEC standard.

### Routine Factory Testing

Each item of MV switchgear supplied shall undergo routine testing at the manufacturer’s works in accordance with standards noted previously.

Copies of all test documentation shall be provided prior to shipping of the equipment.

### Additional Factory Testing

Supply all proposed tests for review and approval prior to the factory testing.

The following tests shall be carried out at the factory tests.

* Dielectric withstand at power frequency test.
* Mechanical operation test.
* Relay and low voltage auxiliary functional test.
* Checking of protection relays and settings
* Functional testing of devices
* Checking of conformity with drawings and diagrams.

All instrumentation and controls functions shall be tested to prove their correct operation. The set points for adjustable devices, such as sensing relays, shall be recorded on test results and additionally marked within the switchboard, with adjustment points sealed to prevent movement and unauthorised tampering. Calibrated instruments shall be used for all tests.

Results of all tests including dielectric strength, and the instruments used to conduct tests, shall be recorded and a copy provided within the operation and maintenance manual. Where initial tests are unsuccessful, the results of these tests together with the corrective measures taken shall also be provided. All test results shall be signed and dated.

Upon completion of construction of the Medium Voltage Switchgear inspections, where required, and prior to the switchboard being shipped to site, arrange for pre-delivery inspections of the switchgear at the factory.

The following section is to be added for projects where testing of switchboard functions is required prior to installation of the switchboard, e.g., for complex or shutdown/changeover type installations:

Proposed commissioning test schedules and protocols shall be submitted for approval in conjunction with shop drawings. Protocols shall be fully detailed and include, but not be limited to, schedules in tabulated format covering:

* proposed calibrated and where permissible non calibrated, instruments to be used and the tests for which each shall be used
* functioning of all switchgear to confirm correct and uninhibited operations over all phases
* injection tests for all protection with 0%, 50% and 100% of full scale readings
* confirmation of all derived metered values, such as, kWh, Power Factor, kVA, etc
* set points for all adjustable devices such as sensing relays, timers and the like
* function of all control circuits with all inputs and outputs for simulation listed, detailing the specified response and with space for recording the actual response
* functioning of all monitoring points provided either for immediate or future connection to internal or external systems
* other functional requirements where specified
* space on each page for signature and date of witness tests

Factory testing of controls shall be accomplished using a purpose made and labelled test panel with all required inputs simulated by the operation of switches, and all required outputs indicated by lamps, or an equal arrangement as approved.

Factory testing shall include the demonstration of monitoring systems specified as part of this contract, in conjunction with metering, controls and function testing detailed above.

Once testing has been completed, factory test results shall be verified and submitted for approval. Following that approval a witness test shall be arranged with the Superintendents Representative. One week’s notice should be allowed for the arrangement of witness testing.

### Site Acceptance Testing

Following delivery and installation of the MV switchgear, the supplier shall arrange for the Engineer to witness an agreed set of acceptance tests for all MV switchgear.

### Integrated Systems Testing

Allow 4 days attendance for Integrated Systems Testing.

### Service Conditions

The MV switchgear shall be suitable for installation and continuous operation into a naturally or forced ventilated indoor environment typically experienced in Dublin Ireland.

The MV switchgear shall be suitable for normal service conditions as defined in IS EN 62271-AC switchgear and control gear designed for indoor and outdoor installation and for operation at service frequencies up to and including 60 Hz on systems having voltages above 1,000 V

| No. | Parameter | Value |
| --- | --- | --- |
| 1. | Altitude | <1000m |
| 2. | Temperature of cooling air | < 35°C at any time.  < 30°C monthly average of the hottest month  < 20°C yearly average  > -5°C |
| 3. | Humidity | Relative humidity of surrounding air not exceeding 95%.  NO drops of water shall be present on the coil. |
| 4. | Wave shape of supply voltage | Sinusoidal with waveform deformation not exceeding 5% total harmonic content or 1% even harmonic content as measured by IEC 61000-2-4. |
| 5. | Maximum ambient temperature | 40°C |
| 6. | Minimum ambient temperature | -25°C |

### MV Switchgear Equipment Rating

The MV Switchgear shall have the following ratings as defined in IS EN 60694:

| Parameter | Unit |  |
| --- | --- | --- |
| Rated voltage (Ur) | kV rms | 24 |
| Rated short-duration power-frequency withstand voltage (Ud) | kV rms | 50 |
| Rated lightning impulse withstand voltage (Up) | kV peak | 125 |
| Rated frequency (fr) | Hz | 50 |
| Rated normal current (Ir) | A | 200 |
| Rated short time withstand current (Ik), for tk=3 seconds | kA | 25 |
| Rated peak withstand current (Ip) | kA | >63 |
| Internal Arc Rating (1 second) | kA | 25 |
| Rated supply voltage of closing and opening devices and of auxiliary circuits (Ua) | V | Refer to general performance requirements |

### Particular Technical Requirements – Main Switchgear

Parameter Requirement

* General
* Installation Location Indoor
* Switchboard assembly Metal Clad
* Switchboard insulation type Air Insulated
* Extensible Right hand side
* Internal Arc Classification (IAC) AFLR
* Loss of Service Continuity (LSC) LSC2A
* Partition Class PM
* IP rating (MV live parts) IP67
* IP rating (between compartments) IP2X
* IP rating (all external faces of Switchgear) IP3X
* Supply System
* Nominal system voltage 10kV, with future 20kV operation
* Nominal system frequency 50 Hz
* Number of phases 3
* System earthing arrangement Solidly earthed
* Busbars
* Number Single
* Rated normal current (Ir) 200 A
* Busbar VT Yes
* Busbar earthing Yes
* Incoming Circuit Breaker Functional Units
* Withdrawable Yes
* Rated normal current (Ir) 200A
* Current interruption medium Air
* Motor operating mechanism Yes
* Outgoing Circuit Breaker Functional Units
* Withdrawable Yes
* Rated normal current (Ir) 200A
* Current interruption medium Air
* Motor operating mechanism Yes
* Earth Switches
* Each Panel Yes
* Manual / Remote Manual
* Indications
* Voltage Presence Yes
* Fault Current Yes
* Mechanical operation counters Yes
* Auxiliary Supply Voltages
* AC Supply 240V AC
* DC Supply – Protection Circuits 48V DC
* Protection Relays 48V DC
* DC Supply – Control Circuits 48V DC
* DC Supply – Communications 48V DC
* Miscellaneous
* Remote/Auxiliary Contacts Yes
* MV cable entry Bottom
* MV cable cross sectional area 1 x 120 mm2 (TBC)
* Battery / charger (Refer to specification) Yes
* Padlocking facilities Yes
* Castel Key interlocking facilities Yes
* Base frame/ raising plinth Yes
* Anti-condensation heaters Yes
* Surge Diverter Yes (Refer to details below)
* Surge Diverter Performance Ratings
* Nominal Voltage 20kV
* Maximum Continuous Voltage 22kV
* Arrester Voltage Rating 20kV
* System Frequency 50Hz
* BIL at least 175kV
* Protection Relay
* Incoming Circuit Breaker Yes
* Outgoing Circuit Breaker Yes

## MV Transformers

### Scope of Works

Provide power distribution transformers to be installed in an eclosure and integrated in the main LV Distribution Board.

The transformers shall generally be supplied in accordance with the following:

### Standards

The transformers shall be designed, manufactured and tested in compliance with the requirements of IEC60076 and in accordance with the particular requirements of the local Electricity Supply Authority.

All transformers shall be provided with the following accessories as standards:

* Earthing Studs
* Rating Plate
* MV Cable Box
* LV Cable Box
* Off Circuit Tap Changer
* Terminal Marking Plates

### Dry Type Transformers

This specification covers the technical requirements for dry-type (cast resin) transformers.

The transformers(s) shall be three-phase encapsulated winding dry-type transformers, with natural air-cooling (AN) and for indoor installation. They shall be of the double wound core type with fully insulated windings.

### Core

A recognised Domain refinement process shall be used to reduce the cross fluxing losses in the transformer core.

Core excitation shall be kept below 1.7T.

Construction of the core shall prevent excessive temperatures occurring at the centre of core limbs.

The framework, clamping arrangement and general structure of the core of each transformer shall be of a robust construction and shall be able to withstand the degree of shocks which may occur during transport, installation movement and service under normal conditions.

The assembled core shall result in a rigid structure, with the clamping pressure of the press evenly distributed, and adjusted to minimize the noise and vibration coming from the transformer when placed into operation.

The magnetic circuit shall be build using high quality, low-loss, non-aging, cold rolled, grain oriented silicone steel laminations, having excellent magnetic properties and especially designed for core use. The core laminations shall be insulted from each other with a material having high-inter-lamination insulation resistance and also capable of withstanding pressure, mechanical vibration, thermal changes and temperatures which may occur under the most severe operating conditions.

The joints between limbs and yoke, in the laminated magnetic circuit shall be interleaved and mitred to adapt the flux pattern to the preferred magnetic direction.

The core clamping frame shall be equipped with lifting lugs strong enough to enable the finished transformer to be safety lifted, complete with all accessories etc. in place.

The flux density in the magnetic circuit, based on the minimum cross-section of the steel in the core, shall not exceed 1.65 Tesla at rated frequency and rated no-load voltage.

### Windings

MV/LV windings shall comprise either copper or aluminium. Winding shall be foil type windings sheet windings or insulated round or square section windings/insulated square section windings, to minimize oscillations due to lightning and impulse voltages. The enamel coating used, which also forms the turn-to turn insulation, shall be suitable to be used for an insulation system with thermal class H (max. temperature 180 degree C).

The transformer shall be insulated using a mixture of epoxy resins and quartz powders to make the transformer moisture proof, suitable for tropical applications, flame resistant and self-extinguishing. Transformer winding shall have Fire Behaviour Class F1. Furthermore, this will ensure a high level of short circuit withstand and avoid the possibility of any cracks caused by mechanical stresses due to temperature variations, or sudden load peaks.

### Excess Losses

Where the no load or the load loss exceeds the guaranteed value by more than 10%, the transformer will be rejected.

### Operating Environment

The transformer and ancillary equipment shall be suitable for continuous operation.

The equipment shall be treated to resist corrosion and, if necessary, components shall be manufactured from corrosion resistant materials.

### Mechanical Construction

The core, windings, framework, clamping arrangements and general structure of the transformers when assembled shall form a rigid construction entirely unaffected by short circuit conditions, transport or ordinary handling during installation, inspection and repair.

Transformer enclosure shall be manufactured from sheet metal and shall integrate into the LV Distribution board. Transformer enclosure shall be suitable for assembly at site if required.

IP rating shall be minimum IP21.

Transformer enclosure shall allow access to the internal equipment via hinged or removable lockable doors for both MV and LV sides. Doors shall be interlocked with upstream and downstream supplies to ensure that doors cannot be opened prior to supplies being de-energised. If doors are forced, provide inter-trip to upstream CB.

All structural steel used in the assembly of the cores shall be cleaned of rust and scale and painted before assembly. Core bolts and structural steel supports shall be adequately insulated by materials, which shall not be affected by the conditions under which they operate.

All windings shall be wound in the same sense of direction and shall be adequately braced against the forces arising under system fault conditions. The winding assembly shall be pre-shrunk during construction so that shrinkage during the life of the transformer shall be negligible.

Each transformer shall be provided with four bi-directional rollers/wheels, channel frame, four lifting points and haulage points on the base. Transformer enclosure and base shall be suitable for permanent fixing at final position.

Transformer enclosure shall be constructed to allow adequate ventilation via openings whilst still restricting access to all live terminals within the enclosure. Openings shall be arranged to allow air movement via convection. Air intake shall be at low level and discharge shall be at high level.

### Non Automatic Voltage Regulation

Bolt on terminals/taps shall be provided for transformers without automatic tap changers.

The device shall operate on the MV windings to provide five tapping positions affording selections of ± 2.5% - ± 5% either side of the principal tap.

Each tap shall be capable of providing the full transformer kVA rating. Tap positions shall be clearly marked and mechanically registered to identify the tapping selected.

### Terminal Arrangement

The MV and LV terminals shall be located on opposite sides of the upper pressbeams of the transformer.

### Earth Terminal

Provide earth terminals on the transformer enclosure at both the top and bottom.

Earth terminal shall consist of a stainless steel stud, minimum 12 mm diameter, complete with nuts. Earth terminal must not be painted.

### Cable Boxes

Provide cable boxes for the termination of MV and LV connecting cables. They shall be air insulated and of adequate size for dressing and shaping cables cores as noted on the drawings. Confirm final cable sizes and entry details at time of ordering and installation.

Provide a 3 pole cable box suitable for a heat shrink terminal sleeving kit to receive up to two off 500 mm² XLPE cables per phase for MV terminations. MV cables shall be bottom entry.

Provide a 4 pole cable box suitable for a heat shrink termination sleeving kit to receive up to 12 single core XLPE cables or busway for LV terminations. LV cables/busway shall be top entry.

Ensure adequate frames are provided to allow support of the MV and LV cables at the respective termination locations.

Cable terminations shall be adequate for both copper and aluminium cables.

The terminal bushings and spacings between phases and earth with lugs fitted shall be in accordance with the appropriate IEC Standard. Any special fittings or materials necessary to achieve satisfactory clearances shall be supplied and fitted by the transformer manufacturer.

The neutral terminal of windings rated from 1000 volts shall be enclosed in a cable box separately from the phase terminals.

The minimum distance between the gland plates of air insulated cable boxes and the centre line of the terminal bushings shall be 550 mm.

Provide:

* Compressor glands for all cables other than lead sheathed.
* Armour clamps for all armoured cables.
* Non-ferrous gland plates for single core cables.
* An engraved plate fixed to the outside of each cable box to permanently display the physical arrangement of the terminals together with their markings.

Provide adequate space to mount an Earth Fault CT within the transformer enclosure.

### Rating and Labelling

Rating plates shall be of stainless steel and conform to IEC60076. The details shall be black embossed letters on a silver background and shall remain clearly legible for a minimum of 25 years when exposed to the weather.

Provide labels to indicate danger at both MV and LV sides of transformer enclosure at the access doors.

All other labelling shall be clearly labelled with non tarnishable cast or engraved label of approved size, wording and design, clearly indicating the function and/or circuit designation of the component concerned and securely fixed.

Where laminated plastic labels are adopted, the face shall be white with black machine engraved lettering. In certain instances for safety purposes, danger and fire services labels shall have a red face with white lettering. Edges shall be bevelled.

Generally, equipment identification shall adopt 5mm high letters.

All lettering and numbers shall be in metric SI units.

### Overload Protection

Provide a thermometer connected to Resistance Temperature Detectors (RTD) sensors in each phase winding to measure the winding temperature. Measure in degrees Celsius with a range 0 to 120oC with instantaneous and maximum temperature indication.

Thermometer shall provide a remote alarm signal when winding temperature reaches a user set temperature (below the maximum winding temperature).

Thermometer shall provide a remote alarm signal to protection relays located at upstream MV switchboard when maximum winding temperature is reached.

Remote alarm signals shall be provided via volt free contacts in terminal strips in the control panel.

Also provide a separate remote alarm signal via High Level Interface to the BMS.

### Noise level and Radio Interference

Transformers shall operate over the full range of voltage and loading without exceeding the standard sound levels specified in IEC60076.

Transformers shall not produce any emission likely to cause interference with communication equipment. When operated at voltages up to 10% above normal system rating transformers shall be substantially free from partial discharge in either internal or external insulation likely to cause interference with communications systems.

### Control Panel

A control panel shall be provided, integrated into the external enclosure of the power transformer. Control panel shall be segregated from the remainder of the transformer by a sheet steel housing. Provide within control panel housing the following:

* Fuses/MCCBs for protection of control and alarm circuits
* Display of winding temperature (viewable without opening housing)
* Audible alarm horn and mute button
* Transformer door interlock signals from MV and LV Switchboards
* Terminal strip for remote alarm signals to MV protection system
* Terminal strip for High Level Interface to BMS

Control panel and equipment shall be suitable for power supply at 230V AC.

### Inspection and Testing

### Type Tests

Submit evidence with tender that all type tests required by IEC 600726 and IEC 60270, IEC 600763 have been successfully carried out on a transformer of identical design. If these tests have not been carried out the Contractor shall guarantee in the tender that all the type tests will be successfully carried out and the test certificate delivered at least three weeks before dispatch of the equipment.

Tests shall include sound level tests, temperature rise tests, impulse voltage withstand and short circuit testing.

The reference temperature for the load losses and the short circuit impedance shall be 75 degree C. In addition a partial discharge test shall be carried out.

### Routine Factory Tests

Carry out routine Factory Acceptance tests for each transformer.

Deliver the routine test results to the Engineer for acknowledgment of acceptability before dispatching the equipment from the manufacturer’s premises.

The Engineer reserves the right to inspect transformers during manufacture, and to witness any testing. Advise the Engineer in writing at least 5 working days before manufacture commences and again at least 5 working days before testing is scheduled to commence so that the Engineer or a representative can arrange to carry out any inspections and witness testing as deemed appropriate.

### Partial Discharge Tests

In addition to the routine tests, every complete transformer or high voltage coil shall undergo a partial discharge test acc. To IEC Recommendation IEC 60270 and Annex A of IEC 600763. This shall be understood as a routine test for very transformer, and not a special optional test. The maximum acceptable value for the partial discharge test shall be restricted to 10pc. The manufacturer’s, in order to achieve this level, shall have access to a testing field with a disturbance level of 10pc or less.

Any transformer with a higher partial discharge level than 10 pc will be ejected. Evidence of this requirement can be given either by testing the complete transformer or by testing the windings of the transformer separately.

### Transformer Particular Technical Specification

The transformer must be rated for continuous operation at the specified ratings, on any tapping position, under service conditions as defined within this specification, without exceeding the specified temperature rise limits. The transformer must be capable to delivering full rated power, without any derating or limitation, in its enclosure (where provided) or in the specified installation conditions.

All distribution transformers must meet with performance requirements of Commission Regulation (EU) No 548/2014 on implementing Directive 2009/125/EC of the European Parliament and of the Council, which outlines maximum level of losses for transformers placed on the market or commissioned from 1st July 2015 and purchased after 11th June 2014.

### 2.5MVA Indoor Cast Resin (Dry-Type) Transformers

| **No.** | **Description** | **Unit** | **Requirement** |
| --- | --- | --- | --- |
|  | Type of transformer |  | Dry Type/Cast Resin |
|  | Rated power (AN or ONAN) | kVA | 2,500 |
|  | Type of cooling | - | AN (Naturally Cooled) |
|  | Number of phases | - | 3 |
|  | Rated nominal voltage (MV side) | kV | 10 (tapping 1) 20 (tapping 2) |
|  | Primary supply voltage variation | % | ±6 |
|  | Rated nominal voltage (LV side) | kV | 0.400 |
|  | Secondary supply voltage variation | % | ±5 |
|  | System frequency | Hz | 50 |
|  | Winding Connections |  |  |
|  | 1. Primary |  | Delta |
|  | 1. Secondary |  | Star |
|  | 1. Vector Group |  | Dyn11 |
|  | Supply ΔV/f | % | < 5 |
|  | Medium Voltage Winding Conductor Material | - | Copper |
|  | Rated short duration AC withstand voltage | kVrms | 28 or higher (1 minute) |
|  | Lighting impulse withstand voltage (BIL) | kVpeak | 75 or higher |
|  | Low Voltage Winding Conductor Material | - | Copper |
|  | Rated short duration AC withstand voltage | kVrms | 3 |
|  | Neutral conductor rating | Amps | Full load phase to neutral current |
|  | Maximum supply source fault contribution (at MV winding terminals) | MVA | 350 |
|  | Nominal Impedance @ Full Load and at 75°C | % | 6 |
|  | Impedance tolerance  principal tapping  other tapping | ± %  ± % | ± 10% of declared value  ± 15% of declared value |
|  | Ability to withstand short circuit | - | For specified system fault currents in accordance with the requirements specified in IEC 60076-5 |
|  | Maximum insulation system temperature | °C | 155 (F) |
|  | Average winding temperature rise at rated current | K | 100 |
|  | No Load Losses | Watts | <3900 |
|  | 100% Load Losses @ 75°C | Watts | <22600 |
|  | Installation location | - | Indoor |
|  | Minimum Unit Efficiency @ 50% Load | % | 99 |
|  | Transformer type by enclosure | - | Enclosed dry type |
|  | Enclosure provided by | - | Manufacturer.  Enclosure Special Requirements:  System integrated into LV Distribution Board. |
|  | Enclosure degree of protection | - | IP31 IK7 |
|  | Enclosure paint colour | - | As per Manufacturer |
|  | MV connection to system | - | Insulated cable |
|  | LV connection to system | - | Insulated cable |
|  | Transformer climate class as per  IEC/EN 60076.11 | - | C3 |
|  | Transformer environmental class as per IEC/EN 60076.11 | - | E3 |
|  | Transformer fire behaviour class as per IEC/EN 60076.11 | - | F1 |
|  | Tap Changing Facilities |  | Yes |
|  | Type of tap changer |  | Off load |
|  | Tap changer operation |  | Manual crank |
|  | Tapping winding |  | MV |
|  | Number of tap positions |  | 5 |
|  | Nominal tap |  | 3 |
|  | Tapping voltage range | % | + 5, - 5 of nominal voltage |
|  | Tapping step | % | ± 2.5 of nominal voltage |
|  | LV winding | - | Solidly earthed neutral (terminal brought out and connected to station earthing system) |
|  | Sound level | - | Acoustic Power Level Lwa 70 dB(A)  Acoustic Pressure Level LPA 55 dB(A) |
|  | **Special Requirements:** |  |  |
|  | Winding Temperature Thermometer/Resistance Temperature Detector (RTD) with 2 Solid State Tripping Devices and 1 Relay Output. | - | Yes |
|  | Temperature indicator | - | Yes |
|  | Remote Analogue Temperature Signal | - | Yes (4-20mA and HLI FOR Connection to protection Relay and BMS) |
|  | Arrangement for bolting to floor | - | Required |
|  | Lifting lugs | - | Required |
|  | Base support structure | - | Swivel wheels (90° in horizontal plane) |

## UPS Systems

### Overview

The Uninterruptible Power Supply (UPS) systems are required to provide continuous, regulated AC power to the equipment of The Organisation, irrespective of any disturbances or disruptions occurring on the main power supply.

### System Scope

The scope of this supply is for the following systems:

Vendor 1 UPS system - 4 x 500kVA Modular UPS System operating in Parallel with a 10minute battey autonomy at full load. The batteries should be of the LiIon type.

Vendor 2 UPS system - 4 x 500kVA Modular UPS System operating in Parallel with a 10minute battey autonomy at full load. The batteries should be of the LiIon type.

AWS IT UPS System = 1 x 60kVA Modular UPS System with a 5 minute battery autonomy at full load. Batteries should be modular and hot swappable.

### Standards

The UPS shall be designed in accordance with the applicable sections of the current revision of the following standards. Where a conflict arises between these documents and statements made herein, the statements in this specification shall govern.

* IEC/EN 62040-1 - Uninterruptible power systems (UPS) – Part 1: General and safety requirements for UPS
* IEC/EN 62040-2 - Uninterruptible power systems (UPS) – Part 2: Electromagnetic compatibility (EMC) requirements
* IEC/EN 62040-3 - UPS – part 3: Method of specifying the performance and test requirements

### System Description

The UPS system shall consist of the following main components:

* UPS frame (also called cabinet) and
* UPS modules.
* Decentralised topology i.e system must not have any centralised static bypass or centralised control system.
* Availability of six nines (99.9999%).

The units shall be true online, transformerless unit suitable for the site input power supply. The output of the UPS shall be 400V/230V, 50Hz three phase + Neutral.

### Approved Manufacturers

The following manufacturers are approved:

* Vertiv
* Eaton
* Schneider Electrical

# Appendix 1: Schedule of Equipment Mounting Heights

|  |  |
| --- | --- |
| **Item** | **Mounting Height** |
| Lighting control switches | 1150 mm above FFL  150 mm from doorframe |
| Socket outlets in general areas | 450 mm from FFL |
| Socket outlets above worktops | 225 mm above worktops and to suit tile courses |
| Fused connection units | To suit installation heights of equipment |
| Spur sockets | 1250 mm above FFL |
| Break glass units | 1150 mm above FFL  150 mm from doorframe |
| Sounders and chimes | 2200 mm above FFL |
| Isolators, stop buttons, wall mounted panels | 1250 mm above FFL |
| Low voltage switchboard | Floor mounted |
| Socket outlets in plant rooms | 1250 mm AFFL |

# Appendix 2: Schedule of Manufacturers

|  |  |
| --- | --- |
| **DESCRIPTION** | **MANUFACTURER / SUPPLIER (Equal or Approved)** |
| **Switchgear** |  |
| Panel Builder | Davenham Switchgear, M&L Manufacturing |
| ACBs | Schneider/ ABB |
| MCCBs | Schneider/ ABB |
| MCBs | Schneider/ ABB |
| RCBOs | Schneider/ ABB |
| Note: The Ethos Engineering co-ordination study is based on ABB ACB’s, MCCB’S, MCB’s & RCBO’s. If the Electrical Contractor is to use an alternative Schneider product, then the electrical contractor must produce a full co-ordination study for approval by Ethos Engineering. | |
| Power Meters | Schneider   * PM 5110 Series |
| SWA Cables | Anixter  Cleveland Cables |
| **Power Distribution** |  |
| Cable Containment | OBO Bettermann, Unitrunk, Schneider, Cooper |
| **General/ Mechanical Power** |  |
| General Outlets | Schneider |
| Plant Room Outlets | Schneider |
| Dado Trunking | CMD, Legrand, Schneider |
| Floor Boxes | Powerplan 65mm depth P99365G (Core Elec) |
| Floor Grommets | CMD Betatrack PCFG238G 40mm depth (Core Elec) |
| Busbar (Including tap offs) | CMD Betatrack (Core Elec) |
| 3 Phase Power Outlets | MK Commando, Legrand Tempra Pro |
| Isolators (IP 54) | Kraus & Neimer, MK, Legrand, Cooper |
| Induction Loop | Sound Productions |
| **General Lighting** |  |
| Control System | Core (DALI2) |
| General Outlets | Legrand (Synergy Chrome), MK |
| **Disabled Services Systems** |  |
| DA Refuge | OmiCare (Baldwin) |
| DA Toilet | OmiCare (Baldwin) |

|  |  |
| --- | --- |
| **Lightning Protection** |  |
| Specialists | Lightning Protection Ireland, Joe Clancy JAC |
| Surge Protection Equipment | Furse, Dehn |
| **Induction Loops** |  |
|  | Sound Productions |
| **Electrical Vehicle Charging** |  |
|  | Zaptech Pro |
| **Electrical Bicycle and Scooter Charging** |  |
|  | Turvec |

# Appendix 3: Schedule of Equipment

|  |  |  |
| --- | --- | --- |
| **Product Name** | **ALC-PRM-VFC** | A picture containing toilet, white, tiled  Description automatically generated |
| **Manufacturer** | Legrand |
| **Product Number** |  |
| **Preferred Supplier** | Electrical Contractor |
| **Notes** | ALC-PRM-VFC - Key features of PRM Switching detectors include:   * Switching with lux level sensing * Programmable via our programming handset * Absence detection functionality * User handset available to control on/off and lux levels   Electrical contractor to co-ordinate surface and flush mounted variants. |
| **Accessories** | DBB – Surface mount back box  DBB-EXT – Surafe mounte back box extender |
| **Area** | Internally as noted on layouts |

|  |  |  |
| --- | --- | --- |
| **Product Name** | **7.4kW Single Phase EV Charger** | Icon  Description automatically generated with medium confidence |
| **Manufacturer** | Zaptec |
| **Product Number** | Zaptech Pro |
| **Preferred Supplier** | Core Electrical |
| **Notes** | 7.4kW Single Phase, car charger with energy management system. |
| **Accessories** | All required sundries and backing plates  Zaptech Single and Twin Column to be included where required. |
| **Area** | B01 and B02 Parking Areas. |

|  |  |  |
| --- | --- | --- |
| **Product Name** | Disabled Refuge Alarm Controller | A picture containing text, indoor  Description automatically generated |
| **Manufacturer** | Baldwin Boxall - Omnicare |
| **Preferred Supplier** | Baldwin Boxall - Omnicare |
| **Notes** | Contractor to co-ordinate installation & mounting |
| **Accessories** | All required sundries |
| **Area** | Main Receptions |

|  |  |  |
| --- | --- | --- |
| **Product Name** | **Airblade Hand Driers** |  |
| **Manufacturer** | Dyson |
| **Preferred Supplier** | Dyson |
| **Notes** | Contractor to co-ordinate installation & mounting |
| **Accessories** | All required sundries |
| **Area** |  |
| **Product Name** | Isolators |
| **Manufacturer** | Katko |
| **Preferred Supplier** |  |
| **Notes** | Various ratings as required |
| **Accessories** | All required sundries |
| **Area** | Plant Rooms |

|  |  |  |
| --- | --- | --- |
| **Product Name** | **Isolators** | A picture containing jack, white  Description automatically generated |
| **Manufacturer** | Schneider GMC20SN |
| **Preferred Supplier** |  |
| **Notes** | Various ratings as required |
| **Accessories** | All required sundries |
| **Area** | Plant Rooms |

|  |  |  |
| --- | --- | --- |
| **Product Name** | **Fused Spur** | A close-up of a switch  Description automatically generated with low confidence |
| **Manufacturer** | Schneider GMC13SPN |
| **Preferred Supplier** |  |
| **Notes** | Various ratings as required |
| **Accessories** | All required sundries |
| **Area** | Plant Rooms |

|  |  |  |
| --- | --- | --- |
| **Product Name** | **Brushed Steel Blank** | Image result for MK brushed steel blank plate |
| **Manufacturer** | Schneider |
| **Preferred Supplier** |  |
| **Notes** |  |
| **Accessories** | All required sundries |
| **Area** | Lift Lobbies |

|  |  |  |
| --- | --- | --- |
| **Product Name** | **Fused Spur** | A picture containing text, electronics, jack  Description automatically generated |
| **Manufacturer** | Schneider GU5411WPB |
| **Preferred Supplier** |  |
| **Notes** | Flush Stainless Steel unit with White Inserts and Neon Indicator |
| **Accessories** | All required sundries |
| **Area** | Front of House areas |

|  |  |  |
| --- | --- | --- |
| **Product Name** | **Socket Outlets** | A picture containing jack  Description automatically generated |
| **Manufacturer** | Schneider GU3631GMC |
| **Preferred Supplier** |  |
| **Notes** | Metal clad socket outlets |
| **Accessories** | All required sundries |
| **Area** | Plantroom areas |

|  |  |  |
| --- | --- | --- |
| **Product Name** | **Socket Outlets** | A picture containing electronics, jack  Description automatically generated |

# Appendix 4: Mechanical BMS Points Schedule

# Appendix 5: Site Earthing Report

# Appendix 6: RTU Distribution Board Layout