



*Project Managers
Chartered Civil, Structural
& Building Services Engineers*

CAHIR DIGITAL HUB



A.5.1.2 ELECTRICAL GENERAL SPECIFICATION

TENDER ISSUE

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1 UK's WITHDRAWAL FROM THE EUROPEAN UNION

On 01 February 2019, the European Commission published QUESTIONS AND ANSWERS RELATED TO THE UK's WITHDRAWAL FROM THE EUROPEAN UNION WITH REGARD TO INDUSTRIAL PRODUCTS. The document gives guidance in relation to Industrial Products in the event of the UK leaving the European Union without a ratified withdrawal agreement or ordered transition period. It relates to construction products covered by the Construction Products Regulation (EU) No 305/2011.

Manufacturers, distributors, importers and authorised representatives must comply with their obligations and responsibilities under Regulation (EU) 305/2011 when placing a construction product on the EU market.

The Commission's previous publication NOTICE TO STAKEHOLDERS – WITHDRAWAL OF THE UNITED KINGDOM AND EU RULES IN THE FIELD OF INDUSTRIAL PRODUCTS, dated 10 January 2018, confirmed that UK Notified Bodies will lose their status as EU Notified bodies when the UK leaves the EU.

That Notice stated that manufacturers, distributors, importers and authorised representatives of construction products will need to take the necessary steps to ensure that they hold certificates under the responsibility of an EU27 Notified Body to demonstrate compliance for products placed on the EU market post-Brexit. In practice, this means either arranging for a transfer of certificates from a UK notified body to an EU27 Notified Body, or applying for a new certificate with an EU27 Notified Body. The Commission's latest publication, the Questions and Answers document, provides further guidance and clarification on the rules.

Builders, specifiers, designers, certifiers etc., should be aware of the changes above. They should ensure that the CE Marking/ Declaration of Performance and relevant product-related documentation is appropriate to demonstrate and ensure compliance with the Building Regulations. Further information on the compliance with the Construction Products Regulation is available at the following link: <https://www.housing.gov.ie/housing/building-standards/construction-products-regulation/construction-products-regulation>

The Department of Housing, Planning and Local Government is responsible for policy and regulation of building standards, including implementation of the Construction Production Regulation. The Department is the Notifying Authority for construction products covered by Construction Products Regulation (EU) No 305/2011 and in this respect, is actively assessing applications from bodies seeking to become Notified Bodies in Ireland. The 'Nando' EU commission web site provides the full listing of all current European wide Notified Bodies at the following link <http://ec.europa.eu/growth/tools-databases/nando/>

2 STANDARDS**IS10101 National Rules for Electrical Installations**

IEC 60038	IEC standard voltages
IEC 60051	Direct acting indicating analogue electrical measuring instruments and their accessories
IEC 60071-1	Insulation co-ordination - Definitions, principles and rules
IEC 60076-1	Power transformers - General
IEC 60076-2	Power transformers - Temperature rise for liquid immersed transformers
IEC 60076-3	Power transformers - Insulation levels, dielectric tests & external clearances in air
IEC 60076-5	Power transformers - Ability to withstand short-circuit
IEC 60076-7	Power transformers - Loading guide for oil-immersed power transformers
IEC 60076-10	Power transformers - Determination of sound levels
IEC 60076-11	Power transformers - Dry-type transformers
IEC 60076-12	Power transformers - Loading guide for Dry-type power transformers
IEC 60146-1-1	Semiconductor converters - General requirements and line commutated converters - Specifications of basic requirements
IEC 60255-1	Measuring relays and protection equipment - Common requirements
IEC 60269-1	Low-voltage fuses - General requirements
IEC 60269-2	Low-voltage fuses - Supplementary requirements for fuses for use by authorized persons (fuses mainly for industrial application) - Examples of standardized systems of fuses A to K
IEC 60282-1	High-voltage fuses - Current-limiting fuses
IEC 60287-1-1	Electric cables - Calculation of the current rating - Current rating equations (100 % load factor) and calculation of losses - General
IEC 60445	Basic and safety principles for man-machine interface, marking and identification - Identification of equipment terminals, conductors terminations and conductors
IEC 60529	Degrees of protection provided by enclosures (IP code)
IEC 60644	Specification for high-voltage fuse-links for motor circuit applications
IEC 60664	Insulation coordination for equipment within low-voltage systems - all parts
IEC 60715	Dimensions of low-voltage switchgear and controlgear. Standardized mounting on rails for mechanical support of electrical devices in switchgear and controlgear installations.
IEC 60724	Short-circuit temperature limits of electric cables with rated voltages of 1 kV ($U_m = 1.2$ kV) and 3 kV ($U_m = 3.6$ kV)
IEC 60755	General requirements for residual current operated protective devices
IEC 60787	Application guide for the selection of high-voltage current-limiting fuses-link for transformer circuit
IEC 60831-1	Shunt power capacitors of the self-healing type for a.c. systems having a rated

	voltage up to and including 1000 V - Part 1: General Performance, testing and rating - Safety requirements - Guide for installation and operation
IEC 60831-2	Shunt power capacitors of the self-healing type for a.c. systems having a rated voltage up to and including 1000 V - Part 2: Ageing test, self-healing test and destruction test
IEC 60947-1	Low-voltage switchgear and controlgear - General rules
IEC 60947-2	Low-voltage switchgear and controlgear - Circuit breakers
IEC 60947-3	Low-voltage switchgear and controlgear - Switches, disconnectors, switch-disconnectors and fuse-combination units
IEC 60947-4-1	Low-voltage switchgear and controlgear - Contactors and motor-starters – Electromechanical contactors and motor-starters
IEC 60947-6-1	Low-voltage switchgear and controlgear - Multiple function equipment - Transfer switching equipment
IEC 61000	Electromagnetic compatibility (EMC)
IEC 61140	Protection against electric shocks - common aspects for installation and equipment
IEC 61201	Use of conventional touch voltage limits - Application guide
IEC/TR 61439-0	Low-voltage switchgear and controlgear assemblies - Guidance to specifying assemblies
IEC 61439-1	Low-voltage switchgear and controlgear assemblies - General rules
IEC 61439-2	Low-voltage switchgear and controlgear assemblies - Power switchgear and controlgear assemblies
IEC 61439-3	Low-voltage switchgear and controlgear assemblies - Distribution boards intended to be operated by ordinary persons (DBO)
IEC 61439-4	Low-voltage switchgear and controlgear assemblies - Particular requirements for assemblies for construction sites (ACS)
IEC 61439-5	Low-voltage switchgear and controlgear assemblies - Assemblies for power distribution in public networks
IEC 61439-6	Low-voltage switchgear and controlgear assemblies - Busbar trunking systems (busways)
IEC 61557-1	Electrical safety in low voltage distribution systems up to 1000 V a.c. and 1500 V d.c. - Equipment for testing, measuring or monitoring of protective measures - General requirements
IEC 61557-8	Electrical safety in low voltage distribution systems up to 1000 V a.c. and 1500 V d.c. - Equipment for testing, measuring or monitoring of protective measures - Insulation monitoring devices for IT systems
IEC 61557-9	Electrical safety in low voltage distribution systems up to 1000 V a.c. and 1500 V d.c. - Equipment for testing, measuring or monitoring of protective measures - Equipment for insulation fault location in IT systems

- IEC 61557-12 Electrical safety in low voltage distribution systems up to 1000 V a.c. and 1500 V d.c. - Equipment for testing, measuring or monitoring of protective measures - Performance measuring and monitoring devices (PMD)
- IEC 61558-2-6 Safety of transformers, reactors, power supply units and similar products for supply voltages up to 1100 V - Particular requirements and test for safety isolating transformers and power supply units incorporating isolating transformers
- IEC 61643-11 Low-voltage surge protective devices - Surge protective devices connected to low-voltage power systems - Requirements and test methods
- IEC 61643-12 Low-voltage surge protective devices - Surge protective devices connected to low-voltage power distribution systems – Selection and application principles
- IEC 61643-21 Low voltage surge protective devices - Surge protective devices connected to telecommunications and signalling networks - Performance requirements and testing methods
- IEC 61643-22 Low-voltage surge protective devices - Surge protective devices connected to telecommunications and signalling networks - Selection and application principles
- IEC 61921 Power capacitors - Low-voltage power factor correction banks
- IEC 61936-1 Power installations exceeding 1 kV a.c. - Part 1: Common rules
- IEC 62271-1 High-voltage switchgear and controlgear - Common specifications
- IEC 62271-100 High-voltage switchgear and controlgear - Alternating-current circuit breakers
- IEC 62271-101 High-voltage switchgear and controlgear - Synthetic testing
- IEC 62271-102 High-voltage switchgear and controlgear - Alternating current disconnectors and earthing switches
- IEC 62271-103 High-voltage switchgear and controlgear - Switches for rated voltages above 1 kV up to and including 52 kV
- IEC 62271-105 High-voltage switchgear and controlgear - Alternating current switch-fuse combinations for rated voltages above 1 kV up to and including 52 kV
- IEC 62271-200 High-voltage switchgear and controlgear - Alternating current metal-enclosed switchgear and controlgear for rated voltages above 1 kV and up to and including 52 kV
- IEC 62271-202 High-voltage switchgear and controlgear - High-voltage/low voltage prefabricated substations
- IEC 62305-1 Protection against lightning - Part 1: General principles
- IEC 62305-2 Protection against lightning - Part 2: Risk management
- IEC 62305-3 Protection against lightning - Part 3: Physical damage to structures and life hazard
- IEC 62305-4 Protection against lightning - Part 4: Electrical and electronic systems within structures

3 SITE SERVICES (60)

3.1 Site Survey

The Contractor shall carry out a full electrical survey of the site prior to the commencement of any works.

4 ELECTRICAL SUPPLY AND MAIN DISTRIBUTION (61)

4.1 Switchgear

Standards & Regulations.

- IS 10101:2020
- ETCI Regulations
- IS EN 61439
- IS EN 60947
- IS EN 60529

General

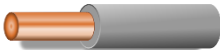
All switchgear plant will include for a minimum of 25% spare capacity for future expansion. This spare capacity will be catered for in a balanced manner across the relevant plant item in a sensible design which best accommodates future expansion.

Distribution Boards

The responsibility for a safe and satisfactory distribution board which meets the needs of the particular building, the contract drawings and the contract specifications will lie with the panel manufacturer. Unless indicated differently in the contract drawings the following distribution board types will be provided:

Board	Type
Main Distribution Board	Form 4 Type 6
Sub-Distribution Board	Form 2B

All distribution boards shall be lockable and will incorporate an insulated neutral bar and earth bar. Separate terminals will be included for all circuits. Spare terminals will be covered with an insulated covering. Colouring for phase-ways should be as per the E.U. harmonised cable colours:

Cable	Colour
Single Phase: L	Brown 
Three Phase: L1	Brown 
Three Phase: L2	Black 
Three Phase: L3	Grey 
Neutral	Blue 
Protective Conductor	Green and Yellow 

Main distribution boards will be manufactured and provided in line with the ETCI's Code of Practice for Switchgear Assemblies and IS EN 61439. They will be factory-built assemblies of sheet-steel cubicle-type construction with minimum 2.5mm thickness for all enclosure frame-work (sprayed and stove-enamelled) and minimum 1.5mm thickness for enclosure doors. Sub-distribution boards will be of the same construction. For sub-distribution boards only, the contractor may make a submittal for provision of custom-built assemblies but this will only be approved by the Employer's Representative if deemed to be satisfactory and complete compliance with the ETCI's Code of Practice for Switchgear Assemblies has been demonstrated by the contractor in their submittal.

A minimum of protective rating of IP54 will be provided for all internal distribution enclosures in line with IEC 60947-1. All distribution boards will be fitted with an engraved "Traffolyte" label outlining the purpose of the board in black. If the board has more than one phase a second "Traffolyte" label with the wording "DANGER 400 VOLTS" engraved in red will be fitted.

Busbars will comply fully with BS 159:1992 and shall be type tested in accordance with IS EN 61439. All bus bar and associated connections shall be firmly secured and supported on self-

extinguishing polyester, ceramic or fibre type mountings. Bar rating shall be a minimum of 800A and shall be capable of withstanding a short circuit current of 42kA minimum for 1 second. Phase and Neutral bus-bars will be of the same cross-section. Earth busbars will have a cross-section a minimum of half the Phase bus-bar cross-section size. The bus-bars will be constructed of HDHC copper and will be capable of carrying the necessary load as per the contract documents and installation. Busbar connections will be as follows:

Load	Connection Type
<=63Amps	Cable (Braced and Supported)
>63Amps	HDHC rectangular section copper busbar (Insulated and Supported)

All terminals for distribution boards will comply fully with IEC 61032:1997. Terminals will be provided at the top or bottom of distribution board enclosures as specified. All terminals will be:

- Numbered
- PVC grade
- Sized to accept incoming cable sizes

Push-in terminals are not acceptable

Any internal cabling shall be single core LSZH (6491B) pattern, solid or stranded conductor as appropriate. Where enclosed in trunking their spacing factor shall not exceed 30% shall be grouped and labelled at intervals of 300mm maximum.

Cables to any moving parts (i.e., doors etc) shall be flexible and housed in PVC spiral wrap or some other equal and approved means of protection.

A main earthing cubicle shall be provided as an integral part of the main switchboard. This cubicle shall be complete with a suitably sized copper bus bar or terminal bar to accommodate the connection of the main earthing conductor and the main equipotential bonding conductors as installed by the electrical contractor. All cable connections to this bar shall be lugged and bolted. All cables shall be identified at the connection point with an industry standard cable ferrule. Doors shall be bonded by 1.5mm² cross section minimum size flexible cable.

Engraved labels shall be provided indicating the purpose of any switch or control device. The description (*agreed with the Engineer*) shall be solid W/B/W 'Traffolyte' type. ('Dynotape' or other non-permanent labelling will not be accepted).

Typed or printed circuit charts shall be provided, Perspex covered and fitted to the inside of each distribution board access door. Each chart shall indicate final circuit designation, type of phasing, type of protective device, maximum earth loop impedance, and the test value of the earth fault loop

impedance. Each chart shall also include the short circuit rating of the equipment or design value and the external loop impedance design value at 20°C.

The contractor shall include for Traffolyte labelling of all electrical outlets throughout the building, including all socket outlets, light switches, isolators, spur outlets etc. Each label shall be securely fixed to the respective outlet.

Each label shall convey where the circuit is supplied from, its circuit number and phasing and finally the nominal rating of the protective device in question.

The contractor shall ensure that the electrical loads are circuited and connected as indicated over the three phases. Where required phase barriers and warning labels as detailed in BS 7671 shall be supplied and installed. The contractor shall be responsible for ensuring that all loads are balanced as evenly as possible upon commissioning.

All plant or switchgear containing two or three phase circuits at a voltage greater than 240V shall be marked with a Red Danger label declaring the nominal voltage.

In addition to the labelling required by general specification, the contractor shall provide an 'Electrical Review' First Aid Chart, 508 mm x 381 mm, wall chart of Instructions for Dealing with Electric Shock, located alongside each sub distribution board and at the main switchboard. These shall be printed in red and black, sheathed in plastic.

The contractor shall supply and install a suitable rubber mat complying with BS 91 - 1976 adjacent the main switchboard. The mat shall be 1 metre wide and shall run the complete length of the main switchboard.

The switchboard and distribution boards shall have only 1 type of key to open all locks. The contractor shall supply 2 sets of keys for handing over under the contract.

A full set of manufacturer's drawings including both schematics and layouts will be provided to the Employer's Representative for approval before manufacture. On dispatch the following items will be supplied to the Employer's Representative:

- 2No. sets of manufactured drawings
- 2No. sets of terminal lists
- 2No. Schematics

The contractor shall allow in his tender for the main switchboard to be commissioned by the panel manufacturer on site before the project is handed over and for the instruction of the staff in its operation.

All switchboards shall be subjected to the following tests before despatch:

- An Insulation-Resistance Test at 1,000 Volt D.C. (Megger Test) between phases, phases to neutral, phases and neutral to earth.
- A High-Voltage 50Hz Test to 2,500 Volt for one-minute (flash test) between phases, phase to neutral, phases and neutral to earth.
- A Continuity Test designed to measure the conductivity of each circuit between incoming and main outgoing terminals.
- Simulation Test to test selected circuits on overload and short circuit.
- Function Test to Test operation of control system.
- Test on mechanical operation of switching devices, inter-locks, locks, sequence controls, connections, etc.
- The values obtained from the above Tests shall be recorded and a Full Copy in the form of a Test Record shall be supplied to the Engineer before delivery is made.

After erection on Site all switchboards shall be subjected to the following tests in the presence of the Engineer or his Representatives.

- An Insulation-Resistance Test at 1,000 Volt D.C. (Megger Test) between phases, phases to neutral, phases and neutral to earth.
- A High-Voltage 50Hz Test to 2,500 Volt for one minute (flash test) between phases, phase to neutral, phases and neutral to earth.
- A Continuity Test designed to measure the conductivity of each circuit between incoming and main outgoing terminals.

Minipillars

Minipillars will be manufactured in glass reinforced plastic to fully comply with Electricity Supply Industry Specification ESI 37 and IS EN 61439-5. The same requirements are to be met as for distribution boards in terms of capacity, busbars etc.. The enclosure will have a minimum protection rating of IP64. Each mini-pillar will include:

- Quick-acting barlock and high security padlock.
- Set of isolator operating and locking off tools.
- Spare fuse tray with spare fuses.
- A 65 Watt switched, fused anti-condensation heater. This heater should incorporate thermostatic control for on and off control.
- Purpose-made base unit for cable entry.

All minipillars will be painted against rusting (stove glass enamel). Colour to match standard manufacturer's finish. After final painting treat interior with a cork based paint to reduce level of condensation by providing a thermal barrier between enclosure metalwork and internal air.

4.2 Protection Devices

Selection of Devices

The contractor shall demonstrate during submittal stage that the proposed components achieve the required discrimination and cascading characteristics. This may be done using manufacturer's software or charts.

Fuses

Fuses shall be NH type in accordance with IEC 269-2-1

Current Rating	Type
≤ 25 Amps	DZII type to VDE0635 or BS88
25 Amp ≤ 35 amp	DZII type to VDE0635 or BS88
> 35 Amps	NH type to VDE0636 or BS88

Miniature Circuit Breaker (MCBs)

In general, MCB's will be rated to at least 10kA. MCB's shall be of plug-in type mounted on DIN rail mounting, for ease of replacement.

MCBs shall be categorised to IS EN 60898 and IS EN 60947 and types B,C,D provided to the following table:

Type	Instantaneous Trip Current	Application
B	$5 \times I_N$	Resistive Loads
C	$10 \times I_N$	Discharge Lighting, Small Motors etc,
D	$20 \times I_N$	Large Inductive Loads, Large Motors, Welding Plant etc,

Where the prospective short circuit current exceeds the breaking capacity of the MCB, back up protection by means of fuses shall be provided in accordance with Manufacturer's Recommendations.

Main Incomer

The main Incomer will meet the following minimum requirements in addition to the specific device requirements outlined in the sections below:

Parameter	Performance
Prospective Short Circuit Current Rating	Minimum of 40kA at Power Factor of 0.2
Internal Trip Unit	Electronic (tested to P2 Category IEC 157-1)

Air Circuit Breakers (ACBs)

All ACBs shall comply fully with IS EN 60947-2:2017/A1:2020. Where two ACBs are used in parallel (e.g. parallel generator supply) the ACBs will be restricted to being switched one at a time by mechanically and electrically interlocking the ACBs. All ACB's shall be Traffolyte labelled.

Moulded Case Circuit Breakers (MCCBs)

All MCCBs shall comply fully with IS EN 60947-2:2017/A1:2020. Their contacts shall be capable of inspection. All MCCB's shall be manufactured to BS EN ISO9001. All MCCB's shall be complete with Thermal and Magnetic overload settings except where indicated. All switching toggles shall be in the up/down operation. All MCCB's shall be Traffolyte labelled. Spare spaces shall be fitted with blank labels for future engraving.

Earth Leakage Circuit Breakers (ELCB's)

ELCB's shall be current operated type in full compliance with the following standards:

- IS EN 61008-1: 2012 (+A1:2014)(+A2:2014)(+A11:2015)(+AC:2016)(+A12:2017)
- IS IEC 61008-2-2:1990

They will also have the following performance characteristics:

Parameter	Performance
Trip Current	30mA
25 Amp Short Circuit Current Rating	1.5kA
40 Amp Short Circuit Current Rating	1.5kA
63 Amp Short Circuit Current Rating	2.5kA

They shall have a trip current rating of 30mA unless specified otherwise, and shall have a short circuit current rating of not less than (25 Amp - 1.5kA) (40 Amp - 1.5kA) (63 Amp - 2.0kA).

All ELCB and RCBO's are to be Type B.

Load Break Switches

All Load Break Switches will be fully compliant with IEC 408. They will be rotary air break type with door interlock. On/off indication will be incorporated and the load break switch will be lockable in the off position. The prospective short circuit ratings of installed load break switches will be as follows:

Load Break Switch Current Rating	Prospective Short Circuit Rating (RMS – 1s)
<= 63 Amp	2.5 kA
<= 100 Amp	4.0 kA
<= 160 Amp	9.0 kA
<= 250 Amp	13.0 kA
<= 400 Amp	13.0 kA

4.3 Control and Indicating Devices

Contactors

All contactors shall be fully compliant with IEC158-1 with the following categories:

Type	Minimum Operations	Application
AC1	1,000,000	Resistive Loads
AC3	1,000,000	Motors, Lifts, Pumps, Compressors

The contactors shall be surface or panel mounted metal clad units poled, phased and rated as indicated on the drawings. Each contactor will have 1N/O and 1N/C spare contacts.

Motor Starters

Starters shall be fully compliant with EN 60947-4-1:2010+A1:2012 or equal and approved.

They shall incorporate the following protection features:

- Thermally delayed over-current release on all poles set to trip at 120% full load in two hours and incorporating temperature compensation
- Positive protection against single phasing in the form of an extra differential tripping bar or similar approved device
- Manual reset with protection against premature re-closing.

Push Buttons and Control Switches

Push buttons shall be fully compliant with EN 60947-5-1:2017 and IEC 60947-1. Each push button will have a minimum protection rating of IP65.

The following colour coding will be used for Push Buttons and Control Switches:

Operation	Colour
Start/On	Green
Stop/Off	Red
Reset	Yellow/Black

Pilot Lights & Indicators

Pilot lights shall be fully compliant with EN 60947-5-1:2017 and IEC 60947-1. Each pilot light will be LED type with a minimum protection rating of IP65.

Time Switches

Time clocks shall be manufactured by Horstmann or equal and approved by engineer. Timeclocks shall be digital, 16A rating with minimum 3 No. channels, which are 24 hour 7 days controllable complete with day omission and 36-hour spring reserve and wall-mounted. The clocks shall be wall-mounted, such that they are accessible for adjustment without opening any switchboard panel or

door. Terminals shall be available for connection of the remote mounted HOA switches. Time clocks/switches shall not be DIN rail mounted or integral to main switchboard.

Instrumentation

Instruments will be fully compliant with IEC473, VDE 0414 and BS EN 61869-2:2012, BS EN 61869-5:2011.

For clear reading and inspection all instrument displays or meters will have a minimum area of 90mm².

Energy Meters

Multi-function meters shall be fitted as indicated on the schematic drawings to provide digital indication of true RMS values of phase and line voltages, phase currents and real, apparent and reactive power.

The meters shall be recessed into the relevant compartment doors on incoming sections and outgoing compartments of form 4 boards, otherwise they shall be mounted in a metering section.

Multi-function meters shall be fed from the load side of MCCBs as per the drawings. They shall have LCD display and individual direct access key for the following functions:

Instantaneous and max currents values.

Voltages and frequency.

Active, reactive and apparent power (instantaneous and max values)

Power factor.

Energy over a specified period.

Energy meters shall be manufactured by Socomec or equivalent. DIRIS A40 meters and A20 meters c/w modbus connections shall be provided as indicated. Meters shall be installed and commissioned as per manufacturer's recommendations. Contractor to allow for specialist supplier commission meters and set up interface with BMS System.

4.4 Electrical Containment

Standards & Regulations

The electrical containment system will comply and be in accordance with:

- IS 10101:2020
- Relevant British Standards

General

The Contractor shall supply install and test the entire electrical containment installation as indicated on the drawings and specification documents.

In general, the following containment will be used, to the individual specifications provided in following sections:

Distribution	Containment
Primary Distribution	Hot Dipped Galvanised Steel Wire (HGSW)
Power and ELV Services	Galvanised Steel Trunking
Final Circuitry to Outlets	Galvanised Steel Conduit

In line with IS 10101:2020 requirements the entire system is to be electrically and mechanically continuous.

Also, in line with IS 10101:2020 any area where the conduit or trunking system passes through a fire-rated construction a fire barrier will be provided.

Where expansion of the building has been allowed for by the use of settlement joints in the building structure similar allowance must be made in the containment system attached to the building. Circular through or adaptable boxes will be provided within 300mm on both sides of all containment crossings of expansion or settlement joints. Boxes will be joined with Type C flexible conduit with PVC sleeving to provide a minimum protection rating of IP 44.

It is the responsibility of the contractor to ensure that the conduit system is free of burrs. Bending of conduit will be carried out in compliance with British Standards using a bending machine. Bending operations will be carried out without the use of heat and must ensure no reduction in the cross-sectional area of the conduit. Circular/Adaptable boxes will be used where 90° bends cannot be formed. All conduit should be cut cleanly and square with axis. No tool marks should present on the finished system.

In providing the conduit system and routes the contractor shall ensure the maximum circuit lengths and groupings of cables indicated are not exceeded.

Where dimensions are not indicated select trunking and conduit sizes in accordance with the IS 10101:2020 and manufacturers recommendations using the 'term method'.

The following spacing will be provided between the containment system outer dimension and other services (where these clearances cannot be achieved the Client Representative should be notified):

Service	Clearance
Insulated Steam Services	300mm
Other Services Excluding Steam	150mm
Above Central Heating Radiators	1000mm

The Contractor shall install conduit and trunking systems to ensure internal condensation does not affect operation of associated circuits.

Where conduit passes through external wall between two areas of different ambient temperatures or in other locations likely to cause condensation, install a conduit or adaptable box. After wiring fill box with inert, permanently plastic compound with high insulation value.

Draw boxes will be provided in the conduit system:

- Every 10 metres
- After bends or sets totalling 180°

Switch boxes and socket boxes will be screwed in place (counter sunk or round head) and grouted in place before plastering/screeding.

Conduit will be supported in full compliance with the IEE Appendix I of Guidance Note I Selection and Erection. Conduit is not to be under mechanical stress. Conduit boxes will be supported separately to the conduit.

All fixing will be carried out using saddles. The following saddle types will be used:

Location	Fixing Method
Floor Screeds	Saddles
Buried in plaster or render	Saddles
Above false ceilings	Saddles

The containment installation shall be run neatly in parallel with other services and building lines. Plumb vertical runs will be ensured.

Cable will only be installed once the containment system is completed. Cleaning of the containment system will be carried out with swabs immediately before cabling is installed and all foreign matter removed. Temporary plugs will be used to prevent ingress of water/solids.

Cables and circuits shall be segregated in full compliance with IS 10101:2020 and as indicated on drawings. Nylon draw wires with fitted eyelets shall be left in empty conduit for use by specialist installers. Lubricants will not be used to aid the drawing of cables. The containment system will be designed so that re-wiring can be carried out from installed boxes only, particularly in the case of concealed conduit. Concealed containment must be approved by the client's representative before concealment and chasing of walls must be coordinated with the Architect. For conduit buried in walls a minimum depth of 12mm must be achieved with plaster/rendering. Any fittings or conduit to be buried in concrete or installed in plaster must be protected against corrosion and electrolytic action.

Conduit System

The conduit system will be rigid metal in full compliance with BS EN 61386 to the following classes:

Location	Fixing Method
General Areas	Metal Rigid Class 2
Areas with risk of high impact or ingress	Metal Rigid Class 4

The following resistance to corrosion will be provided in line with BS EN 61386 classification.

Classification	Protection Afforded	Example
1	Low protection, inside and outside	Priming paint
2	Medium protection, inside and outside	Stove enamel/electro zinc plate/air drying paint
3	Medium/High composite protection inside: class 2 outside: class 4	Stove enamel Sherardizing
4	High protection, inside and outside	Hot dip zinc coating Sherardizing Stainless steel

The conduit system will have the following properties:

- Steel Material
- Rigid Structure
- Threadable Connections
- Suitable for Bending to BS EN 61386
- Electrically Continuous
- Resistant to Corrosive/Polluting Substances
- Coated with stove enamel paint. Colour to Architects requirements.

Solid couplers will match the conduit grade and finish and will be used to join lengths of conduit to each other, conduit fittings and adaptable boxes. The adaptable boxes shall be of a malleable iron adaptable box type with a minimum size of 100mm x 100mm x 50mm. Fittings, circular box covers and adaptable box covers will also be of the same class and finish as the conduit system.

Steel dome or cheese headed screws to secure covers for Class 2 finish shall be used. The number of entry holes within loop-in boxes shall be limited to four.

The Contractor shall use couplers and externally screwed brass bushes to connect conduit to loop-in circular conduit boxes, switchgear, distribution boards, and adaptable boxes. Spacer bar conduit fixing saddles shall be used by the Contractor. Hexagonal malleable iron plugs shall be used. Hexagonal steel locknuts shall be used.

In addition to the above requirements for Class 2 Rigid system the following additional requirements for Class 4 will apply:

- Hot Dip Zinc Coating Finish
- Brass Dome or Cheese Headed screws to secure covers (as opposed to steel).
- Supports and fixings using proprietary suspension system comprising channel sections with return lips and compatible fixing accessories made of material to IS EN 10162, IS EN 10210 and/or slotted angles to BS 4345

The Contractor shall ensure support components have the same finishing method as the conduit carried out after manufacture. The Contractor shall ensure components in direct contact with the conduit match profile of conduit.

The Contractor shall ensure all steel components such as studding, bolts and steel screws, bolts, nuts and washers are either cadmium plated and passivated or zinc electroplated to BS 7371-12:2018 after manufacture. Do not use metal fixing components likely to deteriorate and/or cause damage through electrolytic action.

Cable Trunking and Fittings

The cable trunking system will be medium impact metallic (galvanised steel) complying fully with BS EN 61386 and be supplied by a single manufacturer.

The following gauge will be met in compliance with BS 4678:

Trunking External Dimensions	Minimum Nominal Thickness of Body with Return Flange	Minimum Nominal Thickness of Body without Return Flange	Minimum nominal Thickness of Cover
38 x 38	1.0	1.0	1.0
50 x 38	1.0	1.0	1.0
50 x 50	1.0	1.0	1.0
75 x 50	1.2	1.2	1.2
75 x 75	1.2	1.2	1.2
100 x 50	1.2	1.2	1.2
100 x 75	1.2	1.2	1.2
100 x 100	1.2	1.4	1.2
150 x 50	1.2	1.4	1.2
150 x 75	1.2	1.4	1.2
150 x 100	1.2	1.4	1.2
150 x 150	1.4	1.6	1.2
200 x 100	1.6		1.4
225 x 50	1.6		1.4
225 x 75	1.6		1.4
225 x 100	1.6		1.4
225 x 150	1.6		1.4
225 x 225	1.6		1.4
300 x 50	1.6		1.4
300 x 50	1.6		1.4
300 x 75	1.6		1.4
300 x 100	1.6		1.4
300 x 150	1.6		1.4
300 x 300	2.0		1.6

The following requirements will be met:

- Factory painted finish
- Compliance with BS 4678
- Partitions and covers to same material
- Manufactured with inward return edge flanges and fitted with flange couplers.
- Minimum 0.0012mm electroplated zinc covering internally and externally
- Purpose made brackets to fix to structural steel or suspension rods
- External fixing lugs shall be provided where specified protection for the installation is IP44 or greater
- Partitions and Covers to be electrically continuous with trunking body

- Full segregation must be provided by partitions
- Purpose made fittings of the same manufacture where trunking connects to switchgear and distribution boards shall be used.
- Cable supports shall be provided to horizontal trunking with removable cable retainers or bridges to retain cables in situ
- Cables supports shall be provided to vertical trunking with pin racks to support cables at 3000 mm maximum spacing. The Contractor shall use insulated pins or insulation sleeved pins on pin racks.

The following temperature restrictions shall apply to the metallic trunking system:

- 5°C storage and transport; a minimum installation and application temperature of - 5°C, a maximum installation and application temperature of 60°C.

Action	Temperature
Storage	- 5°C
Installation and Application	Minimum: - 5°C
Installation and Application	Maximum: 60°C

The Contractor shall use purpose made jointing pieces fixed with screws into captive nuts. Screws shall not protrude through the nuts. The Contractor shall ensure rigidity of the trunking is maintained across the joint. External dimensions of the trunking shall be maintained and not reduced by more than 4% across joints between trunking lengths and/or fittings.

Where applicable the Contractor shall provide flanges for the connection of flush floor trunking to vertical trunking to maintain the cross sectional area of compartments with 50 mm minimum radius. Electrical continuity at each joint shall be maintained by a copper link, (tinned copper for galvanized trunking), fixed on outside of trunking, secured by screws, nuts and shakeproof washers. Screws must not project through the nut. The Contractor shall make provision for continuity to be achieved without the need to remove paint from ferrous metal where trunking has a painted finish.

The Contractor shall not use self tapping screws. Only cheese or round head screws shall be used except where provision is made for the use of counter-sunk heads. These screws shall be steel zinc coated BS 7371-12:2018.

The Contractor shall use separate trunking or multi-compartment trunking for segregation of services. Steel partitions shall have a provision for connecting a circuit protective conductor. The separation of wiring for circuits shall be provided as required by IS 10101:2020.

The Contractor shall provide proprietary suspension systems comprising channel sections with return lips and compatible fixing accessories made of material to IS EN 10162, IS EN 10210 and/or slotted angles to BS 4345.

The Contractor shall ensure support components for Class 4 conduit have the same finishing method as the conduit carried out after manufacture. The Contractor shall ensure components in direct contact with conduit match profile of conduit.

All steel components such as studding, bolts and steel screws, bolts, nuts and washers are either cadmium plated and passivated or zinc electroplated to BS 7371-12:2018 after manufacture. The Contractor shall not use metal fixing components likely to deteriorate and/or cause damage through electrolytic action.

The Contractor shall provide cable trunking and fittings to BS 4678 for the trunking of insulating materials. The cable trunking and fittings shall comply with BS 4678. Use trunking of each type from one manufacturer.

Separate or multi-compartment trunking shall be used for the segregation of services. Steel partitions shall have a provision for connecting a circuit protective conductor. The trunking system shall provide separation of wiring for circuits as required by IS 10101:2020.

The Contractor shall provide proprietary suspension systems comprising channel sections with return lips and compatible fixing accessories made of material to IS EN 10162, IS EN 10210 and/or slotted angles to BS 4345 for the trunking of insulating materials.

The Contractor shall ensure support components for Class 4 conduit have the same finishing method as the conduit carried out after manufacture. The Contractor shall ensure components in direct contact with conduit match profile of conduit.

The Contractor shall ensure all steel components such as studding, bolts and steel screws, bolts, nuts and washers are either cadmium plated and passivated or zinc electroplated to BS 7371-12:2018 after manufacture. The Contractor shall not use metal fixing components likely to deteriorate and/or cause damage through electrolytic action.

Flexible and Pliable Conduit

The Contractor shall use flexible **steel** conduit for final connections to motors, other equipment subject to vibration or adjustment and to thermostats, motorised valves and similar items mounted in pipelines or ducts.

Sufficient length between equipment and circular through boxes at the ends of conduit runs (minimum 450 mm) to allow necessary full range of withdrawal, adjustment or movement shall be allowed for in the installation. Solid type adapters to terminate flexible conduit shall be used by the Contractor.

The Contractor shall use PVC covered flexible conduit where installed externally, exposed to weather or in any position where ingress of moisture or condensation may occur.

The Installation of Screwed Steel Conduit

The Contractor shall use materials clean and free from defects, rust, scale and oil. They must obtain prior permission in writing for use of materials subject to remedial work before erection. Always repair any damage caused by threading, bending or erection by painting with zinc rich paint before any rust occurs.

The Contractor shall ensure length of thread on conduit matches that in conduit couplers, fittings or equipment with no thread exposed after erection except at running couplers. Ensure conduits butt inside couplers. The Contractor shall use lubricant when cutting threads and use a minimum number of running couplings

When running couplings in Class 2 conduit, use a coupler and locknut. Paint exposed thread with zinc rich paint. The Contractor shall use three-piece conduit unions for running couplings in Class 4 conduit.

In the unlikely event that conduit is buried below ground, use Class 4 conduit. Do not use any buried conduit boxes unless prior permission in writing has been obtained. Wrap conduit with PVC self-adhesive tape, half lapped. Extend taping 150 mm beyond point where conduit leaves ground. Install circular through conduit boxes at the end of the tape. Fill conduit boxes after cable installation with inert, permanently plastic compound with high insulation value, and wrap in PVC self adhesive tape.

Access

The Contractor shall arrange trunking to allow access to wiring. Locate covers on top or sides of trunking if practicable. Arrange access so covers are on a continuous face and cables can be laid in throughout the length of the trunking. Notify where either condition cannot be achieved.

Fixing Trunking

The Contractor shall ensure trunking is independently fixed and supported from building fabric. Obtain approval for proposed fixings/supports. Support trunking in accordance with the manufacturers' requirements. Use two fixings minimum per standard length.

Steel Trunking Installation

Install steel trunking in accordance with the manufacturers' requirements and those of IS 10101:2020. Use trunking to avoid multiple parallel conduit runs, subject to approval. Cut trunking clean and square with axis, prepare ends and remove burrs and sharp edges. Ensure inside of trunking is free from anything liable to damage cables either during installation or after covers are fitted.

When trunking is held in a vice, ensure surfaces remain undamaged and components are not warped. Avoid tool marking or damage to trunking system components. Do not site fabricated trunking tees, bends, flanges and other accessories. Use only factory-made accessories. Form circular holes over 6 mm diameter in trunking body using correctly sized punch sets. Use twist drill for holes up to 6 mm maximum diameter.

Use only factory formed openings for accessories. Line unprotected apertures in trunking with PVC or nylon edging strip. Fit ends of runs with removable blanking plates. Ensure connections are not made to covers unless indicated or approval obtained. Provide fixed section of cover projecting 25 mm either side of fabric where trunking passes through wall, floors or ceiling. Fit cable retaining straps at 500 mm intervals except where cover is on top.

Trunking of Insulating Material (plastic for example)

The Contractor shall comply with the manufacturer's instructions. Do not install trunking where ambient temperature is below -5°C or working temperature is above 60°C. Use solvents recommended by trunking manufacturer when making solvent welded joints. Remove excess solvent before surface damage occurs. Hold joints rigid and in position until welds set. Use manufacturer's standard radiused bends, connector tees, off-sets, end plates and component parts of trunking system assembly. Ensure no type of trunking other than that specified is installed without approval. Trunking may be substituted for conduit at certain positions subject to approval.

5 CABLING AND INSTALLATION PRACTICES**General*****Cable Manufacture***

The Contractor shall use new cables, delivered to site with seals intact, manufactured not more than one year prior to delivery, labelled with manufacturer's name, size, description, BS number, classification, length, grade and date of manufacture.

Mark all types of cables with CENELEC cable certification marking or if included in British Approvals Service for Cables (BASEC) in accordance with BASEC regulations and those detailed below.

Standard Flexible Cords and Industrial Cable with LSOH Sheathing

Supply cables with Low Smoke Zero Halogen (LSOH) sheathing, tested in accordance with IS EN 50267 and IS EN 50265. Must have a minimum classification of C_{CA}, s1b, d1, a1, according to EN 13501-6.

Mineral Insulated Wiring and Power Cable with LSOH Sheathing

Supply cables with Low Smoke Zero Halogen (LSOH) sheathing, tested in accordance with IS EN 50267 and IS EN 50265. Must have a minimum classification of C_{CA}, s1b, d1, a1, according to EN 13501-6.

Standard Power Supply Cables, Copper Conductors, Thermosetting Insulation, Sheathed and Armoured

The Contractor shall provide these cables to the following standard: BS 5467, Tables 4, 6, 8, and 12. These cables shall be mechanically protected by the armour. Must have a minimum classification of C_{CA}, s1b, d1, a1, according to EN 13501-6.

Standard Power Supply Cables, Copper Conductors, LSZH Sheathed And Armoured

The Contractor shall provide these cables to the following standard: BS 6724, Tables 4, 6, 8, and 10. These cables shall be mechanically protected by the armour. Must have a minimum classification of C_{CA}, s1b, d1, a1, according to EN 13501–6.

Standard Cables for Conduit and Trunking, Copper Conductors, LSZH Insulated

The Contractor shall provide these cables to the following standard: BS 7211, Tables 3(a) and 4(a). These cables shall be mechanically protected by the conduit and trunking. Must have a minimum classification of C_{CA}, s1b, d1, a1, according to EN 13501–6.

Standard Flat Cables, 2-Core or 3-Core, Copper Conductors With or Without CPC, LSZH Insulated Sheathed

The Contractor shall provide these cables to the following standard: BS 7211, Table 7. Must have a minimum classification of C_{CA}, s1b, d1, a1, according to EN 13501–6.

Control and Auxiliary Cables with LSOH Sheathing

Supply cables with Low Smoke Zero Halogen (LSZH) sheathing, tested in accordance with IS EN 50267 and IS EN 50265. Must have a minimum classification of C_{CA}, s1b, d1, a1, according to EN 13501–6.

Paired, Screened and Unarmoured Control Cables:

The Contractor shall provide these cables to the following standard: BS 5308-1, Tables 3, 5 and 9. These cables shall be type 1 un-armoured cables. Must have a minimum classification of C_{CA}, s1b, d1, a1, according to EN 13501–6.

Paired, Screened and Armoured Control Cables

The Contractor shall provide these cables to the following standard: BS 5308-1, Tables 3, 5 and 9. These cables shall be mechanically protected by the armour integral to the cable. These are type 2 cables. Must have a minimum classification of C_{CA}, s1b, d1, a1, according to EN 13501–6.

Multi-Core Armoured LSZH, Sheathed Auxiliary Cables

The Contractor shall provide these cables to the following standard: BS 6724, Table 18. These cables shall be mechanically protected by the armour integral to the cable. Must have a minimum classification of C_{CA}, s1b, d1, a1, according to EN 13501–6.

Fire Alarm Cable

All fire alarm wiring shall be in enhanced fire resisting cable of PH 120 classification when tested in accordance with I.S. EN 50200 and BS 8434-2

Information Communication Technology Cables – Structured Wiring

The Contractor shall provide these cables to the following standard: ISO/IEC 11801-1 & 2:2017; ISO/IEC 61034 & 61156-5; EN 50173-1:2018; EN 50288-6-1; ANSI/TIA/EIA 568.D

Type CAT6, F/FTP, 4x2xAWG 23/1 premium grade Class 6a. Must have a minimum classification of C_{CA}, s1b, d1, a1, according to EN 13501–6.

For the manufacturer and reference see schedule of Equipment in Section B of the specification.

The above-mentioned structured wiring cables shall be flexible cables for wiring and power signals, control and auxiliary signals and for communications.

Optical Fibre Cable

Standard - IS EN 60794 and ISO 11801.

Cables to be 8, 12, 16, 24 Core 50/125 Multimode OM4 fibre.

Cable Glands

The Contractor shall provide glands to the following standard: IS EN 62444:2013 non-metallic, cable retention, IP54; BS 6121-2, A1P. These are for indoor environments.

Cables glands for armoured cables, in dry conditions indoors for power wiring, control and auxiliary shall be to IS EN 62444:2013 metallic, with cable retention Class A and protective connection to earth, IP54.

Cables glands for armoured cables, in conditions outdoors for power wiring, control and auxiliary shall be to IS EN 62444:2013 metallic, cable retention Class A, protective connection to earth, IP54 with shroud.

Cable Terminating and Jointing Sockets

The Contractor shall provide cable terminating and jointing sockets to the following standard: IS EN 61238-1 when termination or jointing is of the compression type.

Cable Joints and Terminations

The Contractor shall only use cable joints as supplied or recommended by cable manufacturer.

For power cables the joint arrangement shall be straight through or tee. The joint type shall be to BS 6910, cold pour or heat shrink. The Contractor shall use where necessary accessories such as armour bonds, BS 7197; filling compounds. These joint types shall be used in underground environments.

Cable Ducts

The Contractor shall provide ducting installations to EN 61386, DN 90 or NJUG 6.

Cable Sleeves

The Contractor shall provide supply and hand to others for installation non-ferrous cable sleeves for incorporation into the structure where cables pass through fire compartment floors and walls.

Packing material

The Contractor shall install either weak mix mortar, intumescent, plaster or mastic, solid intumescent material or intumescent granule filled bags as packing material.

Cable Covers and Markers

The Contractor shall provide cable covers and markers made from recovered plastic, with integral tape where applicable. These shall mark the location of telephone or electricity lines. They will have plastic marker tape and be yellow, marked with electricity or telephone.

Workmanship and Installation Practices of Cables***Cable Installation - General:***

The Contractor shall use and install cables only as directed in the appropriate standard or as directed by the manufacturer in writing. Lay cables in one length unless otherwise indicated. Obtain permission from supervising officer for all through joints, and where overall length requirement exceeds practical drum size.

The Contractor shall install cables when ambient temperature is 5°C or greater, using cables stored at or above this temperature for not less than 24 hours.

The Contractor shall use drum stands, drum axles, fair leads, rollers, cable stockings and other equipment as recommended by the cable manufacturer and as appropriate to the method of installation.

Cable Installation in Low Temperatures

The Contractor shall install cables at lower installation temperatures when authorised by manufacturer in a written statement.

Installation of LSZH Cable

The Contractor shall install LSZH cables in accordance with manufacturer's instructions. Ensure ambient temperature is above 5°C. Ensure oversheaths are not damaged by abrasion or scuffing.

Installation of Unarmoured Cables

The Contractor shall install and use unarmoured cable to BS 6004, BS EN 50525:2011 and BS 7211 in accordance with BS EN 50565-1:2014 or the manufacturer's written instructions.

Cable Trenches

The Contractor shall ensure that trenches for cables and cable ducts are prepared, backfilled and reinstated. Supervise all work to cable trenches by others. The Contractor shall carry out a walk

over survey of the trench route and dig a trial hole in any area considered to be potentially difficult. The Contractor shall establish location of any other underground service adjacent to cable route. The Contractor shall re-plan cable routes after survey and trial holes. Submit report of survey and trial holes.

The Contractor shall then carry out any instructed work to adjacent services. Set out cable trenches, excavate trench carefully setting aside any materials required for backfilling or reinstatement.

Minimum cover in cable trenches

The following depths apply to the following cables:

MV cables 800mm; LV cables 600mm; communications cables 600mm; all cables 1000mm under roadways.

Trench

For trenches that are to house all underground services it shall be constructed as a grade trench bottom to a maximum slope of 1:12. The trench shall be cleared at the bottom of loose stones with bedding placed the full width of the trench.

Bedding in Trench

The bedding in the trench shall be riddled earth 6mm grid for cables; riddled earth 12mm grid for ducts; imported soft sand; or pea shingle, for ducts.

The bedding thickness shall be 75mm or 100mm for ducts. The installation of cables or ducts will be in a bedding material to a minimum depth of 75mm above highest cable or duct.

Cable or duct identification

A yellow warning tape with a black legend will be provided for cable or duct identification. The trench shall be backfilled using two layers of 100mm thick hand rammed earth. The backfilling shall be completed in layers and the trench reinstated. The backfill material will be earth excavated from the trench.

Cable Installation in Trenches

Cables shall be laid on newly prepared bedding. The Contractor shall ensure multiple layers of cable are separated vertically by a 50mm layer of hard rammed bedding material.

When using a power winch, the Contractor shall ensure tension on the cable is taken by element of the cable designed for that purpose that is armour or conductor cores as appropriate and not plastic sheath, metal sheath or core insulation.

When hand pulling the cable, the Contractor shall ensure no kinks are formed and that flaking, when used, is done in the correct direction.

The Contractor shall not allow the cable to twist during installation. The Contractor shall use swivels to connect the pulling bond to cable stocking or equivalent fitting. The Contractor shall check drum is suitable for jacking before commencing the installation. If the drum or reel is unsuitable for

jacking, flake the cable in the correct direction in maximum size turns from drum or reel before commencing the installation. Use skilled labour to supervise all the unreeling, flaking or running of cable from a drum.

Lay the cables in the formation shown, ensuring spacing is not reduced below that indicated.

The Contractor shall bind trefoil groups at 1m intervals. Any associated earth or protective conductor to its cable or trefoil group shall be bound at 1m intervals. The Contractor shall ensure the installation radii and permanent bending radii are not less than those recommended by the manufacturer. The Contractor shall lay cables to BS 6004, BS 6007, BS 6500, BS 7211 or BS 7919 direct in the ground.

Cable Ducts

The Contractor shall supervise the laying of ducts by others. The Contractor shall lay ducts in the formation shown, on to newly prepared bedding. The ducts shall be jointed in accordance with the manufacturer's instructions.

The Contractor shall ensure that ducts slope no more than 1:60 vertically or 1:30 horizontally and ensure that pre-formed duct bends used at ends of duct routes meet the requirements of the cable manufacturer for bending radii.

Construct manholes, draw pits and jointing chambers

The Contractor shall prove alignment of completed duct run by drawing through a mandrel 7mm diameter less than nominal duct bore for minimum length 250mm. The Contractor shall clean completed duct run by drawing through a circular wire brush 12mm diameter more than nominal duct bore.

The Contractor shall install a draw wire of corrosion resistant material and minimum breaking strength 550N in each empty duct. All ducts shall be sealed and plugged with proprietary duct plugs, on completion.

Cable Installation into Ducts

The Contractor shall install cables into newly proved and cleaned duct. The Contractor shall use lubricants, recommended by the cable manufacturer in writing, to assist with the drawing process. Flake the cable if drums or reels are not suitable for jacking. At intermediate draw pits with the exit duct more than 15 degrees off line of entry duct, flake cable before entering or provide comprehensive system of corner plates, roller and blocks. The Contractor shall use maximum practical size of turns when flaking and ensure the direction is correct.

The Contractor shall not exceed manufacturer's installation tension on cable and ensure the pulling tension is taken on cable elements designed for that purpose, that is armour or conductor cores and not on other elements, such as plastic sheath or conductor insulation. The Contractor shall not allow cables being pulled into ducts to twist. Use appropriate swivel between pulling bond and cable stocking or similar appliance. Bind trefoil groups of single core cables installed into a single duct at 1m intervals. Install earth or protective conductors into the same duct as the associated

cable where practical, through manholes, draw pits and jointing chambers. Bind the two cables together. Pull all cables in one duct as a group. Ensure group does not twist or cross over. Report any damage to cable sheath during installation and carry out any instructed work to remedy the damage.

Between the cable and duct ends seal after cable installation. Ensure cable ends in jointing chambers are temporarily sealed where required.

Cable Installation in Conduit and Trunking:

Install cables so that they are orderly and capable of being withdrawn. Arrange single core wiring generally using the loop-in method.

Trunking

In vertical trunking provide pin racks at 3m intervals. Use ties at 2m intervals for all wires of the same circuit reference. Mark ties with circuit reference number at 10m intervals.

Conduit

Provide cable clamps in conduit boxes at 10m intervals in vertical conduit. Allow for full range of movement at building construction movement joints. Make all joints to wiring at terminal blocks in conduit boxes.

Cable Installation on Tray and Rack

Place cables side by side or as indicated. Fix using cleats or cable ties so that any cable may be individually removed. Use metallic ties on cables with specified fire performance.

Cable Surface Installation

The Contractor shall dress cables flat, free from twists, kinks and strain, and align parallel to building elements. When glands and clamps are not required, take the sheathing of cables into accessory boxes and equipment and protect against abrasion using grommets or similar sharp edge protection.

Cable Installation of Flexible Cords

Grip cords securely at connections. Where they do not form an integral part of the connected accessory or equipment, provide separate proprietary cord grips.

Cable Jointing and Terminating Generally

The Contractor shall ensure all joints and terminations are made by appropriately qualified cable jointers, using jointing materials, components and workmanship recommended by the cable manufacturer and the jointing accessory manufacturer. Install cable glands in accordance with BS 6121-5.

Cold pour resin and heat shrink joints in accordance with BS 6910-2

The Contractor shall cut all cable ends immediately prior to jointing or terminating. Seal cables left unconnected for more than 24 hours to prevent the ingress of moisture. The Contractor shall seal the plastic sheathed cables using proprietary shrink on end caps.

Strip cables to bring out the cores and expose conductors, for the minimum length required for connection, to leave no exposed length of conductor after termination. Ensure that strands are not damaged when stripping cable cores. Twist strands together. Do not reduce number of strands. Secure all strands at terminations. The Contractor shall clean the armour thoroughly prior to jointing or terminating. At connections to equipment and switchgear without integral cable clamping terminals, use compression or solder type lugs for bolted terminal connections, of correct bore. Form all compression connections to components using tools that cannot be released unless the correct degree of compression has been achieved.

The Contractor shall install and inspect compression and mechanical connectors on conductors in accordance with BS EN 60228:2005 and BS 7609:1992+A2:2009. Bolt core terminations with lugs to equipment using washers or proprietary shakeproof devices. Do not bunch more than three cores at clamping terminals or bolted connections.

Mark cable conductor phasing, or other core identification, at each end of all cables, and at all joints, maintaining consistency of marking with any existing system. Connect all cores, including multicore cable spare cores, at all joints and terminations. The Contractor shall bond any unused cores or multicore cables to earth at both ends, unless otherwise indicated.

Cable Jointing and Terminating - Elastomer and Plastic Insulated Cables

The Contractor shall joint cables using glands of the type indicated, in accordance with the manufacturer's instructions. Use shrouds at all glands, unless otherwise instructed. At core connections to equipment without integral clamping terminals use compression lugs unless otherwise indicated.

Terminating - Mineral Insulated Cables

The Contractor shall use terminations in accordance with IS EN 60702-2 and components and materials recommended or supplied by cable manufacturer. Use seals with maximum temperature rating indicated, stub caps to the largest size available, and drilled caps and headed sleeves for larger sizes.

The Contractor shall use glands of type indicated. At terminations to accessory boxes within a plaster or render finish, cable clamps fixed to accessory box and firmly gripping cable sheath may be used. Use earth tail seals with sheath grip type accessory boxes.

At equipment not provided with threaded entries, secure glands using lock washers and locknuts or brass conduit bush. Use gland shrouds when plastic covered MI cables are used.

Using PVC, PIB or LSZH material tape to BS 3924 or IS EN 60454 to match sheath, tape overall gland any bare copper sheath and form seal to cable sheath under all shrouds. Mark the core

sleeving with the appropriate identification. Install voltage surge suppressors in accordance with manufacturer's recommendations and surge suppressors to IS 10101:2020.

Cable Joints - Mineral Insulated Cables:

The Contractor shall joint mineral insulated cables using methods and materials recommended by cable manufacturer. Terminate cables in externally threaded glands using seals with temperature rating indicated. Join conductors using crimped connectors. Insulate connectors using PVC tape to BS 3924 or IS EN 60454, ensuring good seal to conductor sleeving. Make off glands into either end of internally threaded brass sleeve of correct size. Protect brass sleeve using heat shrink sleeve.

Communications Coaxial and ICT Cable Installation, Jointing and Terminating

Use methods approved by cable and accessory manufacturers. Employ labour certified by acceptable body as qualified to install and make joints and terminations in the referenced cable. Obtain in writing approval of cable manufacturer for accessories not supplied by them. Identify cables using structured numbering scheme.

Cabling Support and Containment***General***

Cables referred to in this section are only those types that can be installed without further mechanical protection.

Cable supports

The Contractor shall support all cables throughout their length using conduit; or trunking and enclosures; or cable tray; or cable racking; or special support systems; or cleat or clip fixing direct to building fabric as indicated on the drawings/schedules. The Contractor shall ensure tray, racking and special support systems are continuous and firmly fixed to building fabric. Allow space for additional cables as indicated on the drawings/schedules. The Contractor shall ensure cable support system allows for spacing in accordance with IS 10101:2020 for the design current of the cable.

Fixings finishes

The Contractor shall ensure finish for all support components, fixings, hangers and accessories are as the cable support system or manufacturer's standard.

Cable Support System - Perforated Tray

The above shall be of the flanged or return flanged type. Perforations shall be of the admiralty pattern for light or medium duty; GD&C pattern standard 23; or manufacturer's standard pattern. The thickness shall be as the manufacturer's standard thickness for type.

The Contractor shall use factory made fittings throughout of same material, type, pattern, finish and thickness as cable tray. The Contractor shall use reducers, inside angles and outside angles as manufacturer's standard. The Contractor shall use flat bends, equal tees, unequal tees and crosses with corners gusseted.

Lengths of tray shall be joined and fittings using manufacturer's standard shouldered ends, fish plates, or couplers, with galvanized or zinc plated slotted domed head 'roofing' bolts, nuts, washers and shakeproof washers.

The Contractor shall use hot rolled steel galvanized after manufacture to IS EN ISO 1461; or bending and profiling quality hot dipped galvanized steel to EN 10346:2015 or IS EN 10143 and EN 10346:2015. The finish shall be self-colour galvanized.

Cable Support System - Cable Cleats

The Contractor shall use one piece or single way pattern or claw pattern or two bolt patterns. The material shall be die-cast aluminium alloy; moulded black polyethylene; or nylon. The finish of the cleats shall be self finish.

Cable Clips and Cleats

These shall be manufactured to standard EN 61914:2016. They will be made from impact resistant material. They shall have resistance to electromagnetic forces and be of the one-piece type. Polypropylene surface type with pre-fixed hardened steel pin for general use except on mineral insulated cables. For mineral insulated cables use bright copper one hole 'P' clips for unsheathed mineral insulated cables, PVC covered for sheathed mineral insulated cables.

Proprietary cable ties

Proprietary cable ties shall be of the two-piece cable tray pattern type. Two-piece cable tray pattern, on cable tray only. Wrap round self-locking non-releasable pattern on everything except cable trays.

Cable Support System - Two Way Saddles

The Contractor shall use bright copper for unsheathed mineral insulated cables. PVC covered bright copper for sheathed mineral insulated cables.

Cable Tray Installation

The Contractor shall support from the building fabric with minimum clearance behind of 20mm and install fixings at regular intervals to prevent visible sagging when loaded, with maximum spacing 1.2m and 230mm from fittings.

The Contractor shall keep cutting of cable tray to a minimum. Cut along a line of unperforated metal. Make good finish with zinc rich paint, primer and top coat, or two pack epoxy paste, as appropriate to tray material and finish. The Contractor shall fit holes cut in tray for passage of cables with grommets, bushes or other lining. All bolts, fixings and hangers shall be installed with threaded portion away from cables.

Cable Cleats, Ties, Saddles and Clips Installation

For cables on horizontal tray use ties for each circuit. Use tie manufacturer's special tensioning tool where available. Crop off tie ends.

For cables on vertical tray use cleats bolted to tray for paper, plastic or elastomeric insulated cables and saddles or clips for mineral insulated cables. Use cleats sized to grip cables firmly without undue pressure or strain on cable, but preventing slipping.

For cables on vertical or horizontal rack use proprietary fixings to rack for paper, plastic or elastomeric insulated cables and saddles or clips for mineral insulated cables. On continuous flat surfaces of wood, plaster, brick etc.

Use polypropylene surface fixing clips with prefixed hardened steel pin for PVC insulated and sheathed cables and sheathed or bright mineral insulated cables. Use round or flat or flat twin pattern as appropriate, manufactured specifically for cable being fixed.

Use one hole 'P' clips or two-way saddles of bright copper for unsheathed mineral insulated cable.

Use PVC covered for sheathed mineral insulated cables. Space cleats, ties, saddles and clips in accordance with IS 10101:2020

6 POWER (62)**General Services and General-Purpose Power Installations****General**

The Contractor shall supply, install, test and commission the complete general services and general-purpose power installations as indicated on the drawings and as specified herein. All cables will be LSZH type.

Equipment

General services equipment shall be as indicated on the Schedule of Equipment.

XLPE/SWA/LSZH ARMoured DISTRIBUTION CABLES

All sub-mains and all other distribution cables shall be complete with separate circuit protective conductor (CPC) fixed to the main cable by means of cable ties at 300mm intervals. Separate CPC's shall be sized in accordance with the drawings and IS 10101:2020. Cross sectional areas (CSA's) of the various sub-main cables and other final circuit cabling shall be as detailed in respective sections of the specification or as indicated on the electrical distribution schematic.

XLPE/SWA/LSZH cables shall be:

- 600/1000 volt grade of the sizes detailed in the schedules/drawings with high conductivity plain copper wires.
- Insulated with extruded XLPE
- Cores shaped, numbered or coloured for identification and sheathed with LSZH.
- Armoured with a single layer of galvanised steel wires, sheathed overall with LSZH. (Not in the case of Hi-Tuf cable).

It is the responsibility of the contractor to ascertain all cable routes and distances associated with the site and buildings in general. No claim shall be entertained due to lack of knowledge regarding the layout of the proposed building, ceiling structures and location of the distribution boards and main switchboard.

Conductors shall be plain annealed copper with XLPE insulation. Bedding shall be thermosetting low smoke and fume compound. Armour shall be galvanised steel wire with an LSZH thermosetting compound sheath.

Manufacture shall be to BS 6724, insulation to BS 6724, armour to BS EN 10257, Sheath to BS 6724 and shall comply with BS EN 3766 and IEC 332, Pt 3 Cat C flame tests. Conductors shall be circular or shaped, stranded or solid as determined by cable sizes. All cabling shall be manufactured by a BASEC approved manufacturer.

FIRETUF PLUS ENHANCED FR (FIRE RESISTANT) CABLING SYSTEMS

The contractor shall note that PH120 enhanced fire cable MUST be used throughout and loops shall only be wired using 2-core cable. A fire-resistant cable with a lesser PH classification than PH120 and if not of enhanced grade status shall not be permitted on this project. Firetuf Plus Enhanced FR cables shall be used for fire alarm and detection circuit wiring throughout the premises complying with the following: -

- PH120 rating
- 600/1000 Volt Grade stranded
- 3-hour Fire Rating according to IEC 331 Sheath Colour Red for Fire Alarm System Wiring Indication
- 2 Core & Earth Type Manufactured by Draka (UK), www.drakauk.com or equal quality.

All cabling shall be manufactured by a BASEC approved manufacturer.

Firetuf Plus enhanced cables shall be installed strictly in accordance with the manufacturer's requirements.

In summary, Firetuf Plus cables shall be installed as other non-metallic sheathed cables: -

Horizontally and vertically they shall be clipped direct using metallic 'P' clips (to meet clause 26.2 of BS5839 for fixing of fire cable) to the underside of the floors at 450mm intervals or 1000mm intervals if fixed to wire tray. (No other forms of fixing shall be acceptable) Fire alarm cabling shall be completely segregated from electrical services at all times.

Where conduits terminate into the control panel base, couplers and brass bushings with lead washers shall be utilised.

At each detector base, a galvanised throughway/U box is required in conjunction with 20mm PG glands, (colour = red), for safe, secure and tidy termination of the fire alarm cabling. Detectors shall be supported by bridging supports provided and installed by the builder and under no circumstances should they rely solely on the ceiling slab for support.

All drops to manual call points shall be made in 25mm surface galvanised conduit. The electrical contractor shall install surface boxes with 25mm knockouts and the use of couplers and brass bushings with lead washers is required.

Fire alarm cabling shall be at least 300mm apart from 230V mains cabling in all circumstances. The cables shall be in accordance with IEC 331, BS 4066, BS 6387 Part 1 and IEC 332 Part 1 and Part 3.

They shall be screened to provide 100% protection from external electro-magnetic interference.

The cables shall have low smoke emission, low toxicity and shall not propagate a fire. They shall be halogen free and have flame retardant properties to BS6425 Part 1.

The cables shall be in compliance with the C, W and Z requirements as defined in IS3218, BS5839-1: 2017 and BS 8434-2: 2003+A2:2009 and BS EN 50200: 2015 Classification **PH120**.

General Services Socket outlets

The Contractor shall provide socket outlets where shown on the drawings. No more than 4 twin socket outlets are to be wired on the one circuit. All socket circuits shall be protected by Type B 30mA RCBO's at the local distribution board. The use of a common RCD in conjunction with individual MCB's shall not be acceptable.

Socket outlets generally shall be of the surface or flush mounted with finish as per the datasheets, to BS 1363, IS 411, double-pole switched, outboard rockers, with dual-earth terminals to provide high-integrity earthing and in compliance with BS1363 with suitable back boxes without knockouts. Outlets will have no indicating lamps unless otherwise indicated on the drawings. Socket outlets shall be mounted at 450mm AFFL unless otherwise indicated. Socket outlet circuits shall be wired in 4mm² LSZH cabling in trunking and conduit. Single un-switched socket outlets shall be provided for low-level kitchen equipment where shown on the drawings.

Where low level under counter sockets are installed a double pole isolation switch shall be installed above the counter for each socket.

The Contractor shall supply plug-tops for 25% of the quantity of socket outlets in the building or 30No plug-tops, whichever is the greater. The Contractor shall supply protective socket covers to all sockets.

Connection Units/Spur Outlets (FSCU's)

Connection units/spur outlets shall be provided where shown on the drawings. No more than 4 spur outlets shall be wired on the one circuit with the exception of power supplies for water heaters and hand dryers and any other services indicated on the drawings. Each spur outlet circuit shall be protected by a 20A MCB on the local distribution board unless otherwise indicated. Spur outlet circuits are to be wired directly from distribution boards on their own circuits. Spur outlet circuits shall not be wired in a radial fashion off of another general services power circuit.

Connection units shall generally be mounted at 450mm AFFL for low level services and at 2100mm AFFL for high level services unless otherwise indicated. Connection unit circuits shall be wired in 4mm² LSZH cabling in trunking and conduit. Connection units for general purpose power services shall be of the switched fused indicating types to BS 4662 unless otherwise indicated. They shall be provided with a switch and neon indicator as necessary depending on item of equipment to be served. They shall comply with BS EN 60669 and be complete with earth terminals. Dimensions shall be 86 mm x 86 mm max.

Connection units for Security equipment shall be of the un-switched fused indicating type to BS 4662 and be on the same phase. Connection units for CCTV equipment shall be of the un-switched fused indicating type to BS 4662 and be on the same phase. Connection units for Fire Alarm equipment shall be of the un-switched fused indicating type to BS 4662 and be on the same phase.

Cooker Control Unit

The Contractor shall provide 45A DP Cooker control units - without sockets to BS 4177, (enclosure box to BS 4177) and associated cord outlet to BS EN 60947-1:2021 shall be provided where shown on the drawings. The cooker control switch shall be wired in 3 core 10mm² XPLE/SWA/LSZH.

Isolating Switches

The Contractor shall provide isolating switches to IS EN 60669-1 with rocker bar switch type where shown on the drawings. The rating and pole configuration shall be DP, three pole or TPN as indicated on the drawings. The isolating switches shall be wired as follows:

Current	SP&N	TP&N
20A	3 core 4mm ² LSZH & earth	4 core 4mm ² LSZH & earth
25A	3 core 4mm ² LSZH & earth	4 core 4mm ² LSZH & earth
32A	3 core 6mm ² LSZH & earth	4 core 6mm ² LSZH & earth
50A	3 core 10mm ² LSZH & earth	4 core 10mm ² LSZH & earth
63A	3 core 16mm ² LSZH & earth	4 core 16mm ² LSZH & earth

Weatherproof Sockets

The Contractor shall provide weather proof sockets with cable and appliance couplers for 16A, 240V single phase for general purpose use, to IS EN 60309-2 as indicated on the drawings. They shall be of polycarbonate construction with male and female connectors. Weatherproof sockets shall be wired as follows:

Current	SP&N	TP&N
20A	3 core 4mm ² LSZH & earth	4 core 4mm ² LSZH & earth
25A	3 core 4mm ² LSZH & earth	4 core 4mm ² LSZH & earth
32A	3 core 6mm ² LSZH & earth	4 core 6mm ² LSZH & earth

Mechanical Plant and Controls Cabling Installation

The Contractor shall include for the complete wiring and testing of all cabling associated with the mechanical plant and controls.

The general allocation of responsibilities for the installation of the mechanical plant and controls cabling as described below.

Power Wiring

The Mechanical specialist/building management system specialist shall confirm to the Electrical specialist the power wiring cabling requirements. The installation, glanding off, termination, testing and permanent labelling shall be carried out by the electrical contractor. The building management system contractor/specialist supplier shall verify the termination of the power wiring cabling.

Controls Wiring

The Controls Specialist shall confirm to the Contractor the controls wiring cabling requirements. The installation, glanding off, termination, testing and permanent labelling shall be by the electrical contractor. The final verification of termination shall be by the Controls Specialist.

Controls Devices

The supply and labelling of controls devices shall be by the Controls Specialist. The installation of the pipeline and ductwork mounted instruments/devices shall be by contractor. The installation of the room mounted instruments/devices shall be by the Contractor.

MCCs and Panels

The supply and delivery shall be by the Controls Specialist. The offloading and positioning of MCC panels shall be by the Mechanical Services Specialist. The installation of the MCC panels shall be by Contractor. The commissioning of these panels shall be by the Controls Specialist.

Variable Speed Drives Outside of MCC Panel

The supply and delivery of VSD's shall be by the Controls Specialist. The offloading and positioning of the VSD's shall be by the Mechanical Services Specialist. The installation of the VSD's shall be by the Contractor. The commissioning of the VSD's shall be by the specialist supplier to the Controls Specialist.

Variable Speed Drives Inside of MCC Panel

The supply of VSD's within the MCC panels shall be by the Controls Specialist. The installation in the MCC panels shall be by the Contractor. The commissioning shall be by the specialist supplier to the Controls Specialist.

Variable Speed Drive Sizes

The specialist supplier of the VSD's shall issue a questionnaire for information required to the Controls Specialist. The Controls Specialist shall advise the specialist supplier and the Contractor of all relevant manufacturers' details.

7 LIGHTING SERVICES (63)

7.1 General Lighting

General

The Contractor shall include for the supply, installation, wiring, testing and commissioning of the general lighting installation as described in Section A of this specification and as indicated on the tender drawings. The Contractor shall further refer to the Section B of this specification for the particular selection of light fittings and associated items intrinsic to the lighting installation.

Standards & Regulations

- IS 10101:2020
- CIBSE Lighting Guides
- IS EN 12464.
- The Building Regulations
- Luminaires: BS EN 60598-1
- Fluorescent tubes: BS EN 60081
- Lamp holders: BS EN 60400, BS EN 60061, BS EN 61184, BS EN 60238
- Ballasts: BS EN 60921, BS EN 61347
- LED Luminaires: As detailed in dedicated section on LED Luminaires

Wiring and Installation

The internal lighting circuits shall be run in 2.5mm², with 2.5mm² earth throughout the installation. All lighting circuits shall be protected by MCB's of a minimum size of 10A. The circuits shall be arranged to minimise voltage drop and provide the correct operating voltage for each luminaire.

The Contractor shall ensure that support is adequate for weight of the luminaires provided. Where luminaires are to be mounted on suspended ceiling grid, they shall under no circumstances rely solely on the grid for support. Typically for a 1500mm linear fluorescent type fitting, 2 no. 6mm threaded rods shall fix the fitting to the actual building roof/ or floor structure.

Power supply for each luminaire shall be extended in cable and conduit to a position not less than 1.2m in plan length from the lighting outlet point. The power supply shall be extended via a connection box mounted in the ceiling space, to facilitate the installation of light switches.

Final connections to luminaires shall be via flex from a galvanised conduit BESA box. All BESA boxes and galvanised conduit associated with the general and emergency lighting wiring installation shall be fixed to the cable trunking or roof structure, if this is deemed a more practical approach by the engineer.

Where sloped plasterboard ceilings are provided, luminaires in such situations shall also be surface mounted on the ceiling slopes.

Cabling to light switches shall be carried out in cable in galvanised steel conduit as described in the containment section earlier in the technical specification, installed on the surface of fair faced hollow block walls.

The Contractor shall provide the following minimum number of supports for each luminaire longer than 600mm.

Luminaire width (mm)	Minimum number of supports
Up to and including 300	2
Over 300	4

Where a luminaire is supported from trunking the Contractor shall use proprietary clamps or brackets appropriate to the luminaire and trunking.

The Contractor shall not support luminaires directly from trunking made from non-metal or heat sensitive materials, where the temperature of the material may exceed 60°C or the mass suspended exceeds 3kg.

Where unavoidable and two or more phases are present in the Switchbox, phase segregation barriers shall be installed in the Switchbox and labels shall be provided within the Switchbox. Every attempt however, shall be made to avoid multiple phases in the switchbox.

Equipment

Luminaires shall be as detailed in the Schedule of Equipment of the specification. All luminaires' photometric data shall comply with BS EN 13032-3:2021. All luminaires shall be in accordance with IS EN 60598. The Contractor shall ensure that luminaires of similar type have same photometric performance as published data within the tolerances defined by BS EN 13032. All hazardous area luminaires shall comply with IS EN 60079, and IS EN 50014; IS EN 50018 or IS EN 50020 as appropriate. All luminaires shall be so designed such that they may be installed and fixed easily to required surfaces. All luminaires shall provide areas for easy cable access and have internal cable ways if required.

The Contractor shall ensure that the lamps of each type are from same manufacturer and are of the same colour temperature and rendering characteristic.

The Contractor shall incorporate integral photo-cell on luminaire where indicated on the drawings. The Contractor shall clarify with the consultant before hand the lighting control strategy. Where photocells are indicated separate from the light fitting mounted on the underside of the ceiling this is how they shall be installed. The Contractor shall alert the consultant immediately after being appointed as the successful Contractor as to any changes to the lighting control strategy.

The Contractor shall employ a lighting control specialist to fully test and commission the lighting control system. The Contractor shall install high frequency electronic control ballasts for all tubular fluorescents. These shall be mounted integral to the light fitting or shall be fully accessible if in a concealed location

Throughout this installation the Contractor shall install all lamps.

LED Luminaires

LED luminaires and components are to conform to the latest edition of the following standards:

Standard	Title
Product electrical safety standards	
EN 60598-1:2013	Luminaires: General requirements and tests
EN 60838-2-2:2006 + A1:2012	Miscellaneous lamp holders. Particular requirements. Connectors for LED modules
EN 62031:2008 + A1:2013	LED modules for general lighting. Safety specification
Photobiological safety standards	
EN 62471:2008	Photobiological safety of lamps and lamp systems
Product performance standards	
EN 62384:2006 + A1:2009	DC or AC supplied electronic control gear for LED modules. Performance requirements
EN 62386-207:2009	Digital Addressable Lighting Interface. Particular requirements for control gear. LED modules (device type 6)
IEC/PAS 62707-1	LED. Binning. Part 1. General requirements and white grid
IEC 62717*	LED modules for general lighting. Performance requirements
IEC 62722-2-1*	Luminaire performance. Particular requirements for LED luminaires
Electromagnetic compatibility	
EN 55015:2013	Limits and method of measurement of radio disturbance characteristics of electrical lighting and similar equipment
EN 61547:2009	Equipment for general lighting purposes. EMC immunity requirements

Minimum luminaire efficacy is to be 80lm/cW unless otherwise indicated on the Project Lighting Datasheets.

As per S.I.151:2011, all lanterns are to be listed on SEAI's Triple E Register of energy efficient products, or are to comply with the Triple E criteria.

The LED light source is to comply with the following requirements:

- Correlated Colour Temperature shall be a maximum of 4,000K or as noted in the product datasheets.
- Colour Temperature Tolerance is to be within a 3-step ellipse.
- Colour Rendering Index (CRI) is to be greater than 80 for interior lighting and 65 for exterior lighting.
- Failure Fraction (Fy) shall be less than 10% at the declared L70 i.e. F10 @ L70

The LED Driver is to comply with the following requirements:

- The driver is to be designed to operate at maximum performance and efficiency with the LED chips or module used.

- The rated case temperature shall be suitable for operation in the luminaire operating at an ambient temperature of 15°C.
- The lifetime of the driver shall not be less than the rated L70 value for the luminaire.

The following measured luminaire data is to be provided:

Product Name/Catalogue No:	
Description	Unit
Rated Power	W
Power Factor	-
Lumen Output – Initial	Lumens
Luminaire efficacy	LL/cW
Lumen Output - % @ 6,000 hours	%
L ₇₀	Hours
F _y	-
Ambient temperature (t _a)	°C
Correlated Colour Temperature (CCT)	K
Colour Temperature Tolerance	Step Ellipse
Colour Rendering Index (CRI)	-
S/P Ratio	-
Risk Group in accordance with EN 62471	-

Testing and Commissioning

The general lighting installation shall be fully tested and commissioned in accordance with the above standards and the lighting manufacturer's recommendations. 100hrs burn-in shall be applied by the contractor before handover.

7.2 Emergency Lighting

General

The Contractor shall include for the supply, installation, testing and commissioning of the entire emergency lighting installation as indicated on the drawings and specified herein. All components, including batteries, in the emergency lighting installation shall have a full system warranty for a period of 3 years minimum provided that battery life has been maintained by the correct testing schedule. Any component found to be defective within this period of time shall be replaced free of charge to the Client.

There is an increasing tendency to use stand-alone LED emergency lights, often in conjunction with automatic test systems. The Particular Specification and Schedule of Equipment will detail these where they are used.

Standards & Regulations

The emergency lighting installation shall comply in its entirety, and be certified upon completion, with the following National Standard, IS 3217 “Code of Practice for Emergency Lighting” in conjunction the following European Standards:

- IS EN 1838 “Lighting Application – emergency Lighting”
- IS EN 50171 “Central Power Supply Systems”
- IS EN 50172 “Emergency Escape Lighting Systems”
- BS EN 62034:2012 – “Automatic test systems for battery powered emergency escape lighting”

Wiring and Installation

Emergency lighting circuits shall be run in 2.5mm², 2-core cable, with 2.5mm² earth as above, and cables shall be colour coded to IS 10101:2020. The supply to the Emergency Luminaires shall be taken from the Adjacent Distribution Centre.

All emergency luminaires shall be fed from the downstream terminals of the MCB feeding the local lighting circuits, with not more than four luminaires per circuit, via a normally closed contact of a multi-pole relay. The multi pole relay in each Distribution Boards shall be controlled from a Central Test/Timer Unit.

Equipment

Exit signs

Exit signs shall be as indicated in the schedule of equipment and be of the combined type. All safety signage utilised in conjunction with the emergency lighting system must comply with the Health and Safety Authority's Safety and Health at Work (Signs) Regulations 1995 (S.I. No. 132 of 1995).

Gateway

The system shall be monitored by a central wireless Gateway which will upload system status and energy performance to a website for users to view in a graphical format.

System test times and other parameters shall be programmed via the website, this information shall be automatically downloaded to the Gateway. The Gateway shall control all emergency testing and reporting automatically.

All luminaires shall report status to the Gateway once per day. This will include failure status and energy performance data. These records shall be uploaded to a website periodically where the data will be stored securely and displayed in graphical format. The website will also store supporting site documentation including ‘as fitted’ drawings, commissioning certificates and any other documentation required by the end user.

Emergency luminaires

The Contractor shall provide all exit luminaires of the maintained, self-contained type with stove-enamelled steel body, opal diffuser LED lamps with the word EXIT in 125mm high lettering in accordance with IS3217. These luminaires shall have a silkscreen printed in green upon the diffuser and shall be operated from a three-hour battery set with automatic re-charging set. All exit luminaires shall comply with EN 1838:2013 and have a Running Man Pictogram.

Twin spot emergency luminaires shall be of the non-maintained, self combined type with 2 No. 3.5W Watt LED Spot Lights mounted in a metal battery cabinet, complete with three-hour battery set with automatic re-charging set. The cabinet shall be stove enamelled.

Twin spot emergency luminaires, where provided in accordance with M&E drawings, shall be wall mounted or supported from the trusses/purlins by means of clamp on type brackets by the nominated sub-Contractor.

The emergency lighting luminaires/equipment shall be to the approval of the engineer and comply with the requirements of EN 60598-2-22.

The complete emergency lighting system shall be tested and commissioned and the various completion certificates as listed in IS3217: 2013+A1:2017 shall be issued to the office of the consulting engineers. A copy of these certificates shall form part of the O&M manuals. Practical Completion or Handover of the building shall not be achieved without this carried out in its entirety.

Emergency Conversions

All invertors shall be of the fully enclosed type, either metal or plastic can. All batteries utilised integral to luminaires shall be high temperature (55°C), sintered plate, Nickel Metal Hydride (Nickel Cadmium is not an acceptable alternative), secondary cell type, rechargeable.

All conversions shall, wherever possible, be integral to the original luminaire, only following specialist assessment, investigation and test, to ascertain the suitability for conversion from an electrical, electronic, mechanical, thermal, EMC, serviceability and safety viewpoint.

All conversions shall not affect the Ingress Protection Classification (IPXX) of the original luminaire and shall not affect the photometric performance of the original luminaire and shall also not affect the Safety Classification of the luminaire (Class I, II, III).

The Contractor shall include for the recertification of the original luminaire following the conversion process, specific to the EMC and LV Directives, Ingress Protection Classification, Safety Classification and Performance criteria by the System Supplier.

High temperature nickel metal hybrid battery packs suitable for use with specified diameter tubes shall be installed in fluorescent luminaires and shall power one of the lamps on mains failure for a duration of three hours.

The battery and charger circuit utilised shall be fully encapsulated and come complete with battery disconnect male/female connector(s) to aid isolation and services. All batteries used shall be either Gas recombination Sealed Lead Acid of the High Temperature variety or Sintered Plate, High temperature Nickel Metal Hybrid. All batteries shall be suitably sized to power the required load for a minimum period of 3 Hours with a 25% ampere-hour capacity to allow for capacity fall off with age over useful life (i.e. 4 years) yet still maintain 3 Hours duration. All Chargers shall be solid state, constant voltage or constant current format, depending on battery type utilised. Each charger unit shall come complete with solid state controls to initiate deep discharge protection of the battery automatically in the case of extended power failure. All chargers and changeover controls shall be fully automatic and fail-safe upon power failure or resumption of supply. The charger shall come complete with a neon warning light to indicate that all circuitry is complete and functioning correctly and that the batteries are being charged. Batteries shall have a minimum recharge time of 24 hrs at 230V 50 Hz.

Overload & short circuit protection

All emergency luminaires shall incorporate separate protection for each incoming supply line, to include the unswitched and switched supplies, integrally, within the luminaire by means of suitably fused terminal block(s) to aid safety, isolation and discrimination functions. All fused terminal blocks for the purpose of connection to the supply network shall be suitably sized for the connection to each terminal of at least 2 No. 1.5mm² cables or 1 No. 4.0mm².

Testing & Commissioning

The Contractor shall include for testing and commissioning of the system by the system suppliers and for attendance on the suppliers during commissioning.

The system shall not be deemed complete until a satisfactory commissioning Certificate is submitted to the Employer's Representative. Certificate shall be in exact accordance with I.S. 3217. The external lighting installation shall be carried out as indicated on the Drawings and as specified. Luminaires shall be as set down and described equal & approved in the Schedule of Luminaires. External lighting circuits shall be run in 6mm² two-core PVC/SWA/LSZH Cable to ground mounted luminaires and in 2.5mm² cables in conduit to building-mounted luminaires. The switching of all site luminaires shall be by means of contactor control circuits from a switching position adjacent the main distribution board.

The external luminaires shall be controlled by solar dial time switch/photo cell distribution centre via a contactor, with an over-ride switch facility positioned as indicated on the drawings.

Photo electric cells shall be normally open, close on low-light type, complete with conical plastic cover and shall be mounted at roof level away from all direct light sources. The photoelectric cell shall be of the adjustable type setting from 2 -800 lux, and shall be complete with sixty seconds time delay on/off.

The building flood lighting/carpark lighting shall be controlled by separate time switches and photocells. The switching details shall be as indicated on the drawings.

8 DATA & COMMUNICATIONS (64)

Category 6a Foil-shielded Twisted Pair (FTP) (ISO 11801 – Class EA) /Class EA, ISO 11801 (fast Ethernet) system will be supplied for all rooms as indicated on the Drawings in accordance with the latest version of the National HSE Structural Cabling Systems.

All data products shall be randomly tested through the year by 3rd party test houses, as opposed to product that is selected specifically for test. The following parameters shall also be met with regard to the data system installation:

- Guarantee from manufacturer to end-used for 25 years
- Lifetime of applications
- Warranty must cover both copper and fibre
- Warranty must cover IEC fire ratings
- Full cost of replacement (**labour** and parts)
- Transferable warranty
- Extended distances (see technical specification)
- Fully compliant with latest International and European standards
- Fully Technical support from manufacturer in event of an accident
- Manufacturer must audit site during installation
- Proof of training of installer (not older than 2 years) must be supplied.
- All products must cover 3rd party compliance documents. 3rd party compliance must be **random** tested, **not sample** testing.

All cabling in new builds MUST comply with Cat 6a standards. Cabinets/Racks should be clearly labelled with the cabling standard employed so appropriate patch leads can be deployed.

Fibre optical cable used to construct the cabling system backbone MUST meet the following specifications 8, 12, 16, 24 Core 50/125 Multimode OM4 fibre. Tight buffered, indoor/outdoor cable with an internal strength member must be used. Each core must be terminated using SC/ST piglets within a 19-inch fibre patch-panel case.

Cabinets must be 800x1000mm with 47U. There shall be cable managements on each side of the cabinets. Each full-size cabinet should include 2 x 10-way power distribution units (1 no. UPS supply and 1 no. non-UPS supply) and at least 2 heavy duty shelves and 2 cantilever (front mounting) shelves. The cabinet should have a glass front door which must be lockable. The standard height is a 47U cab. In the case of new large sites, the number of racks will be $X + 2$, where X is the number of racks required to accommodate all the field points. The other 2 racks are for the rack mounted voice solution and the active data equipment.

Patch leads are to provided as follows:

- (i) N/3 1M Green patch-leads for voice patching within the communications room.
- (ii) N/6 2M Green patch-leads for voice patching within the communications room.
- (iii) N/4 .5M Green patch-leads for voice patching within the communications room.
- (iv) N/4 1M Grey patch-leads for data patching within the communications room.
- (v) N/10 2M Grey patch-leads for data patching within the communications room.
- (vi) N .5M Grey patch-leads for data patching within the communications room.
- (i) 2N/3 2M grey patch-leads for data patching on the floor.
- (vii) N/20 1M blue patch-leads for analogue port patching within the communications room.

Cabling Installation Standards

The cable length from faceplate outlet to patch-panel must not exceed 90M.

2M of slack should be provided where practical on all cabling terminations at the Cabinet/Rack

The bend radius of a cable must not be greater than 4 times the cable diameter.

The installer MUST be fully conversant with TIA/EIA 568.D as improper handling of the cable at pulling-in stage can result in failure of the cable to meet the required specification.

Where cable is being installed into cabinets/racks, cable-tray should be fitted to the cabinet/rack to accommodate the cable which should be cable-tied in groups of twelve.

The cabling should be run along the side of the rack so as not to hinder subsequent installation of active network equipment.

Cabling should always be presented in a tidy manner.

Trunking and cableways must be sized to 2.5 times the requirement of the current installation, i.e. if current installation is 2 cables then cableways must be sized for 5 cables.

Cableways must be completely separate from electrical power installations.

Cables must not be loomed in numbers greater than 25.

The contractor will be responsible for the removal and re-instatement, to the original condition, of any ceiling tiles or panels required to perform the installation. Reinstatement of tiles or panels must not create pinch points or other reductions of the quality of the cables.

Cables must not be tied to power cables or run along the same conduits or ducts or run through the same connection box.

Cabling within structured desks must be separated from the power cabling as described in BS6396:2022.

Cables should be fixed in straight parallel runs and should be held in place by broad cable ties at not more than 600mm centres on horizontal trays and 300mm on vertical trays.

Each group of 12 cables should be fed through the cabinets/racks along cable-trays as described above before being brought out for termination at the rear of the passive patch-panels. All passive patch-panels should have strain relief bars fitted onto which the cables should be cable tied.

All terminations should be performed using tools approved by the vendor of the product being used. The contractor should provide details of the vendor name and the part numbers of the termination tools proposed before commencing termination of the cabling.

Cabinets/racks should be labelled with a 4-inch printed label as A, B, C etc depending in the numbers of cabinets/racks installed.

All field points and their patch-panel terminations should be labelled with a printed adhesive label within a clear plastic insert in the case of field points starting from 1 and working incrementally upwards. The final labelling system will be agreed on a site by site basis at the initial site meeting described above.

There is no requirement for tray bridges to separate data and voice cables.

The maximum unsupported cable length shall be 300mm. Suitable unistrut, tray supports and tray bends should be installed as required. All support steelwork should be suitably earthed. Installed cable shall take the shortest route consistent with the usage of the containment system and defined routes, and shall not, unless specified, contain length in excess of the distance required. All cables, whether on trays, in ducts or laid directly on the concrete floor, which cross service pipes carrying hot or refrigerant fluids shall be protected from excessive high or low temperatures or condensation. This may require separation and/or thermal insulation.

Cables shall be kept clear of fire suppression outlets, heat and smoke detectors and water detector strips.

Installed cables shall not be laid where they may be subject to vibration or movement. Cables shall not be fixed using staples.

Voice and data cables may be run on the same tray. In such cases, voice multicore and data cables shall be kept in their own separate looms, when tied to the supporting trays. Cable bundles shall not be run over hard or sharp edges such as the edges of trays. Particular care shall be taken that cables are not laid on tray bridges, or other features, that present sharp or small radius edges to the cables. Cables shall leave trays at right angles and shall be suitably cable tied and dressed. Where basket tray is installed, cables shall exit through the bottom or side of the tray. Cable exits shall be strictly controlled such that additional cables can be easily and neatly added to trays in the future. Cables shall be installed to use the minimum of the tray width. Cables shall not be stacked higher than 50mm on basket trays at any location. Cables shall not be stacked higher than 150mm on smooth surfaces. The manufacturer's recommendations are not to be exceeded.

Cables within raised floor voids shall leave main routes at right angles. Cables shall follow the floor tile grid, shall rest on the concrete slab and shall be tied together at regular intervals to form a neat bundle and be tied to floor pedestals at intervals. The distance from the main routes to grid outlet points shall be the shortest possible. Cables shall not be laid diagonally to the floor tile grid. Cables shall not be laid on areas exposed to external weather conditions. Cables shall not be laid on wet or damp concrete surfaces and any water or moisture subsequently detected after cable laying shall be assessed for remedial action.

Network cables shall be run in separate compartments of trunking, where practical, usually this means either the top or bottom compartments of 3-way trunking are used, the cable only enters the central compartment when entering the back-box where terminations take place. Trunking compartments shall be no more than 50% full to allow for future installation of cables. Cables shall enter and exit trunking via bridges to ensure complete separation between communications and power compartments.

The number of cables in each conduit shall be controlled to allow for future cable installation and to stay within the manufacturer's maximum allowable cable pulling tension.

The Contractor must make every effort to physically protect the data cable, before, during and after installation. Particular attention to ensure that the cable is not snagged, knotted, kinked, stretched, walked upon, or damaged in any other way, either before or during installation. If any cables are snagged during the installation and the other sheaths are damaged, they will be required to replace these cables in full, no cable joints are allowed on the cabling.

Internal grade cables shall be jointed to external grade cables within 3 metres of the point of duct entries. Joints shall be carried out in wall-mounted or tray mounted joint boxes. Joint boxes shall be earthed to protective earths either locally or earth cable shall be run back to the nearest protective earth bar. Aluminium tape or foil screens of external cables shall be earthed at one end only.

In all new builds and refurbishments, two ducts should be provided to allow services from Service Providers to be diversely provided to the development either in a North/South or East/West orientation depending on the proximity of the development to the nearest Service Provider ducts. Such information will be provided at the initial site meeting described above. These ducts should be installed adjacent to existing Carrier Junction Box (JB). At any point where there is a need for a bend in the installation, a JB should be installed, with the ducts finishing at the internal walls of the JB. Consultation with HSE ICT and Local Carriers are required for approved routes and JB dimensions, before any work is to take place.

Testing of wiring shall be performed prior to any devices being connected to the network. 100 percent of the Cat6a cabling shall be tested for conformance to the specifications of TIA/EIA-568.D Category 6a using a level 3 test meter. The installer must provide copies of all test results in an electronic readable format, preferably on a CD with the following details included, Site, Installation Technician and Date of Test. One full page of detailed test results per data outlet is required. It will not be sufficient to show a data outlet number and a test status of pass for that particular outlet. The installation contractor should supply two copies of the test results.

As a minimum all FTP cable must be tested to assess conformance with the following:

- Continuity
- Wire map
- Attenuation
- Cable length
- NEXT
- PSNEXT
- ELFEXT
- PSELFEXT
- Return Loss

The incoming cables will have all 4-Pairs terminated at both patch panel and outlet in accordance with the TIA/EIA 568.D specification. To maintain transmission performance of the cabling system the twists in the cabling must be maintained as close to the point of termination with a maximum untwist of 13mm from the point of termination. The Contractor should also ensure that if introducing twists back into the wiring then only one twist may be performed. The stripping of the cable sheath

will be limited to the minimum amount required for a successful termination. Contractors shall design the system such that sufficient slack remains to enable re-termination of the outlets a minimum of twice and a limited scope for movement of the cabinets. Cables underneath the cabinets are only acceptable where there is a possible need to move the cabinet forward from its location to allow access. This should be agreed with HSE ICT. All data cables will be installed with no form of joint on the cable run between the patch panel and the outlet. If cables are damaged along the run of cable then they must be removed and replaced with new cable. Each patch panel and outlet will be labelled with black labels on a white background; each outlet will have an individual number with cabinet no., patch-panel no. and outlet number on it. All cables must be tested using a Fluke DSP4000 Digital Cable Analyser or an equivalent cable analyser. All test results must be recorded and supplied to the HSE ICT.

Testing of all type of fibre cable, whether single or multimode should comply with the following standards. All OTDR plot information reading should be saved in the test equipment memory. On completion of the testing, a full download of the test data should be transferred into a Windows standard database for subsequent delivery and availability to HSE. Test data must include the Site Name, the date of the test, the engineer's name, the Pass/Fail result, the link name, the test standard used, identification data of the test equipment, plots, db losses and the last date of calibration of the test equipment used. The OTDR should be used to verify the length of the fibres, the attenuation and loss within the connections and traces of the cores being tested. Testing should confirm that the loss exhibited by the cable is less than or equal to 3 dB/Km and the loss across a connector is less than or equal to 0.5 dB.

Multicore Cat 3 copper cable should also be tested to confirm correct pair number, polarity, continuity and length and the results should be recorded in an electronic format which can be retained by HSE for their records.

Infrastructure and Materials Specification

The installation of the rack/cabinet shall comply with Part 7 of the "National Rules for Electrical Installations" of the IS 10101:2020. There is a requirement for the cabinet to be fed by a clean Electrical Supply. A 20A circuit breaker will be installed at the main distribution board and a 13A fused un-switched spur unit, complete with neon indicator will feed the cabinet. This circuit shall not be protected by an RCD. All Cabinets to be earthed and bonded with 16mm² earth wire using crimp lugs.

After completion of total installation, a minimum of 30% of cabling may be tested independently. The purpose of this testing will be to verify that the as installed cable meets all the requirements for Cat 6a cabling. A 100 % pass rate of all cabling is required before customer acceptance of the cabling system takes place. If at this stage a 100% pass rate is not achieved then the installation

contractor will be instructed to retest the entire installation. After the installation contractor provides proof of retest then the independent body will again retest 30% of the cabling. Any failures detected at this stage will result in the installation contractor being requested to re-terminate and re- test the entire installation as the installation will at this stage be considered to be below specification.

At the conclusion of the installation and final testing a preliminary walk through with the installation contractor will be performed to check for installation quality, accurate performance of the work, and to verify completed drawings. Any modifications to the documentation or the installation that may be required shall be accomplished within a two (2) week period. "Customer Acceptance" does not release the installation contractor from repairing any cabling errors or improperly labelled circuits, caused by the installation contractor, which may be discovered at a later date.

Fibre optic cable should conform to the following specifications;

- Thermoplastic flexible jacket.
- No metallic strength members or components
- Minimum crush resistance of 200N/100mm
- Each fibre optic element shall be able to withstand a tensile load of at least 600N under long term conditions.
- Each fibre optic element shall have a minimum bending radius less than 40mm.
- Each fibre optic element shall be distinguished by an individual colour.
- Where a fibre optic cable has more than 12 elements, each group of 12 elements shall be bound in a spirally wrapped and individually colour coded binder or otherwise kept separate from the other group(s).

Wi-Fi Provisions

Within the ceilings, with 5 metre separation, a dual faceplate shall be terminated in a single back box with 2 metres of slack cable coiled at its termination point. These cables should be terminated on a separate Cat 6a patch panel(s) within the cabinet. The location of these "Wireless points" must be accurately identified on any hand over building drawings. It is preferred that both the faceplates and patch panels for Wireless are labelled with White lettering on a Blue background, with the same detail as per the labelling set out above. These patch panels should be positioned above the structured cabling patch panels and within cabinets, only Wireless cabling should be terminated on these patch panels. All must be tested in full to Cat 6a as previously stated.

Handover Documentation

On completion of the cable installation, termination, labelling and testing, the installation contractor responsible for the installation must provide the floor plans showing locations of all outlets with their outlet numbers. Drawings showing cable routes for all backbone cables, both fibre and multicore (where applicable). Test Results for all horizontal cabling. Test results for all backbone cabling. 25-year application warranty. Floor plans which have data outlet numbers written on by hand are not acceptable. A final inspection will take place involving both HSE ICT and the contractor, where this documentation can be handed over. This inspection does not release the contractor from any cabling or labelling errors, caused by the contractor, which may be discovered at a later date.

Mobile Carrier Coverage

Due to materials used within the construction of modern and existing buildings, mobile carrier users sometimes experience issues with poor service quality etc. As part of all new HSE installations we require an in-Building Cellular Enhancement System, where mobile coverage is an issue. This is commonly implemented by a Distributed Antenna System "DAS".

Active Components

The HSE ICT reserves the right to decide which equipment can be attached to the HSE network.

No other devices can be installed on the network without this consent.

Within the comms rooms no other equipment is allowed to be positioned within new or existing cabinets without prior written approval, this applies to all CCTV, Alarm Systems, PA Systems, and Building Management Systems etc

9 PROTECTION AND SECURITY (67, 68)**9.1 Fire Alarm****General**

The Contractor shall supply, install, test and commission the complete new, or extended, fire alarm system in accordance with IS3218 coverage as detailed in the site specific specification. The fire alarm system shall be as indicated on the drawings and specified herein. The fire alarm system shall be an analogue addressable system. The fire alarm system shall be connected to a remote monitoring station via the intruder alarm system multi channel digi-dialler over a standard PSTN phone line. This shall be arranged and tested by the Contractor. The Contractor shall be responsible for all liaison with the Remote Monitoring Company and if required the local authority fire brigade regarding setting up and testing the remote monitoring functions of the fire alarm system. The Contractor shall submit a set of drawings to the fire alarm system specialist prior to commencement on site for comment and approval of conformation with current regulations. The Contractor shall supply, install, test and commission the complete Disabled refuge system in accordance with BS 5839 Part 9:2021 and consist of Type B outstations which communicate with a master station.

Standards & Regulations

The fire alarm system shall comply with IS3218.

The Disabled refuge system shall comply with BS 5839.

Equipment**Fire Alarm Control and Indicating Equipment**

The Fire Alarm Control and Indicating Equipment shall consist of a main fire alarm panel, battery and housing and mimic diagram as indicated on the drawings. The fire alarm control and indicating equipment shall be in accordance with BS 5839- 1, BS 5839-6 Annex B, IS EN 54-2, IS EN 54-4, IS EN 50130-4 and IS3218. The main fire alarm panel shall have integral 80-character alphanumeric display with Indication of origin of alarms, fault zone indication, short circuit and open circuit faults, Incorrect addressing; unauthorised device removal or exchange, pre-alarm condition, detector contamination; panel mounted printer; no more than 512 detectors affected by first fault; a maximum of 200 addressable points controlled by a single processor.

Battery & Power Supply System

The Contractor shall supply test and install a battery and power supply system in accordance with IS3218 and as per the main fire alarm panel manufacturer's standard requirements.

Manual Call Points

The supply and installation of the manual call points shall comply with the following standards: IS EN 50130-4, IS EN 54-11 and IS3218. Generally, the Manual Call points shall have protection against accidental operation, indication of operation and be addressable. Colour of device is to be Red in accordance with regulations. All manual call point units are to be of the fully re-settable type via key operation. The use of breakable glass in the call units is to be avoided.

Automatic (smoke) Detectors

Provide automatic fire detectors from the same manufacturers and with common facilities in accordance with IS EN 50130-4. All detectors shall have the following general characteristics: Plug in bases; common bases for all detector types; addressable detector bases; 3 way or T bases; All automatic fire detectors shall generally be of the optical smoke detectors type. These detectors shall have an address code setting. Separate addressable plugs for each detector shall be provided. The Contractor shall provide end of line devices mounted in sensor at the end of line. The Contractor shall label each detector and base with address number. The colour of detectors shall be white. Detectors to be of the optical point type unless otherwise indicated on the drawings and shall be in accordance with BS EN 14604:2005, IS EN 54-7 and IS3218. Sensitivity of the smoke detectors shall be set by the main panel control software. Each detector will be complete with a line isolator.

Heat Detectors

Heat detectors to be of the type indicated on drawings and be in accordance with BS 5446-2, IS EN 54-5 and IS3218.

Common Base

All detectors shall use a common base, which shall be suitable for BESA box mounting. This will allow interchanging of devices if necessary and also protect the integrity of the loop if the devices are accidentally removed. Where mounted on a suspended ceiling, automatic detectors shall be provided with a recessed mounting kit and wooden back pattress.

Sounders

Fire alarm sounders are to be Electronic type and in accordance with IS EN 54-3 and IS 3218.

In instances where the system is being extended they are to match the existing sounders, whether these be electronic or bell type.

Beacons/Strobe Units

These shall be addressable looped powered units with high intensity LED's. They shall have the ability to vary the flashing frequency. Operating temperature range shall be between -10°C and +50°C. The units shall comply with IS3218: 2013+A1:2019 and may be combined with sounders.

Interface Units

Provide interface units where shown on the drawings and ensure that power supplies are available for same.

Testing and Commissioning

The complete fire alarm installation shall be tested and commissioned in accordance with the regulations and interfaces with other electrical sub-systems shall be tested for operability before the final certification is issued.

Record Drawings and Operating Instructions

The Contractor shall provide instructions on the use of installation to person(s) responsible for the use of the premises. Supply the user with a logbook and certificate of installation and commissioning, in accordance with IS3218. The Contractor shall provide record drawings to the user for maintenance and record purposes. The Contractor shall show the position of various items of equipment, junction boxes, etc. and sizes and routes of cables and wires. Include wiring diagrams of junction boxes and distribution cases. The Contractor shall provide circuit diagrams of the fire alarm system and its components.

9.2 Intruder Alarm**General**

The Contractor shall include for supplying, installing, connecting, cabling, setting to work and commissioning of the complete Grade 3, Environmental Class II (minimum) Intruder Alarm System, in accordance with ISEN 50131 and DD243:2004 (sequential verification of alarms). The Contractor shall be a certified NSAI installer or shall appoint a NSAI registered Intruder Alarm Specialist to complete the full works. The Services Specialist shall allow for the wiring of all items of his equipment from the nearest power outlet. Positions of power outlets required and connected load shall be indicated to the Employer's Representative and shall form part of the Contractor Drawings. The power supplies shall be taken from suitably rated, fused spur outlets with neon indicator. This work shall be carried out by a Qualified Electrician. The Services Specialist undertaking the intruder alarm installation shall need to be registered on the NSAI list of registered installers. If the Contractor wishes to make a technical design proposal in accordance with the parameters set out hereunder. Proposals shall be submitted in sufficient detail to permit evaluation in terms of adequacy, quality and cost.

Alarm Sensors

Movement detectors shall be of the Grade 3 Passive Infra-Red/Microwave 'Dual Tec' type of sufficient range and coverage for areas indicated. They shall be suitable for Wall or Truss Mounting as appropriate. The sensor shall be suitable for the coverage of the perimeter window areas as indicated on the drawing. The Services Specialist shall include for additional Sensors as necessary to ensure complete coverage of the perimeter areas indicated on the drawings. All alarm sensors shall be suitable for the areas and locations which they are installed and shall include full anti-tamper facilities. All Alarm Sensors shall conform to ISEN 50131. The Services Specialist shall note that ceilings are plaster finished in some areas and no access will be available above the ceiling.

Alarms

An audible alarm shall be provided to sound clearly throughout the premises. The sounder will be multi-toned, its sounder level can be set for progressive mode. It will be able to provide alert signal and status reporting. An external audible and visual alarm shall be provided as per the drawings. Alarm sounders to suit architectural finishes shall be provided. The external system will be IS EN50131 Security Grade 3 Environmental class IV. A false external Bell Box, identical in finish to above, shall be installed (final location to be agreed) as shown on the drawings. The wiring shall be installed throughout the Building and in its own recessed conduit to doors/windows where required. All wiring shall be installed by the Services Specialist and shall be installed throughout its entire length, within a completely separate steel conduit system and within the low-voltage compartment of cable trunking, with all patent glands, brushes etc. where necessary. Trunking and conduit installations shall be carried out by the Services Specialist. The Services Specialist may consider as an alternative, other wiring systems on the basis of proven experience in this specialised installation work. An external alarm unit shall be housed in a weatherproof cabinet which shall incorporate battery standby and be fitted with flashing strobe protected by a weatherproof wire cage.

Wiring of the intruder alarm

Internally the system shall be wired using 8c 0.7mm² LSZH cable in radial circuits. Activation & deactivation of the entire system shall be by key fobs and keypad. External wiring shall be carried out in multipair Poly/Poly gel filled cable.

The installation shall be a closed-circuit system to comply with EN50131-

1:2006+A2:2017, and the installer shall hold a current installers licence in conjunction with the PSA. (Licence number to be provided at time of tender submittal) The detectors shall be as indicated on the contract drawings. Each external detector shall be wired on a radial circuit to allow protected areas to be zoned on an individual basis. Equipment shall be manufactured by Honeywell or equal & approved. Keypads with incorporated proximity readers shall be used to control intruder alarm system.

The contractor shall liaise with the specialist installer prior to submission of his tender to ensure that all wiring, containment and power supplies have been allowed for in the overall tender figure.

It is the responsibility of the contractor to verify all requirements prior to submitting his tender. No claims shall be entertained post tender.

Alarm Panel

The Services Specialist shall allow space for a minimum of 2 no. future detection loops in the intruder alarm panel. The intruder alarm system installation shall be as indicated on the accompanying drawings. All LEM units shall be mounted in areas out of public view. The Contractor shall include in its tender for sufficient cabling to locate LEMS. Indication shall be presented at the local keypad of the status of each local zone. The system shall be arranged so that all Alarm Bells are sounded and zone indication is given at the Control Panel. The Services Specialist shall be responsible for the correct operation of the system and all components. Should a fault develop on any part of the system within the twelve months maintenance period, the Contractor shall replace the faulty section/component free of charge (no charge to be made for materials, labour and/or expenses.) Should any component in the system have repeated faults/failures, the Contractor shall replace the component with a similar part of a different manufacture, free of charge. The Services Specialist shall include for the supply and installation of an 8 Channel Digital Communicator located remote to the Intruder Alarm Panel. Upon completion of the system, the Contractor shall submit a Completion and Commissioning Certificate and give a full demonstration of the System. The Contractor shall also allow for the instructing of the Client's Nominee in the operation of the installation and shall obtain the Nominee's Signature stating that he is satisfied with the instructions given. All tenders must be based on the System outlined in this Specification and indicated on the Drawings. Alternative systems shall be submitted separately giving full detailed specification the proposals. The contractor shall be deemed to have visited the Site and familiarised himself with the building and service. The Contractor shall include for supplying all necessary permanent mains power supplies to the panel, the digital communicator and all standby power supplies. This work shall be carried out by a qualified electrician. The power supply shall be taken from an un-switched spur outlet with neon indicator. Upon completion of installation the system shall be capable of being programmed for 'Double Knock' operation whereby each space detector acting alone must be activated twice within a fifteen second period before an alarm is registered on the Control. (First single knock pulse count shall be provided). However, in the event of two or more detectors being activated, an alarm condition shall be registered immediately at the Control Panel without any time delay. The Contractor shall include in the Summary of Prices for an Employer's Representative to be present at all alarm call outs during the first four weeks of operation of the system by the Employer. The Contractor shall include in his Tender for 12 Months Maintenance/ Defects Liability Period.

Method of signalling (external monitoring)

The intruder alarm system shall be connected up to 'national monitoring networks' for remote monitoring of the installation. The system shall have GSM dual path signalling monitoring service, which shall monitor the system 24-hours a day, 7 days a week, by 'national monitoring networks'. This phone line monitoring service operates 24 hours a day, verifying that the phone line is operational and has not been cut by intruders. In addition, if the phone line goes down, the GSM will automatically switch alarm communications to the mobile phone network, allowing the alarm system to operate as per normal even though the regular phone line is inoperative. In this way, the phone line is disrupted due to intruder attack or other reasons (e.g. accidents etc) the system will still be fully functional.

The intruder alarm specialist shall allow for liaising with National Monitoring Networks for the provision and initial cost for setting up external monitoring including the first 12 months coverage. This shall be included by the alarms specialist costs at tender stage. The contractor shall be responsible for providing all telephone cabling as necessary within the building between Eir's incoming position and intruder alarm panel.

Maintenance

The specialist installer shall include in their tender for the cost of comprehensive maintenance of the systems for a period of 12 months from the date of commissioning. This cost shall include for 24-hour engineering maintenance cover. Preventative maintenance and corrective maintenance will be provided and will consist of 2 site visits to be carried out on a 6-month basis. Copies of all maintenance carried out shall be forward to the engineer for his records.

Testing and Commissioning

The complete system shall be tested and commissioned by the specialist Installer in conjunction with the equipment manufacturer's representatives in accordance with PSA: 2004. Two copies of the commissioning certificates shall be provided.

Link to External Building Lighting

As a requirement by the Department of Education the intruder alarm system must be connected to the external lighting installation. In the event of an alarm signalling, the external lighting shall go into 'hand' mode and turn all external lights 'On'. This applies to all external lighting circuits. All necessary contactors and relays shall be provided by the electrical contractor.

Link to Fire Alarm System

For security purposes the fire alarm system must be connected to the intruder alarm system, which will automatically connect to a 24-hour central station. The communicator to the ARC (by intruder alarm specialist) will be capable of distinguishing whether the alarm is fire or intruder. The contractor shall include for this connection. The fire alarm and intruder alarm specialist shall indicate wiring details.

Specialist Supplier

The specialist supplier shall be a PSA approved installer.

9.3 CCTV Installation

General

The Contractor shall supply, install, test and commission the entire CCTV installation as indicated on the drawings and specified herein. The system shall be IP. The Contractor shall be a certified NSAI installer or shall appoint a NSAI registered CCTV Specialist to complete the full works. The Services Specialist shall provide a digital video recording system with the components mentioned below and be capable of providing the following functions: An internal matrix enabling any of up to 16 cameras to be switched to any of the two monitors; multi-user / triplex™ capability which enables live and recorded images to be viewed simultaneously on one monitor while continuing to record. Two independent split screens shall be provided by the Services Specialist. A storage capacity of 5TB shall be provided (upgradable to 10TB). An audio recording capability shall be provided. Jog/shuttle control for variable-speed forward, reverse play and frame-by-frame searches shall be provided. Ethernet connectivity for remote access to live and recorded images shall be provided. The completed CCTV system will allow the users to print or copy to a CD-recorder without the need of a PC. The ability to search video clips using motion search to find motion in a user-defined area will be provided. The Services Specialist shall supply monitors as directed in the Particular Specification and shown on the drawings.

If an existing system is being extended by means of additional NVR's these are to be fully networkable with the existing control equipment

Standards & Regulations

The CCTV installation shall comply with the following standards and regulations:

ISEN 50131-1 "Alarm Systems - Intrusion Systems - Part 1: General Requirements"

ISEN 50132-2-1 "CCTV Surveillance Systems for Use in Security Applications - Black and White Cameras"

ISEN 50132-5 "Alarm Systems - CCTV Surveillance Systems for Use in Security Applications - Part 5: Video Transmission"

ISEN 50132-7 "Alarm Systems - CCTV Surveillance Systems for Use in Security Applications - Application Guidelines"

Wiring and Installation

All Cat 6a cables, outlets and patch panels shall be supplied and installed as part of the Specialist Customer Premises Cabling System Contract.

The optical fibre cable shall be a multi-core, multi-mode, 50/125 micron to ISO/IEC 11801 (OM3) depending on compatibility with the CCTV components and network switches. The cable shall be based on gel-filled loose tube configuration, with an LSZH outer strength with anti-rodent protection, suitable for use in (non-dry) underground ducts and on exposed cable tray. The number of cores shall be as indicated on drawings.

The cables shall be terminated in patch panels with ST connectors and the required quantity of patch leads (0.5m) shall be provided to connect the patch panel ports with the network switches.

At each end of the fibre optic cables linking cameras to network switches, the Specialist CCTV Contractor shall supply and install fibre optic transceivers to convert the signals (video & control) carried to those carried over Cat 6a cabling linking the transceivers to the cameras and network switches.

The fibre optic cabling and patch panels shall be supplied and installed as part of the specialist customer premises cabling system contract.

The Cat 6a and fibre optic cabling used shall be a different colour than that used in the Building's LAN infrastructure, for identification purposes.

Central Control Equipment

The Central Control equipment shall be located in the Comms Room with the System being configured such that it can be controlled from that Room, directly (and from remote locations via LAN & WAN connections).

The Central Control equipment shall include the following key components - Network Video Recorder(s), Video Encoders & Decoders, Computer Work Station(s), alarm interface unit(s), Network Switches, Monitors/Displays and Video Management Software - as indicated on the drawings and schedules.

The Network Video Recorder, together with the Network Switches, shall form the core of the control system, facilitating the control, viewing & recording of the cameras & programming of the System via the Workstations & Software and the automatic integration of cameras (IP, Digital & Analogue) & monitors/displays and alarms and other systems signals and the allocation and initiation of response actions. The equipment shall be modular, scalable and shall incorporate the following features:

- Support for External HDDs
- Output to Spot / Quad Displays and sequencing
- Control of Pan, Tilt, Zoom, Focus, Brightness, Pre-set positions.
- Record & Reproduction using MPEG-4, AVC, JPEG and Motion-JPEG
- Scheduled Recording
- Multi-recording Function – different camera formats & recording rates can be set per camera.
- Emergency Recording Function – a manual switch (soft or hard wired) can trigger recording of the camera being viewed.
- Event Recording Function – recording triggered by remote sensor or switch or alarm.
- Automatic Protection of Recording of Important Events (to avoid over-recording)
- 16.alarm inputs (min.); 8 alarm outputs (min.)
- Keyboard Interface

- Email Notification of events / alarms
- Remote Access for Viewing and Control
- Password Protection (multi-level)
- 10/100 Network Interface (min.)
- Bandwidth Control / Selection
- The Unit shall be PAL type, operating at 230 V, 50 Hz.
- The Unit shall conform to EN 50130-4, EN 55022 Class B, EN 61000-3-2, EN 61000-3-3, EN 60950-1, EN 61000-4-2/3/4/5/11, EN 55024.

The Video Management Software shall have the following features:

- Open Protocol / Freely Available API, to facilitate easy integration with the other security systems on this project;
- Support 16 no. cameras without a licence; support up to 128 no. cameras with an optional licence.
- View & Record Live Video from Multiple Cameras Simultaneously
- Multiple Recording Modes – continuous, scheduled, on alarm and / or sensor detection and snap shots.
- Configurable pre and post alarm buffering
- Provide playback & export from on-camera storage & from a video recording manager as well as instant replay.
- Support large format 16:9 aspect ratio displays and dynamic 4:3 to 16:9 cameo resizing.
- High Quality Recordings in MPEG-4 (& AVC) and Motion JPEG.
- Unlimited recording database – only limited by disk space.
- Multiple Search Functions for recorded events – based on date/time, camera, event smart motion search and forensic search to specified rules and tagged objects and areas.
- Allow the definition of camera views.
- Audit Log;
- Remote Access via Web Browser
- Control of PTZ and dome cameras (IP, Digital, Analogue) using mouse & screen menu / soft buttons or joystick and/or keyboard.
- Alarm Alert Functions (sound and e-mail)
- Full duplex, real-time Audio Support
- Provide Intelligent Video Analytics.

Workstation

The Specialist shall include for the supply and installation of 3 no. Computer Workstations (one for the Comms Room, one for an Office and one for the Main Reception) which shall be connected to the System, either directly to the Network Digital Recorder or via the Network Switches and shall

be loaded with the relevant software to configure and monitor (through a graphical interface) the operation of the CCTV System.

Desk Monitors

Desk Monitors shall use LED technology for high performance Ultra HD 4K, operating at 230V, 50 Hz. and suitable for rack mounting.

Wall-mounted monitors

Wall mounted displays shall have the following features:

- The display screens shall be 40" display – 94 cm (dia.);
- The pixel response time shall be 8ms (grey-to-grey).
- Screen Aspect Ratio - 16:9, viewing angle of 178 degrees H & V
- 16 million colours (minimum) static contrast ratio of 1200:1 ANSI (minimum) with viewing angle of 160 degrees.
- Suitable for PAL, SECAM, NTSC, (no tuner).
- Suitable for HDTV (no tuner) – up to 4k
- Inputs for LAN, VGA, HDMI, AV, USB 2.0 and USB 3.0.
- Outputs for 5 x BNC Component Video, BNC Composite Video, Audio RCA & Stereo Jacks.
- Suitable for 220-240V, 50 Hz operation with internal power supply.
- Complete with matching loudspeakers (integral, or attached to, the unit) and audio output (RCA L/R) to separate sound system.
- Complete with wall or ceiling mounting, adjustable elbow bracket suspension tube (as appropriate).
- The displays in all areas shall be orientated to landscape format (Text-based Information, Broadcast TV & DVD Presentations).
- Each screen shall be provided with remote control unit for features selection / control.

Cameras

3MP Dome Vari-Focal Internal Camera

This will be an Internal 3 Mega-Pixel Mini-Dome Vari-Focal 3.6 to 12mm high quality camera producing efficient bandwidth management and is a True Day/Night camera providing 3MP full HD resolution for high-quality images.

Main Features will Include:

- i. 3MP resolution for true HD quality images
- ii. True Day/Night functionality for quality video recording in low light conditions
- iii. True Wide Dynamic Range
- iv. Motion detection for instant intruder alerts
- v. Operating temperature for outdoor model to -50°C using PoE
- vi. IK10-rated

- vii. ONVIF compliant

Active Equipment

The Specialist CCTV Contractor shall supply and install network switches to link the CCTV components and control/monitoring equipment throughout the Building & grounds. The Network Switches shall provide the following features, as a minimum:

- Full wire-speed will be attainable on all ports for all packet sizes (non-blocking)
- Buffers shall be large enough to cope with traffic peaks.
- Support high-speed uplinks to the backbone
- Full bridging, including the 802.1d spanning tree algorithm
 - Trapping of corrupted packets
 - Automatic switching to secondary ports (where provided) in the event of failure of the primary ports.
- Solutions should support the following protocols & standards:
 - IP, RIP, RIP2, VRRP, OSPF, DHCP.
 - IEEE 802.1d — Spanning-Tree Protocol; IEEE 802.1Q — VLAN Tagging; IEEE 802.3ab, IEEE 802.3an — Ethernet Specification; IEEE 802.3u — 100Base TX & 100Base FX Specification; IEEE 802.3x — Full Duplex on 10Base I & 100Base T ports; IEEE 802.3z — Gigabit Ethernet (1000Base SX & 1000Base LX).

The Specialist shall include for network management software to facilitate configuration of the Security LAN and switch ports.

Final Adjustments & Demonstration Day

The specialist sub-contractor after the initial installation of the system shall allow for final alignment and adjustment of the cameras in the presence of the client & engineer. They shall also allow for 2 No. full operational demonstration/training day with the client and/or his representatives approximately, the first taking place 4 weeks after the first demonstration.

Labelling

All accessories shall be labelled with Traffolyte labels to indicate supply source. Allow for all cameras etc to be labelled with device numbers.

8 No. External signs shall be colour A3 in size.

6 No. Internal signs shall be colour A4 in size.

Testing and Commissioning

The entire system shall be tested and commissioned in accordance with ISEN 50132 and shall include 12 Months Warranty.

9.4 Lightning Protection Installation

General

The Contractor shall include for the complete, supply installation and testing of the complete lightning protection installation as indicated on the drawings and as specified herein. The lightning protection system shall be in accordance with the main conductor routes indicated on the Drawings and as set out and described hereinafter.

Standards & regulations

IS EN 62305 - Protection against Lightning.

Equipment, Wiring and Installation

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 90° 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. 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. They shall be bonded to the Structural Steel Members which shall be used as the down-conductor, by means of 70mm² bare copper cable, clamped to the steel and 'Cad-Welded' to the earthing point. 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. All windows between building corners and down conductors shall be bonded to the down conductors.

Wherever possible down conductors shall be routed in the external wall cavity. If down conductors cannot be routed in the cavity to minimise the visual appearance of the down conductors, the conductors shall be PVC coloured to match the parent masonry work and be located where possible at downspouts and building returns etc. The contractor shall allow for a non-standard RAL colour finish on the conductor tape. Each down conductor shall then terminate at ground level in a set of earth rods, driven into the ground approximately 2.8metres deep and housed in an inspection chamber complete with test point. Cross bonding between the electrical earth and the lightning conductor earth to be established.

The thicknesses outlined above may need to be increased in line with the final internal circuit impedances to ensure that arcing will not occur during a lightening event. The responsibility for this design lies with the contractor, the design work included in the contract and any such increase in sizing included in the contractor's tender. The performance of the system in this matter must be confirmed through testing of the relevant impedances.

Testing & Commissioning

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.

9.5 Door Entry System

General

The Contractor shall include for the supply, installation of the complete door entry system as shown on the drawings and as specified herein.

The Central Equipment shall be located in the Comms Room and shall monitor the readers and locks throughout the building.

The Access Control System can be described as a networked access control system, utilising proximity/swipe card/ fob readers and electromagnetic and motorised locks (mains powered) and shall be mainly deployed at the entry and exit doors, selected individual rooms and on internal circulation routes in buildings. A certain quantity of card readers shall be located in external locations.

The system shall include the following components:

- Main Processor, display screen and input keyboard
- Local Interface Units & Power Supply Units
- Readers & Release Buttons
- Electric Locks and Door Closers
- Tokens
- System Software
- Data Logging Printer

The principle of operation of the Access Control System should be of modular design and consist of a Central Processing / Control unit with input and output facilities, which will be located in the Security Room, and will control and log access throughout the building.

The Central Unit for the networked system shall be linked to and control, via Local Interface Units on a communications bus, readers which will operate the electric locks on doors and gates.

The System shall monitor the status of the readers and the usage of tokens and this information will be logged to the System memory for use in producing hard copy records and reports.

The software packages shall have the facilities to programme the tokens in their various encoding methods, assign privileges, manage card usage and monitor the networked readers.

The Tenderer shall also include for the manufacture and supply of a quantity of tokens, utilising the encodings for use with the system.

For this project, the term 'Token' refers to swipe card / proximity (RFID) card / proximity fob: the term 'Reader' refers to swipe card reader / proximity (RFID) card reader / proximity fob reader.

The System shall be capable of being connected to the CCTV Monitoring System, such that the networked local door units and alarm sensors at Access Control Points can be used to activate CCTV cameras to monitor who is at the location or using a token, rather than having them constantly viewed.

Standards & Regulations

IS EN 50133.

EN 50131-1 General Requirements (Grade 3)

PD 6662:2010 Installation Directive (Grade 3)

EN 60839-11-1 : 2013 Access Control (Grade 3)

Wiring and Installation

Wiring for the door entry system shall be in 8 cores 1.5 mm² LSZH.

Equipment

Refer to the schedule of equipment.

9.6 Emergency Call System

General

The Contractor shall include for the supply, installation of the complete emergency call system as shown on the drawings and as specified herein. The contractor shall allow for the installation of a disabled person call alarm system in all disabled persons' WC's.

Wiring and Installation

Wiring for the emergency call system shall be in 8 core 1.5 mm² LSZH.

Equipment

Refer to the schedule of equipment

9.7 Induction Loop Systems

General

Induction loop amplifier systems shall be installed in the locations indicated on the relevant contract drawings to meet with BS 8300: 2018, BS 7594 and EN 60118-4.

Equipment

Refer to the schedule of equipment

MISCELLANEOUS ELECTRICAL SERVICES (69)**Earthing and Bonding****General**

The Contractor shall supply, install, test and commission the complete earthing and bonding installation as indicated on the drawings and as specified herein. The Contractor shall supply, install, test and commission the complete lightning protection system in accordance with the drawings and as specified herein.

Wiring and Installation**Dissimilar Metals**

Ensure, where dissimilar metals are used for system, that purpose made jointing materials are used such that corrosion and deterioration of the electrical connection are not caused. Ensure bonding connections to other metal parts of building are electrolytically compatible with those metal parts. Use the guidance given in BS 7430

Table 8 when bonding dissimilar materials.

Copper Tape Joints

Provide waterproof protection at joints subject to moisture. Joint copper tapes by brazing, using zinc-free brazing metal with melting point at least 600°C or thermic welding.

Stranded Conductor Joints

Provide waterproof protection at joints subject to moisture. Joint copper stranded conductors with compression joints to IS EN 61284.

Protective Cable Terminations

Where bolted connections are to be used, the Contractor shall use crimp type lugs compressed by automatic tool to achieve the correct pressure and crimp depth. Make connections between tape and equipment using high tensile grade brass bolts with brass nuts, washers and locking devices. Use phosphor bronze bolts, nuts and washers where connections are liable to corrosion.

Earth Electrodes**Location**

Locate electrodes not less than 2m distant from building/structure protected, and away from telecommunication and pilot cables and metallic fences.

Driving the Electrodes

Drive rods vertically into ground with purpose designed electric hammer. (Where impenetrable strata encountered at shallow depth, drive at 30° to horizontal). The depth of rod should be 2.8m minimum below finished ground surface. The depth of the electrode heads shall be located just below ground level. Where electrodes are installed in a group ensure minimum distance between electrodes is twice the depth of the rods. The depth of the interconnecting tape or electrode tape shall be 750mm below finished ground level, rising vertically at each electrode. The groups of electrodes to main earth conductor shall be connected via bolted link in the inspection pit as BS 7430 recommends for test purposes.

Materials

Use materials and installations methods for the earthing system in accordance with BS EN 62305-1 to 4:2011, IS 10101:2020, BS 7430, ESB Requirements as appropriate and those detailed below: Rod earth electrodes for lightning protection systems conforming to BS EN 62305-1 to 4:2011 roll threaded rod. The dimensions of the rod diameter shall be a nominal 15 mm. The rod length shall be 2.4m (2 x 1.2) minimum. Use silicon bronze alloy or aluminium bronze alloy for the earth electrode couplings, counter bored to completely enclose rod threads. Ensure that the rods meet in the centres of the coupling. Use a high strength driving cap in contact with the driven rod and couplings of a compatible material fully enclosing the rod threads. Interconnect the electrodes using 25 x 3 mm bare copper tape.

Earth Electrodes Drawpits

The Contractor shall provide a concrete cover, permanently labelled, for electrodes installed through cable drawpit bases. The material and size shall of a minimum be based on BS 7430 Table 4. Molecularly bonded copper clad steel rods to BS 7430 or BS EN 62305-1 to 4:2011 shall be used within the drawpits.

Accessories

The Contractor shall install rod to tape clamps or U-bolt clamps as is necessary for the complete installation of the underground earthing network. The accessories shall be sized to suit the earth rods and connectors. The accessories for earth rod electrodes for system earthing shall conform to BS 7430. Earth rods with female threads each end shall be used.

Dimensions

The dimensions of the earth rods shall be a nominal rod diameter of 15 mm, with a minimum 2.4m (2 x 1.2) minimum rod length.

Main earth conductor connection

The Contractor shall connect the main earth conductor to the first electrode using heavy duty purpose made, silicon, aluminium, bronze body, conductor clamp and high tensile phosphor bronze bolt. The material and minimum size shall be as BS 7430 Table 4 fabricated from copper.

Earth Electrode Clamps

The Contractor shall connect tape to electrode head using heavy duty purpose made silicon aluminium bronze body connector clamps or leaded gunmetal body connector clamps, and high tensile phosphor bronze bolts to IS EN 12163.

Earth Electrode Inspection Facilities

The Contractor shall provide an enclosure for each connection between the earth conductor and the associated earth electrode system. The Contractor shall install so that the top of the electrode is flush with the finished ground or floor level. Ensure enclosure provides adequate access for testing purposes. Provide pit details for builders' work.

The earth electrode inspection facilities shall be labelled with the wording 'earth'.

Main Equipotential Bonds

The Contractor shall provide main equipotential bonds in accordance with BS 7430 and IS 10101:2020. The material used for this equipotential bonding shall be single core insulated cable to BS 6004. There shall be no joints in the main equipotential bonds.

Supplementary Equipotential Bonds

The Contractor shall provide supplementary equipotential bonds to BS 7430 and IS 10101:2020. Joints are not allowed in these bonds. The material used for this equipotential bonding shall be single core insulated cable to BS 6004.

Circuit Protective Conductors

The Contractor shall provide insulated cable of a single core to BS 6004 as indicated on drawings and in documents for the circuit protective conductors. These CPC's shall take the form of metallic screwed conduits (excluding flexible); metallic trunking with tinned copper links; armouring and/or metallic sheathing of armoured cables or integral conductor of multi-core cable. The size of the CPC's shall be as stated in the documents, as shown on the drawings and sized in accordance with IS 10101:2020.

Earthing Clamps

The Contractor shall use clamps complying with BS 951, for bonding pipes and lead sheathed cables.

Earth Busbars

The Contractor shall provide earth busbars manufactured from hard drawn, tinned, high conductivity copper bar.

Substation Earth busbar

The substation earth busbar shall be a minimum of 75 x 13mm cross section 600mm minimum length and shall be in accordance with ESB requirements.

Main Earth Terminal busbar

The main earth terminal busbar shall be a minimum of 25 x 6 mm for incoming live conductor not exceeding 50mm and a minimum of 50 x 6 mm for incoming live conductor over 50mm².

Test Links

The Contractor shall provide two test links, in connections between main earth conductors and earth busbar. The Contractor shall fabricate each from two additional sections of earth busbar. Mount one section on stand-off insulators matching earth busbar and use the remaining section as removable test link. Secure the 12mm high tensile brass studs to fixed sections of the busbar and drill the corresponding clearance holes in the test links and provide brass washers, nuts and locking devices to secure the frame/neutral earthing and the test links.

Lugs/Tags

The Contractor shall provide lugs or tags to enable connection of the bonding conductors to the equipment earth terminals.

Protective Cable Terminations

For bolted connections the Contractor shall provide crimp type lugs compressed by automatic tools to achieve correct pressure and crimp depth.

Protective Conductor Warning Notices/Labels

The Contractor shall provide a permanent label durably marked in letters 4.75mm minimum height "SAFETY ELECTRICAL CONNECTION - DO NOT REMOVE", in visible position, at each bonding conductor connection to extraneous conductive parts.

Main Earth Conductor

The Contractor shall provide green/yellow PVC warning tapes labelled "EARTHING CONDUCTOR" over the complete external lengths of main earth conductors at 300mm depth below finished ground.

Earth bar Label

Label the earth bar "SAFETY ELECTRICAL CONNECTION - DO NOT REMOVE" with wall mounted laminated plastic tablet engraved in 10mm high red letters on white background.

Surge Protection**General**

The Contractor shall supply, install, test and commission the surge protection installation as indicated on the drawings and as specified herein.

Equipment

The surge protection equipment is listed in the Schedule of Equipment.

Identification and Labelling**Labels and Notices**

Apply identification labels and notices in accordance with IS 10101:2020 to all electrical cables plant and equipment including components of mechanical systems.

Identification of protective devices

The Contractor shall provide diagrams, charts and tables to comply with IS 10101:2020. Warning notices, for voltages in excess of 250 volts shall be provided. Periodic inspection and test notices, residual current device notices, earth electrode safety electrical connection label, bonding conductor connector point to extraneous conductive parts label, earth free local equipotential bonding areas warning notice, electrical separation areas warning notice and outdoor equipment socket outlet notices shall all be supplied and installed on the above services by the Contractor.

Labels and Notices Materials

The Contractor shall use materials for labels and notices with a predicted life equal to or greater than the design life of the electrical cables, plant, equipment or installation to which it refers. Externally the labels/notices shall be sign written, or stencil in paint compatible with the surface. The colour of the background shall be the plant standard finish and the lettering shall be white. Internally the labels/notices shall be engraved thermosetting plastic laminate with a white or red background with the lettering the opposite colour of the background, i.e. white background, red lettering and vice versa.

Fixing

The fixing of all labels and notices shall be achieved using materials compatible with label or notice and surface to which it is fixed. This shall generally be by screws into a tapped hole or bolted complete with washer nut and locking device.

Arrangement

The Contractor shall obtain approval prior to the manufacture, with regard to the style, colour, lettering, size and position of all labels and notices. The Contractor shall provide a sample showing the style, colour, lettering and size, for approval.

Lettering and Size of Labels and Notices

The Contractor shall ensure that all lettering and symbols comply with the requirements laid out in IS 10101:2020 and BS 5499. Use BS 5499-1 for height of lettering where not otherwise indicated. Ensure the labels and notices are of adequate size for the lettering required, and allow a minimum margin around all lettering of one-line space vertically and two letter spacing horizontally. The font shall be helvetica of medium size. Size - BS 5499-1 or 5mm minimum high letters.

Conductor Arrangement

Arrange circuit polarity so that phases read in phase rotation order followed by the neutral, if any, from top to bottom in horizontal conductor layouts and left to right in vertical conductor layouts. Ensure the flat horizontal arrays have leading phase to the left and neutral to the right from left to right when viewed from supply point. Arrange the phase or live pole of two wire apparatus at top or left hand and neutral and earth both at bottom or right hand side. In all cases, ensure the conductor arrangements defined are when viewed from front face of all equipment and terminating facilities. Apply identification markers in accordance with IS 10101:2020 to all conductor termination points.

Graphical Symbols for Use on Equipment in Accordance with IS EN 80416

Graphical symbols for use on equipment are to be created and applied in accordance with IS EN 80416-1, IS EN 80416-2, IS EN 80416-3.

Equipment Signs and Labels**Safety Signs**

The Contractor shall label all electrical plant and equipment using safety sign W012 of BS EN ISO 7010:2020+A3:2022 where voltages above ELV exist. The Contractor shall provide with each safety sign W012 supplementary or text signs complying with BS 5499-5 Label all electrical plant and equipment with the labels specified in the appropriate British Standards for that plant or equipment. Identify each substation and main switchroom with safety sign W012 to BS 5499-5 with supplementary signs, notices and signs required by BS 5499-5 for any fire extinguishing system and notice giving details of: Name of the Substation or switchroom. The presence of Medium and Low Voltages. Administrative instructions for access. Location and method of contacting controlling authority. Actions to be taken in an emergency.

Plant and Equipment Labels

Fit labels on all items of plant, equipment, switches, etc., include the following information: service controlled, circuit reference, voltage, type of supply and phase etc., circuit protection type and rating.

Maintenance Notices

Fix notices giving warning of and instructions on, any special maintenance procedures to plant and equipment.

Colour Corrected Light Fittings

Fix a warning or identification disc to light fittings containing colour corrected fluorescent tubes or other colour corrected light sources to ensure that maintenance staff install the correct lamps.

Engraved Accessory Plates

Engrave switchplates, spur units, pushes and special plates for bed head units, call systems, fire alarms, etc. Use 6mm high letters with engraving coloured red.

Switchgear

Fit labels on switchgear as required by IS 10101:2020 and IS EN 61439 to indicate duty of unit, its voltage, phase and current rating, protective device rating size of conductor involved, and all other necessary details. Use an agreed serial coding system, provide at the switch a key to the coding system.

Distribution Boards

On each distribution board identify every outgoing way with a laminated circuit chart in a permanently fitted inside the distribution board cover. Clearly indicate in typed script, circuit identification number, cable size, miniature circuit breaker rating and a description of item supplied and area supplied by circuit.

Schematic Diagrams

The Contractor shall provide purpose made schematic diagrams permanently fixed showing the connections of the equipment and the plant. The location and materials shall be as indicated in contract preliminaries.

Special Purpose Earthing

Fit labels to special purpose earthing conductors and connection points, describing their purposes and any instructions necessary for their operation and maintenance.

Indicator Lamps and Push Buttons for Power Systems

Use indicator lamp and push button colours in accordance with IS EN 60073. Indicator lamps shall have three different colours denoting the following stages of alarm: Red, danger or alarm; yellow, caution; green, safety.

Push buttons

Differently coloured push buttons shall have the following meaning: Red, emergency action; red, stop or off; yellow, intervention; green, start or on.

Conduit and Trunking Colour Coding

In areas of mechanical plant or voids accommodating mechanical services, or where otherwise indicated, identify electrical conduits and ducts in accordance with BS 1710. Apply colour orange to BS 4800 by painting on service as a band over 150mm or applying an adhesive tape type wrap around services over a length of 150mm. Place identification colours at bulkheads, wall penetrations and any other place where identification is necessary.

Cable Identification

Provide all cables, other than final sub-circuit wiring enclosed in conduits or trunking, with labels fixed at each end of cable either side of wall and floor penetrations at approximately 12m intervals at convenient inspection points by means of nonreleasable plastic straps, minimum width 4mm. Ensure labels show the reference number of cable.

Terminal Marking and Conductor Identification

Provide for switchgear and control gear elements whose terminals are marked in accordance with BS 5472 (EN 50005) and BS 6272 (EN 50042). Use a unique reference to identify each element in the switchgear or control gear. Mark on or adjacent to each element its reference. Identify each terminal for connection to external wiring or cabling using a reference system complying with IS EN 60445 based on the element reference and the appropriate element terminal reference adjacent to terminals. Use lettered or numbered ferrules or sleeves to BS 3858 to mark each auxiliary conductor or control cable core with the identity of the terminal to which it is connected and the reference of plant or equipment to which it is connected and the identity of the terminal at the remote end. Ensure that main circuit conductors are identified in accordance with IS 10101:2020. Ensure that all identification of terminals and conductors is recorded and included on record drawings and in operation and maintenance documentation.

Underground Cable Identification

Identify external underground cable routes by means of approved markers along their length at distances not exceeding 50m and where a change of direction occurs on such routes. Provide cables markers with a brass plate or impress concrete to clearly indicate the reference of group of cables or reference number of cable and operating voltage of cable. Provide key to any reference

system used at switchgear. Mark and protect direct buried cables with plastic tape yellow printed black "DANGER ELECTRIC CABLES" elsewhere.

Cable Conductor Colour Coding

Identify cable conductors in accordance with IS 10101:2020; note that a lighting sub-circuit switch wire is a phase conductor in a single-phase circuit. All single phase final sub-circuit phase wiring coded brown.

Cable Jointing and Termination

Connect all cables in the installation so that the correct sequence of phase rotation is maintained throughout. Where straight through joints are approved joint medium voltage conductors as they lie, ensuring their complete length is phased out on completion. Ensure connections at terminations of MV cables are made in the correct phase rotation and ensure cable conductor termination marking if any, complies with this phase sequence. Where straight through joints are approved on low voltage cables, whether power cables or control or auxiliary cables, joint conductors strictly in accordance with their colour or numeric coding. Where such joints are approved on mineral insulated or other non-coded conductor cables, identify each core at the joint and make the joint core to core.

Cable Sheath Identification - Internal

Use to identify coloured cables sheaths for various services as follows. Fire alarm, red;
Clock circuits, brown;
Telecommunications, grey;
Data as system supplier's requirements;
Control, black;
LV, black;
LV mineral insulated, orange;
MV red.

Code cables for various services using alpha numeric symbols as follows:

Code letters preceding cable reference.

Fire alarm, FA.

Clock, CL.

Telecommunications, T.

Data, D.

Control, C.

Low voltage, LV.

Extra low voltage, ELV.

LV Essential circuits EM.

Medium voltage, MV.

Cable Sheath Identification - External

Identify cable sheaths for various services in accordance with **NJUG 7**, as follows.

MV Red; LV Black; telecommunications and data, Grey.

General Fixing and Installation Practices**Preparation**

Mark-out, set-out and firmly fix all equipment, components and necessary brackets and supports.

Manufacturer's Drawings

Use manufacturer's drawings and templates for purposes of marking and setting out.

Fixings

Ensure structure and fixings are suitable for items to be fixed.

Loading Details

Provide loading details for all fixing types.

Building-In By Others

Provide all necessary assistance to enable any item of building-in type to be built in by others.

Size of Fixing

Use largest size of bolt, screw or other fixing permitted by diameter of hole in item to be fixed.

Greasing of Fixings

Ensure all bolts, screws or other fixings used are greased or lubricated in accordance with manufacturer's instructions.

Plugs

Use plugs of suitable size and length for fixings. Use plastic, fibrous or soft metal non-deteriorating plugs to suit application. Do not use wood plugs. Ensure that when screw is in place, threaded length is in plug. Ensure plugs used for screw fixing are set-in to correct depth prior to final tightening.

Screws

Use screws to BS 1210. Generally, use sherardized steel wood screws for fixing to concrete, brickwork or blockwork.

In damp or exposed situations use greased brass wood screws.

Cast-In Fixings

Where cast-in fixings are permitted, mark out and set fixings in accordance with manufacturer's instructions.

Shot Fired Fixings

Obtain approval prior to using shot fired type fixings.

Self Adhesive Fixings

Obtain approval prior to using self adhesive type fixings.

Drilling

Drill holes squarely. Use drills of requisite size and depth, and appropriate to fabric. Do not flame-cut holes in metal work.

Proprietary Fixings

Comply with manufacturer's instructions for all fixings.

Fixing to Reinforced Concrete

Take precautions to avoid fixing through reinforcement.

Fixing to Brickwork

Do not fix to unsound material or mortar between brickwork courses.

Fixing to Timber Rails

Fix equipment, brackets and supports by drilling hole through timber rail and fixing with bolt, back plate, washer and loose nut.

Fixing to Hollow Stud/Tile/Block Walls

Fix equipment, brackets and supports where there is access at rear of wall, by drilling hole through wall and fixing with bolt, back-plate, washer and loose nut. Fix equipment, brackets and supports where there is no access at rear of wall, drill hole and use screw anchor type fixing or gravity type toggle fixing. Fixing to Concrete, Brickwork or Blockwork Fix equipment, brackets and supports using wood screws in plugs. Drill holes and fix using steel bolts of grouted bolt type or expanding bolt type fixing.

Fixing to Metalwork

Fix equipment, brackets and supports by drilling holes and fixing using set screws or bolts complete with washers, shakeproof washers and loose nuts. Fixing to Structural Steelwork and Concrete Structures Provide manufacturer's information on recommended fixing. Obtain approval for any fixing to structure steel work and concrete structures. Generally, use proprietary fixings to structural

steelwork and concrete structures. Obtain approval to cut holes in structural steelwork or concrete structures or weld to structural steelwork.

Off-Site Painting and Anti-Corrosion Treatments

Where particular methods of finish and painting are not specified, ensure following requirements are met. Protect all metal work, plant, equipment, pipelines, ductlines, ancillaries, brackets and supports against corrosion and oxidization. Provide ferrous metals, machined or otherwise with protective coatings at manufacturer's works. Ensure all items requiring on-site decorative finishes are provided primed to suit base material and required finish. Following delivery to site, storage on site and installation make good any damage to finishes, by cleaning, degreasing and re-furbishing and those detailed below.

Paint Materials

Use the following materials as appropriate Solvent borne priming paint to BS 7956 for bare woodwork. Red Oxide priming paint for bare iron and steelwork. Zinc Chromate priming paint for bare ferrous and non-ferrous metals. Undercoating paint for previously primed or painted surfaces before the application of finishing coats. Gloss finishing paint for previously primed or painted/undercoated surfaces. Epoxy resin paint for specialist coatings requiring resistance to acids, alkalis, oils, solvents, abrasion or high humidity. Aluminium paint to BS 388 for structural steelwork, storage vessels, heated metallic surfaces and similar applications where moisture and heat resistant properties are required. Cold galvanizing paint for making good damage to previously galvanized surfaces and protection to galvanized materials modified during installation. Zinc-rich metallic to BS 4652 for bare iron and steelwork where electrical conductivity has to be assured. Black tar-based paint to BS 1070 for moisture resistant protection to metal surfaces where decorating appearance is not important. Bitumen based coatings for cold application to BS 3416 protection to iron and steel, particularly pipelines and fittings for use in contact with potable water. Bitumen based coatings for cold application to BS 6949 not to be used in contact with potable water.

Paint Quality

Ensure paints used are of quality and type to suit application and that:

Primers have good adhesion, covering power, rust-inhibiting and grain filling properties; Gloss finishing paints are of machine finish grade having high adhesion and high resistance to solvents, mineral oils, cutting oils, detergents, chipping and impact damage.

Heat Resistant Paint

Use heat resistant paints for applications to surfaces over 80°C.

Ensure paints are applied in accordance with manufacturer's instructions and to BS 6150.

Weather and Other Conditions

Do not apply paints where weather, temperature, humidity or other conditions may have a damaging effect upon finish or paint.

Cleaning and Preparing Steel Surfaces for Painting

Ensure metal surfaces are thoroughly cleaned, all mill and weld scale removed and finally degreased. Clean steel surfaces in accordance with IS EN ISO 8503 and prepare surfaces for painting in accordance with IS EN ISO 4618-3.

Cleaning

Ensure metal surfaces are thoroughly cleaned, all mill and weld scale removed and finally degreased.

Application Off-Site

Wherever possible ensure paint finishes applied by component manufacturers are spray applied.

Application

Apply paint evenly and ensure finish shows no excessive brush marks, grinning, runs, sagging, ropiness or other application defects.

Cold Galvanizing

Repair damage to galvanized components due to installation process, i.e. following cutting, drilling or welding, by applying 2 no. substantial coats of cold galvanizing paint.

Protection of Bright Machine Parts

Apply a protective coating to all bright machined parts before despatch from works. Do not remove protective coatings unless required for installation, testing or commissioning purposes and, in such cases, reinstate upon completion. Repair any damaged protective coating or bright machined part, or where necessary replace damaged component. Use and apply metal coatings in accordance with manufacturer's instructions. Complete where possible all welding, drilling, bending and other work before metal coating.

Testing of Electrical Services Installations**General**

Comply with IS 10101:2020 and other Irish/European Standards as appropriate.

Supply Characteristics

Obtain information called for in IS 10101:2020 about supply characteristics from ESB other than where to be measured as part of testing procedure.

Design Information

Obtain all design assumptions, calculations and any other information to enable compliance with IS 10101:2020 to be verified and those detailed below.

Incorporated Equipment Characteristics

Obtain and use information from manufacturers of equipment provided. Use information provided, for equipment supplied by others and incorporated into installation.

Prospective Short Circuit Current

Determine values of IP by measurement, unless other means are indicated. Determine IP at all necessary points within installation to confirm correct equipment selections. Obtain from supply undertaker written confirmation of maximum and minimum values of IP at origin of installation. Adjust subsequent measured values of IP accordingly.

Initial Verification

Carry out detailed inspection to verify the requirements of IS 10101:2020.

Test Equipment and Consumables

Provide test equipment and consumables to complete tests satisfactorily, and to retest any failed installations following corrective measures. Test equipment quality assurance requirements to IS EN ISO 10012.

Continuity of Protective Conductors

Confirm continuity. Use ac source or dc source.

Earth Fault Loop Impedance

Use a 25 A test current. Measure and record source impedance (ZE). If alternative LV supply arrangements are available, measure ZS when using supply with highest impedance. Measure ZS with main equipotential bonding conductors connected. Do not summate values of several parts of each loop.

Settings and Adjustments

Confirm characteristics and settings of protective devices are within maximum and minimum specified tripping times. Check correct operation of devices. Confirm interlocks and sequences operate safely and as indicated.

Fire Detection and Alarm Installations

Carry out site testing and inspection and provide test certificates for fire detection and alarm systems in accordance with IS3218.

Lightning Protection Installations

Carry out site testing and inspection and provide test certificates for lightning protection installations in accordance with IS EN 62305.

Fire Protection of Electronic Data Processing Installations

Carry out site testing and inspection and provide test certificates for fire protection of electronic data processing installations in accordance with BS 6266.

Emergency Lighting Installations

Carry out site testing and inspection and provide test certificates for emergency lighting installations in accordance with IS 3217.

Calibration

Provide current certificates of calibration for all instruments used during test procedures. Record particular instrument identity on record sheets.

Certification and Reporting

Complete and hand over to the Client a Completion and Inspection Certificate to IS 10101:2020 and RECI requirements.

Installation Certificates

Provide installation certificates and sub-system certificates for electrical installations in accordance with IS 10101:2020 and RECI recommendations. Record details of departures from IS 10101:2020 on certificate. Provide copies of calculations justifying departure from IS 10101:2020 and attach to certificates.

Records

Record all results and instrument readings on approved Record Sheets and hand over to the client two copies for each inspection and test.

Conductive Parts

Test conductive parts simultaneously accessible with exposed conductive parts of extraneous conductive parts. Establish that they are either not an extraneous conductive part, or that they are reliably connected by metal to main equipotential bonding. Confirm conductive parts which are not extraneous conductive parts are separated from earth by an impedance greater than 50,000 ohms. Confirm other conductive parts are bonded to equipotential zone earthbar by an impedance not exceeding 0.1 ohms.

Phase Sequence

Check and confirm correct polarity of all conductors in all circuits.

High Voltage Tests

Conduct high voltage tests for equipment indicated. Comply with BS EN 60060-1:2010, IS EN 61180 and IS EN 60060-2. Comply with IS EN 61180.

LV Buried Cables

Test continuity and insulation of buried cables immediately after back-filling. Test continuity and insulation of buried cables prior to handover.

MV and LV Buried Cables

Test continuity and insulation of buried cables immediately after back-filling. Test continuity and insulation of buried cables prior to handover. Perform MV tests on buried MV cables prior to handover.

Conduit, Trunking and Ducting

Test and confirm electrical continuity before installing cables.

PRECOMMISSIONING AND COMMISSIONING

GENERAL

The contractor shall be responsible for the pre-commissioning and commissioning of all systems as detailed hereinafter and shall include in his tender figure for all costs which may be incurred due to compliance with the requirements of this section. The terms pre-commission and commission are defined as follows:

Pre-Commission

Pre-commission shall mean the testing, checking and adjustment of each individual component within a system to ensure that its operation is satisfactory, its mechanical and electrical connection are correct and in accordance with the manufacturer and/or suppliers instructions and/or wiring diagrams and installation manuals and to ensure that it is functional and in working order.

Commissioning

Commission shall mean the testing and operation of each system to ensure that it is operating as designed and that the function under control is being maintained within design limits and also that the response of the system to changes in the variables being monitored by the system is satisfactory. Pre-commissioning, therefore, shall apply to each individual controller, indicator etc.

Implementation

The contractor shall ensure that all information necessary to comply with the above requirements is made available by the relevant suppliers. The contractor shall include for all site visits necessary by the suppliers or their agents to ensure compliance with the above. The engineer shall be at liberty to attend all pre-commissioning checks and commissioning checks, as he deems necessary. The final commissioning of the plant and all systems therein shall be carried out in the presence of the engineer, the client and any such representatives, which the client may deem necessary. Should the systems fail to commission for any reason the process must be repeated at a later date after all faults have been rectified by the sub- contractor.

The contractor may at his discretion employ the services of the supplier or his representative to carry out commissioning of any or all of the systems. A commissioning certificate must be supplied for each system tested.

Systems that are commissioned in the absence of the Engineer shall not be accepted and the commissioning will require to be repeated in the Engineers presence.

Instruction and Information

The contractor shall instruct the Client or his appointed representative in the operation of all systems supplied and commissioned with him. A building owner's manual shall be compiled by the electrical contractor and shall include the following:

- Operating instructions for all systems.

- Operating and maintenance instructions for all items of equipment supplied by the electrical tenderer and mechanical sub-contractor.
- Installation and wiring diagrams.
- All guarantees.
- All commissioning certificates Fire Alarm, Emergency Lighting, and Switchboards etc.
- 'As Installed' Drawings.

AS INSTALLED' DRAWINGS AND MAINTENANCE MANUALS

"AS INSTALLED" DRAWINGS

This section of the specification shall cover the preparation and handing over of "As Installed" drawings for the completed electrical services installation. These "As Installed" drawings shall take the form of two completed sets of plan prints. In addition, copies of the drawings shall be provided in AutoCAD 2005 .dwg and .dxf format – Hand marked up drawings shall NOT be accepted.

The information required to prepare the drawings shall be recorded accurately as the works proceed and when complete shall include the following information;

- The precise positions of all underground services
- Location of all fittings and accessories
- Diagrammatic layout of the mains distribution system and all specialised systems comprising the works.
- All circuiting information including diagrammatic layout of all distribution boards.
- Schedule of emergency lighting fittings including manufacturer and reference numbers.
- The cost of the preparation and submission of the 'As Installed' drawings shall be included in the appropriate space in the lump sum form of tender. Tenderers shall note that the drawings shall be submitted to the consulting engineers for approval and/or comment not later than two weeks before the programmed completion date for the works. One set of the prints shall be handed over to the employer at the hand-over inspection. Under no circumstances shall a certificate of Practical Completion be issued until "As Installed" drawings and operation and maintenance manuals have been produced and accepted by the Engineer/Client.

OPERATION & MAINTENANCE MANUALS

The contractor shall handover on completion of the project, 2 No. hard-copy sets of maintenance and instruction manuals. The completed O & M manuals and As-Installed drawings shall also be submitted to the Client in an interactive electronic format. These manuals shall include parts, numbers, references etc. and generally indexed as follows:

- LV Switchgear Descriptions
- LV Switchgear Drawings
- LV Switchgear Catalogues
- Wiring Systems Descriptions E.G. Cables & Infrastructure
- Wiring Systems Catalogues
- Pe Equipment Descriptions
- Pe Equipment Catalogues
- General Lighting Descriptions
- Lighting Fitting Catalogues
- Small Power Descriptions

- Small Power Catalogues
- Fire Alarm System Descriptions
- Fire Alarm System Catalogues
- Disabled Refuge Descriptions
- Disabled Refuge Catalogues
- Disabled Toilet Alarm Descriptions
- Disabled Toilet Alarm Catalogues
- CCTV System Descriptions
- CCTV Alarm System Catalogues
- Structured Cabling Descriptions
- Structured Cabling Catalogues
- Pa System Descriptions
- Pa System Catalogues
- Stage Lighting & Sound Installation Descriptions
- Stage Lighting & Sound Catalogues
- Lightning Protection Systems Descriptions
- Lightning Protection Systems Catalogues
- Earthing Systems Descriptions
- Earthing Systems Catalogues
- Intruder Alarm System Descriptions
- Intruder Alarm System Catalogues
- Fire Alarm Cable Routes And All Connections
- Fire Alarm Commissioning Certificates And Log Books
- Fire Alarm Completion Certificates
- Emergency Lighting Completion Certificates
- Electrical Inspection And Completion Certificates
- Access Control Description And Commissioning Certificates

