CITSO – Headquarters & Medical Centre

Defence Infrastructure Organisation (DIO)

ELECTRICAL SPECIFICATION

CITSO-ACM-XX-XX-SP-EL-000001

June 2024

Building Engineering

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Quality information

Prepared by	Checked by	Verified by	Approved by
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Revision History

Revision	Revision date	Details	Authorized	Name	Position
P01	19/06/2024	Tender	G. Rossi	George Rossi	Project Director

Distribution List

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NOTES FOR TENDERERS

This document has been compiled using text from the National Engineering Specification (NES) which is copyright to Trimble. The format and content of the specification has, however being considerably re-arranged and amended from that provided by Trimble.

The technical content of this specification has been prepared using the Common Arrangement of Work Sections for Building Works and is in four sections. Where any British or other standard referred to in the specification is either out of date or superseded by another standard, the most recent version shall apply.

For reference each work section ends with clause 10000. Here is stated the latest revision of the raw NES on which the AECOM specification work section is based.

SECTION 1 – SCOPE OF WORKS
A summary description of the Works by Work Section.

SECTION 2 – WORK SECTIONS
The specification for each Work Section is generally sub-divided into two parts:

Part 1 System objectives

The system objectives are clauses giving details of the performance and/or design parameters.

Part 3 Clauses specific to the system

These clauses are specific to the Work Section concerned.
Where clauses contain "type" references, these are for cross referencing within the specification and do not necessarily relate to manufacturers types.

NB: (***Part 2*** relates to the format used in the raw NES and selection schedules for the Y clauses. ***Part 2's are not used in AECOM specifications and are replaced by schedules in section 4***)

SECTION 3 – REFERENCE (WORKMANSHIP) SPECIFICATIONS – Y clauses
These clauses specify items that are common to several systems (for example pipework, ductwork and cabling).
The individual clauses are generally arranged in the order of the Common Arrangement "Y" sections from which they originated.
Generally these specifications represent AECOM's standards, contain all contain clauses applicable to each particular category and are not project specific.
Where choices are required, they are made in the Schedules or Scope of Works; otherwise all of the clauses are applicable.

SECTION 4 – SCHEDULES
This section contains schedules of drawings, manufacturers, equipment duties and selections for plant, ancillaries and system components, specific to this project.

ENQUIRIES TO MANUFACTURERS
Enquiries to manufacturers should include all relevant sections as well as any related contractual information. ie the relevant work section and Y clauses pertinent to the plant item in addition to the plant schedule.

NON-NES CLAUSES
Clauses which are structurally different from NES from which they originated, or are AECOM originated clauses, are generally identified by the clause reference being underlined and/or the last digit of the clause number being increased e.g. 300.010 becomes 300.011.

Contents

General

Project Description

The CITSO site is situated East of Nanyuki, a town in Central Kenya. It is bounded by Mount Kenya Forest to the North, East and South, with a Civilian settlement to the West. The site is approximately 15km from Nyati Barracks. The site itself sits within the Meru County boundary.

AECOM were appointed to develop and deliver the design of two facilities within the (Counter Insurgency Terrorism and Stability Operations (CITSO) masterplan in Kenya. The two buildings that have been developed to RIBA Stage 4a (Feasible Generic) are a Headquarters building and a Medical Centre.

B04 – Headquarters Building.

The Headquarters is a single storey concrete frame structure with a pitched metalwork roof. The building has been designed to provide structural stability for earthquake resilience. The Headquarters is situated towards the Western end of the site, close to the overall site entrance point.

B09 – Medical Centre

The Headquarters is a single storey concrete frame structure with a pitched metalwork roof. The building has been designed to provide structural stability for earthquake resilience. The medical centre is situated further to the East of the masterplan to offer support to a wider range of facilities within the training and accommodation areas.

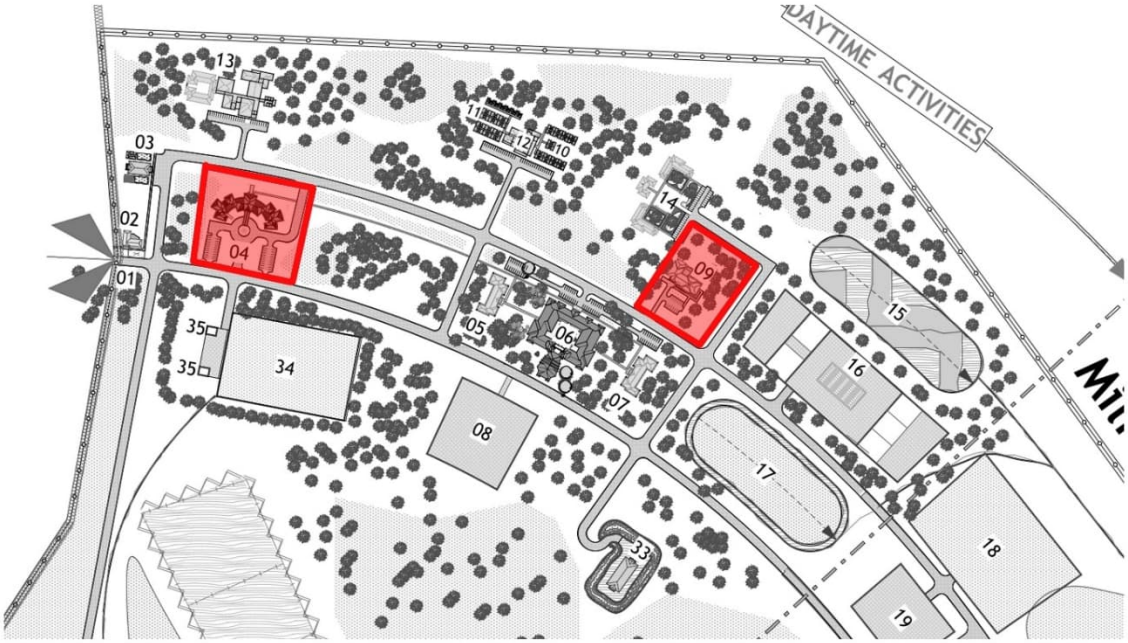

Figure GEN.1 Site Masterplan showing B04, B09 and the Northern Spine road running between the 2 No buildings.

Scope of Works

Building Services

This specification is for the supply, installation, testing and commissioning of the following building services systems.

- LV Distribution
- Small Power
- General Lighting
- Emergency Lighting
- External Lighting
- Structured Cabling Containment
- Fire Alarm
- Lightning Protection
- Earthing and Bonding

Kenyan National and UK Standards

The electrical services design is primarily designed to comply with UK British Standards. The design shall also comply with any Kenyan Standards which are more onerous than UK British Standards.

Builders Work

The demarcation of responsibilities for builders work in connection with the engineering services as defined in the Main Contract Preliminaries shall be agreed with the Main Contractor during the tender period and clearly identified in the tender submission.

The building has been designed to provide structural stability for earthquake resilience. The service routes and penetrations through internal structural walls have been designed accordingly.

Whole Building integrated system testing and Black Building testing

Integrated System Testing (IST)

After completion of all commissioning and testing of all M&E systems and plant and all interfaces between systems have been tested and proven, the contractor shall undertake IST to prove that all the stand-alone commissioned systems work together to perform the functions as defined in the specifications.

This work shall include the demonstration of functionality of all plant in conjunction with the fire alarm in fully automatic operation.

Tender Documentation
Relevant documents that should be priced include the work scope specification (this document), the workmanship clause specification and the associated drawings & schedules.

The separate workmanship clause specification documents applicable to this project must be read in conjunction with this work scope document. These workmanship documents are to be considered a reference document for the scope and must be taken in consideration within the tender price.

Working/Record Documentation
The Contractor should note the responsibility to produce certain types of information during the course of the project. This information is noted within the workmanship clause specifications that are separate to this specification but must also be read in conjunction with this specification.

For summary, this information includes the Contractor producing working drawings and record as fitted drawings. Design/installation/shop/builderswork/etc drawings should be produced at the outset of the project before materials are ordered / install commences to capture/incorporate the exact arrangements and setting out dimensioning that services are to be installed to. Note: These drawings are not to be

direct copies of the tender drawings, as the tender drawings do not contain the specific installation detail which will be required by the Contractors operatives on site.

These Contractor drawings are to be developed by the Contractor throughout the project and these drawings/documents will then form the basis of record drawing presented at project handover.

Approvals
Prior to commencement of manufacture, the Contractor shall submit to the Engineer & Client working drawings for review/comment. These working drawings shall include the following:

- Dimensioned layout/installation drawings (min 1:50 scale).
- Builders-work requirements (min 1:50 scale).
- Plinth / support frame details for all items of equipment.
- Delivery and Crane allowance

Complete delivery and offloading/craneage shall be the responsibility of the Contractor.

The Contractor shall liaise with the Project Manager to ensure that all associated works are fully co-ordinated and comply with the project programme

Overview of Contractors Responsibilities			
Contractors responsibility	**Deliverables**	**Required at stage**	**Status**
Tender Stage			
Fully understand the tender documents. These consist of this specification (this may be in several volumes) and the tender drawings.		Tender Stage	Required
Visit site to make themselves fully aware of the project and site specific issues		Tender Stage	Required
Request any technical clarifications. Note that any questions raised will be confirmed in writing and issued to all tenderers.	Tender clarification documents	Tender Stage	Required
Carry out initial any design work to enable cost estimation for tendering purposes and satisfy themselves of accurate tender.		Tender Stage	Required
Submit tender. The tender should be broken down into each system as listed by the Quantity Surveyors schedules. Confirm on the tender that any technical clarifications issued have been taken into account and that the tender is fully compliant (or list any clarifications). Note that it will be assumed that the tender is fully compliant with the tender documents unless specifically stated.	Tender breakdown.	Tender Stage	Required
Pre-start on site Stage			
Visit site to carry out any surveys necessary.	Survey notes	Pre-start on site Stage	Required
Fully understand the remaining mechanical and electrical systems and any temporary works required to allow the rest of the site to continue to operate during the contract.	RFI's as required	Pre-start on site Stage	Required
Carry out full detailed design of all systems ensuring requirements as detailed in the tender documents are met along the requirements of the individual work sections.	Design report. Design Drawings	Pre-start on site Stage	Required
Formulate and issue technical submissions for each item of equipment and each system – agree the list of submissions with the Engineer. Note that all technical submissions should list any deviations from the specification – any items not specifically mentioned will be assumed to be	Technical submissions	Pre-start on site Stage	Required

fully compliant with specification. Submissions will be reviewed and given a status: (Status A – no comments, Status B – proceed but taking into account comments or Status C – rejected – re-formulate and re-submit.)			
Formulate and issue working drawings for all systems. Note that the use of AECOM drawings on site is NOT acceptable – all drawings used for installation must be working drawings produced by the contractor. To assist in this, revit and AutoCad format AECOM construction issue drawings can be provided but the Contractor must enhance these as required so they are suitable as installation drawings. Working drawings will be reviewed and given a status: (Status A – no comments, Status B – proceed but taking into account comments or Status C – rejected – re-formulate and re-submit.)	Working drawings	Pre-start on site Stage	Required
Produce builderswork drawing and schedule indicating all holes / supports requirements etc	Builderwork drawings Builderswork schedules	Pre-start on site Stage	Required
Produce a commissioning method statement	Commissioning statement	Pre-start on site Stage	Required
Produce all Health and Safety and other method statements as required by the Main Contractor, Client and Engineer.	Health and safety method statements	Pre-start on site Stage	Required
Installation Stage			
Install systems as listed in this scope of works and specification		Installation Stage	Required
Carryout snagging and rectify snags	Snagging status list	Installation Stage	Required
Offer systems for Engineer review prior to commissioning start	Completion certificate for each system	Installation Stage	Required
Commission all systems and produce report	Commissioning report	Commissionng Stage	Required
Offer results to Engineer for review and sample witnessing of the results	System acceptance sheet	Commissionng Stage	Required
Completion Stages			
Update working drawings to full record drawings taking account of any changes during the installation	Record drawings	Handover Stage	Required
Compile Operating and Maintenance manuals in the format required by the Client	O&M Manuals	Handover Stage	Required
Offer O&M manuals and Record drawings to Engineer for review and comments (status A, B or C will be given)	Electronic copy of documents for review	Handover Stage	Required
Attend site to provide familiarisation sessions with the Users for all M&E systems	Video of training sessions	Handover Stage	Required
Attend handover meetings as required – note that snag free handover is a pre-requisite for the		Handover Stage	

PC certificate to be issued.			
At the end of the 12 months defects period, attend site to rectify all remaining defects.	Defects completion report	End of 12 months	Required

V11 - HV Supply/Distribution/Public Utility Supply

Exiting System Description

The 11kV HV sitewide supply enters the Western side of the site and runs down the Northern spine road to a transformer. The supply is in the form of pole mounted, high level, bare conductors with L1/Red, L2/Yellow and L3/Blue.

The HV cabling serves a 630 kVA oil filled transformer located towards the centre of the camp. This transformer currently feeds the existing USAF buildings via fused cut-outs and pole-mounted, 400V bare cables. It is assumed that there is sufficient spare capacity on this existing substation to serve the new Headquarters and Medical Centre. This will need to be confirmed by the KDF.

The high level HV cabling, transformer and high-level LV cabling is all owned and maintained by the Kenya Power Company (KPLC). Any works to these elements must be carried out by KPLC.

Figure V11.1. Existing Transformer, LV Cut-Outs and KDF's new LV switchboard Building.

Proposed System Description

Existing Pole Mounted Cabling

There are no works to the HV cabling, switchgear or existing high level USAF cabling.
However, the pole-mounted HV cabling and pole-mounted LV cabling will be significant constraints to the contractor for the duration of the project works. The pole-mounted cabling runs along the Northen edge of the Northern spine road. This means that the main access road to both buildings will have this constraint and inherent ongoing risk.

The issue will be particularly acute where the cabling crosses the access road to the Medical Centre. At this location, the contractor shall install goal-post type arrangement either side of the pole mounted cabling.

It should be noted that all of this pole mounted cabling is owned and maintained by the Kenya Power Company (KPLC). The goal posts and any other type of protection shall adhere to the KPLC guides and standards. The Contractor shall discuss the protection arrangements with the KPLC before any procurement takes place. The Contractor shall liaise directly with the KPLC for the duration of the project.

The contractor shall also adhere to the guidance and recommendations described in;

- UK Health and Safety Executive Guidance Note GS6 (Latest Edition) - *Avoiding danger from overhead power lines.*
- UK Energy Networks Association (ENA) publication *Look Out Look Up! A guide to the safe use of mechanical plant in the vicinity of Electricity Overhead Lines.*

Figures V11.2 and V11.2. Pole Mounted Cabling adjacent to the Northen spine road.

V20 – LV Distribution

Exiting System Description

The 11kV HV sitewide supply enters the Western side of the site serves an existing 630 kVA transformer. This transformer currently feeds the 2 No USAF buildings.

The Kenyan Defence Force (KDF) have an in-flight project to install a new 630A LV switchboard to serve the overall CITSO camp including the new Headquarters and Medical Centre. This LV switchboard will be served directly from the existing transformer.

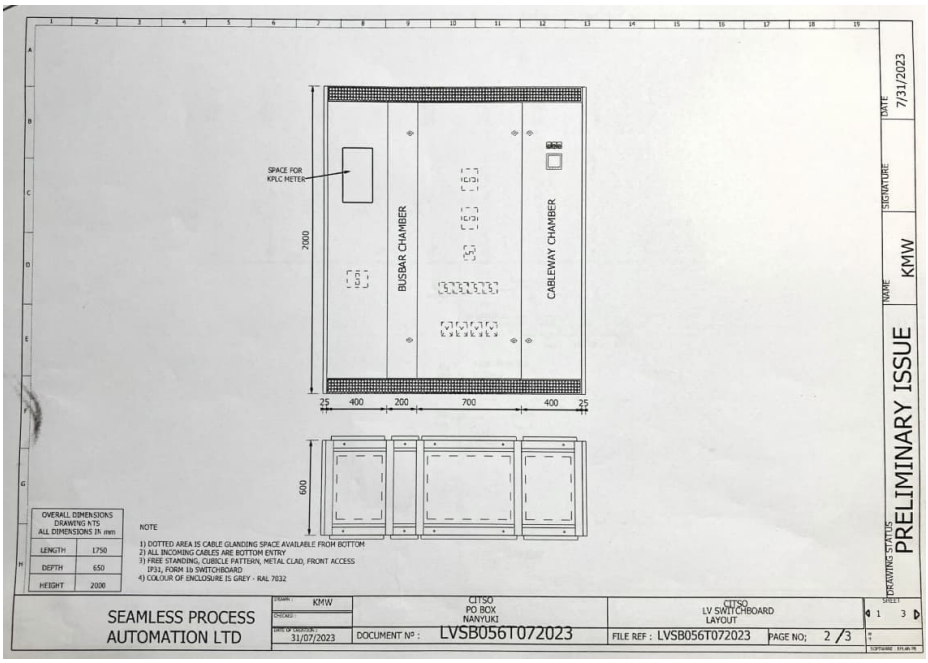

Figure V20.1. KDF design for their new LV switchboard

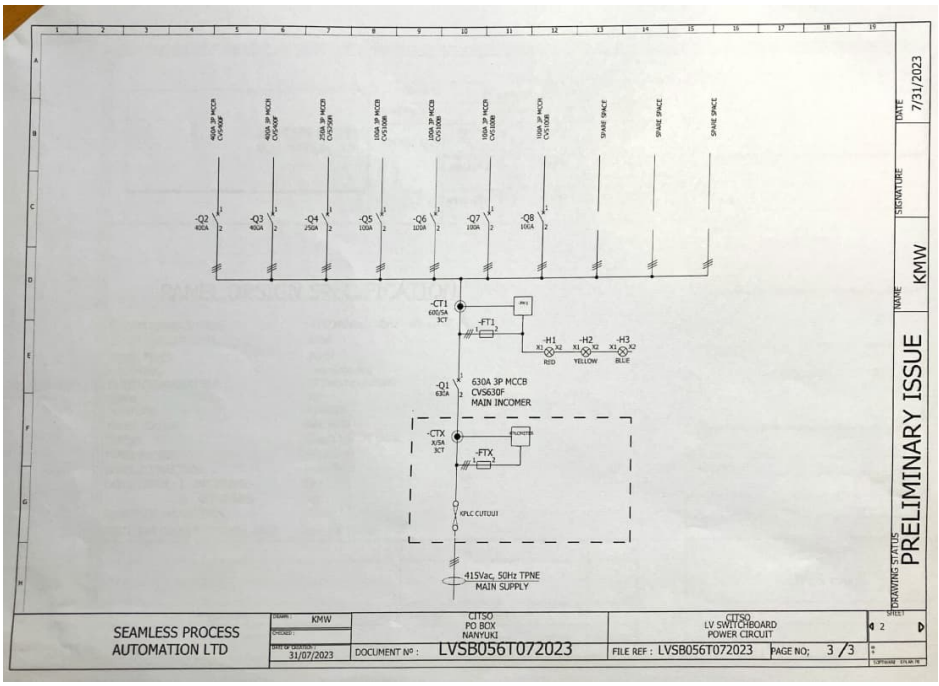

Figure V20.2. KDF LV schematic design of their new LV switchboard

The new KDF LV switchboard will be housed in a new building located adjacent to the existing transformer. This new Switchboard building has already been completed. However, none of the electrical works have yet been completed.

The new Switchboard building will also house a back-up generator and automatic change over switch. However, the generator and change over switching are not yet to be installed in the immediate future. They will be part of a future project.


Figures V20.3. & V20.4 The new LV switchboard Building.

Proposed System Description

System voltage for each building shall be 400 volts, 3 phase, 4 wire, 50Hz.

The contractor shall design, supply, deliver, off-load, protect, position, install, co-ordinate, connect, test, commission and set to works a complete LV distribution system including all necessary switchboards, distribution boards, cabling, containment, frames, brackets, inverters, fixings, co-ordination, energy meters, electrical circuit distribution, connection, protection and all necessary ancillary items to provide a complete functioning LV distribution installation in accordance with Electricity at Work Regulations 1989, BS EN 7671 (18th Edition) and all relevant Local Kenyan standards.

Incoming Supplies

The KDF will provide the main incoming supply cables to each building from their new LV switchboard. The KDF will terminate the supply cable into the incoming manual change-over switch of each building's new feeder pillar.

It is possible that the KDF have not been able to complete their LV switchboard works in time to provide power to buildings 04 and 09. The contractor shall therefore provide a ***below the line*** option cost of providing suitably sized diesel generators to provide power to each of the individual buildings. An individual cost shall be provided per building per week. This cost shall include all delivery, collection, commissioning, decommissioning, fuel and maintenance costs.

04 – Headquarters Building

The building's external feeder pillar will be provided with a 160A, 87 kVA, TP&N supply. This supply and sub main cable will be provided by the KDF.

The building shall be provided with an external feeder pillar into which the KDF will terminate the buildings incoming supply. The Contractor shall install the building supply cable from the feeder pillar to the buildings main LV panel board.

The building shall be provided with a wall mounted, LV panel board, located in the electrical switch room. Supplies to the final distribution boards shall emanate from this panel board.

Split metered distribution boards shall be provide general lighting and power supplies. A power only distribution board shall be provided within the main plant room to provide mechanical supplies within the plantroom. A power only distribution board shall be provided within the comms room to provide power supplies to comms equipment.

Further details of the Panel Board and Distribution Boards are described later in this specification.

09 – Medical Centre

The building's external feeder pillar will be provided with a 160A, 87 kVA, TP&N supply. This supply and sub main cable will be provided by the KDF.

The building shall be provided with an external feeder pillar into which the KDF will terminate the buildings incoming supply. The Contractor shall install the building supply cable from the feeder pillar to the buildings main LV panel board.

The building shall be provided with a wall mounted, LV panel board, located in the electrical switch room. Supplies to the final distribution boards shall emanate from this panel board.

Split metered distribution boards shall be provide general lighting and power supplies. A power only distribution board shall be provided within the main plant room to provide mechanical supplies within the plantroom. A power only distribution board shall be provided within the comms room to provide power supplies to comms equipment.

Further details of the Panel Board and Distribution Boards are described later in this specification.

Feeder Pillars

Each building shall be provided with its own external feeder pillar. Each of the 2 No feeder pillars shall include

- Manual 160A Three Phase Change-Over Switch.
- 6 Way Schneider Powerpact 4 Style C Panel board.
- Connection Point for Temporary Generator.
- Surge Suppression.
- 6 Way Single Phase Type A Distribution Board for Feeder Pillar local circuits.
- Earth Bar connected to rebar of generator base.

The feeder pillars shall be installed on Generator Bases which have been specified and installed as part of an Enabling Works package. These bases are shown on the external services drawing.

Main LV MCCB Panel Boards
LV Panel Boards shall be provided in both buildings. In order to simplify the client's future maintenance regime, all of the MCCB panel boards within this project shall be of the same make, manufacturer, rating and specification. AECOM drawings and specifications are based upon Schneider Powerpact 4 Panelboard.

The LV MCCB Panel Boards installed within the building shall be;

- Form 3 Type 2,
- Rated to 400A with fully rated neutral busbars.
- Rated to 690V and 65 kA.
- 12 way and provided with outgoing MCCBs as per LV schematic.
- Wall mounted with bottom entry and top exit cable ways.
- Accessed and maintained from the front.
- Externally rated to IP43.
- Provided with glazed front door.
- Certified to IEC BS EN 61439-1/-2 and IEC 60439-1.
- Integrated outgoing meters
- Surge Protection

Panel Boards shall have a long-life enclosure fabricated from corrosion resistant pickled sheet steel with durable electrostatically deposited epoxy powder paint finish to RAL 7035-light grey.

Each panel boards shall be provided with 2 No 390mm x 1650mm side cable chambers. I.e. A chamber on each side of the board. Outgoing metering shall be installed within the facia of the cable chambers with 6 No. meters in each chamber. The cable chambers shall be designed and installed such that the terminated cables do not restrict future access to the neutral or earth terminations, and the installation of one cable shall not impede termination onto adjacent MCCB's.

All MCCB's shall conform to the requirements of BS EN 60439-1, BS EN 60947-2 and all relevant Kenyan Standards. AECOM drawings and calculations are based upon Schneider ComPact NSX-B range of MCCBs.

MCCBs shall be provided with electronic trips - TMD trips shall not be acceptable. MCCBs shall be provided with Earth Leakage Protection (Earth Fault). AECOM drawings and calculations are based upon Schneider Micrologic Vigi 4.2 electronic trips which includes an integral Earth Fault functionality. Earth Leakage Protection shall be adjustable between 30 mA and 5Amps and shall include adjustable time delay settings from 0.1 second to 1 second in staged intervals..

Final Circuit Distribution Boards
Buildings shall be provided with 400V, 3 phase distribution boards as shown in the layout drawings and the LV schematic.

Distribution boards shall be;
- Type B arrangement.
- Rated to 250A with fully rated neutral busbars.
- Rated to 690V and 35 kA.
- 24 Way where they are split boards (12 ways for lighting and 12 ways for power).
- 12 way where they are power only boards.
- Manufactured from 1mm cold rolled sheet steel.
- Finished with durable electrostatically deposited epoxy powder paint finish to RAL 7035-light grey.
- Provided with incoming isolator switch.
- Provided with outgoing MCBs and RCBOs as per Distribution Board Schedules.

- Provided with a minimum of 25% spare ways with a minimum of 3 No. three phase ways.
- Wall mounted with bottom entry and top exit cable ways.
- Accessed and maintained from the front.
- Equipped with hinged, latched and lockable door.
- Externally rated to IP43.
- Certified to IEC BS EN 61439-1/-2.
- Provided by the same manufacturer.

All MCBs and RCBOs shall be rated to 15kA as a minimum, i.e. dual rated at 10kA BS EN 60898 & 15kA BS EN 60947-2 in B, C or D curve and make use of cascading where possible. All outgoing ways shall have padlocking facilities. All circuits containing sockets shall be provided with RCBOs.

All spare ways shall be provided with full MCB blanks.

Metering
Energy metering shall be provided on each section as required to provide a continuous, safe, functional system in accordance with this specification requirements, with energy metering in accordance with Building Regulation ADL2A, TM39 and the Kenyan Building code.

The LV switchboard, panel boards and distribution boards shall be provided with metering as per the LV schematic. A large proportion of the LV distribution boards shall be provided with split metering This split metering will meter the final lighting and power circuits separately.

All meters shall be provided with pulsed output and shall be provided with the facility to be monitored by any future BMS. This includes the provision of meters, associated tails and connections ensure a complete electrically continuous distribution system from the point of supply to the building up to and including each and every final point of utilisation.

All metering shall be by digital meters and shall give the following readings as a minimum: Amps, kW, kVA, Hz, Power Factor.

Surge Suppression
To be read in conjunction with the lightning protection system section (W52). The contractor shall undertake a complete risk analysis calculation to ascertain the level of surge suppression required with reference to the LV Panel, Panel Boards, Final circuit Distribution Boards, IT cabling etc.

As a minimum and for tender purposes, the Electrical Contractor shall allow for maximum surge system exposure level (high) and high impulse current (10kA). Protection shall be provided to incoming LV mains, interconnecting and outgoing LV, and comms services. Electronic surge protection shall be installed integral to the main switch board of each building.

Surge suppression shall;

1) Have a let-through voltage not exceeding 600 volts (tested to BS 6651: 1992 Appendix C, Category C-high 6kV 1.2/50 microsecond open circuit voltage, 3kV 8/20 microsecond short circuit current).
2) Protect in all modes (i.e. phase(s) to neutral, phase(s) to each and neutral to earth).
3) Have a peak discharge rating exceeding 25kA per phase.
4) Have a full status indication with lights to show full protection, pre-failure and failure.
5) Be mounted in the main LV switchboard.

LV Switch Rooms
Switch room doors shall open outwards and the width and height of openings shall allow sufficient clearance for the removal of the largest item of equipment in the switch room.

In order to minimise solar gain and to improve security, windows shall not be provided.

All necessary Health and Safety signage shall be provided and installed. An encapsulated “As Fitted” LV Schematic printed to A1 shall be wall mounted alongside each building’s main switch board. The drawings shall be submitted to the Engineer for approval before being placed in a durable frame with a protective Perspex cover and mounted in a suitable location adjacent to the switchgear.

Sub-Mains Cabling
The Contractor shall supply and install all low voltage sub-main cabling as required to form a complete distribution network between the client installed switchboard, the building LV switchboard, distribution boards, MCP’s and any other fixed equipment. All cables shall use fully rated, copper conductors.

Where cables drop to distribution board/boards fixed onto walls, they shall be fixed to cable tray.

For multi-core cables greater than 16mm diameter – steel or aluminium claw type cable cleats shall be used. All armoured cables shall be installed on cable ladder racking and/or cable tray. All cables shall be installed and run such that they are arranged in an orderly manner and to minimise the number of crosses. Where crosses are necessary the cables shall be lifted above each other and supported by a ‘Unistrut’ or similar bridge piece such that one cable’s diameter distance is maintained from adjacent cables. Cable cleats shall be of the correct diameter/size for the cables being fixed. All cables shall be terminated utilising brass compression glands.

When terminating onto distribution boards, gland plates or trunkings, bond from an earthing stud to the cable gland earthing ring to the distribution board casing/gland plate/trunking and also cross bond onto the distribution board/panel earth bar using LSF/Copper conductors of at least half the cross sectional area of the cable phase conductor. All cables shall be terminated using cable glands of the correct type and size.

Sub main cabling shall be in the form of Low Smoke Zero Halogen (LS0H)

Labelling
The main LV switchboard, LV panel boards and final distribution boards shall be clearly and permanently labelled with a unique identifier references in accordance with the drawings. They shall also be labelled with the supply characteristics measured at that point in the distribution system (earth loop impedance and prospective short circuit fault current).

All incoming and outgoing ACBs and MCCBs shall be clearly and permanently labelled to identify the origin/equipment being fed.

Sub-main cables shall be clearly and permanently labelled with a unique identifier references in accordance with the drawings. All sub main cabling shall include as a minimum the circuit reference and the size & number of conductors. Sub main cables shall be labelled at either end/termination and on either side of any wall or floor penetrations

Labels shall be made from traffolyte, or similar sandwich type material, comprising white/black/white laminations for normal supplies and white/red/white laminations for Fire Alarm supplies.

Labels shall utilise Arial text with a minimum font of 14.

The main LV switchboard, LV panel boards and final distribution boards shall be provided with paper reference schedules/charts describing all of the outgoing ways. Charts will be types and printed at A4 and installed within a plastic protective wallet fixed taped to the inside of the board door.

Containment
The AECOM design drawings show only indicative primary containment routes and sizes. The Contractor shall design and install all secondary containment. LV sub main power shall be routed around the buildings via a network of galvanised steel cable tray. All multi-core armoured cables

shall be supported throughout the entirety of their length. All final circuits serving small power and lighting shall be contained within galvanised steel trunking and galvanised steel conduit. Electrical accessories shall generally be surface mounted and shall be served using single core cables installed within surface mounted galvanised steel conduit.

General Philosophy

It is the intention that the vast majority of the final circuit cabling shall be installed within the Dado trunking installed throughout the 2 No buildings. This shall include small power circuits and light switches thermostats, controllers and even Manual Call Points where possible.

Cleaner sockets can be installed within the dado trunking. Surface mounted cleaner sockets within the corridors can be served from the dado trunking in the rooms directly behind the socket outlet.

In plantrooms, cleaners rooms, stores, etc, electrical accessories shall be surface mounted versions which shall be served by surface mounted galvanised steel conduit.

The intention is these installation techniques will significantly reduce the amount of conduit/cabling that is required to be chased into the walls.

The chasing in of conduits/cabling shall only be permitted on a case by case basis and in agreement with both AECOM architect and MEP consultant. It is expected that this will be in the kitchens and tea-points where the chasing in can be covered by a tile.

Cable Tray/Cable Basket

Galvanised cable tray/basket shall be used throughout the installation.
Where routed above suspended ceilings the cable tray/basket shall be generally supported using Unistrut cradles.

All cable tray and baskets shall be complete with 45° gusseted corner pieces at tee junctions, crossovers and changes of direction. This is a requirement to achieve minimum bending radii of cables.
Within suspended ceilings/bulkhead areas the cable tray/basket shall be supported from purpose made unistrut channel and drop rods or wall mounted top hat brackets.

Galvanised Steel Trunking

The Services Contractor shall supply and install a comprehensive galvanised steel trunking installation throughout the scheme, these are minimum requirements and the Contractor shall extend the size or quantity or, if the cable routes overload beyond IEE regulation requirements, any lengths of specified trunking, at no extra cost to the contract. Primary containment shall be provided with a minimum of 15% spare capacity at the time of handover.

Within suspended ceiling areas the cable trunking shall be generally supported using unistrut cradle and drop rods.

All tee joints shall be flanged and, where tee or crossover bridge accessories are required, the Contractor shall ensure the same effective wiring space per compartment as the main trunking run is maintained, or alternatively provide single cable trunking to bridge between each cable trunking compartment.

The interior of the trunking shall be fitted with intumescent pillows where passing through fire walls.

Conduit Installation

All conduits shall be galvanised steel.

Where conduits drop/rise from the ceiling void/roof space they shall generally be surface mounted and fixed to the building fabric to provide a complete surface mounted installation.

The chasing in of conduits into walls shall only be permitted on a case by case basis and in agreement with both AECOM architect and MEP consultant. It is expected that this will be in the kitchens and tea-points where the chasing in can be covered by a tile.

Where conduits are allowed to be installed in the floor screed, they shall be installed at a depth and in a manner, which will not reduce the strength of the floor or cause cracking of the screed.

Where flexible conduit is required in this specification type A unpacked PVC served steel flexible conduit shall be used and limited to a maximum length of 600 mm. It should be noted that flexible conduit is generally only acceptable for cabling passing between the ceiling containment and the dado trunking.

Fire Stopping
Where containment passes through fire compartment walling, the Contractor shall provide fire stopping in the form of Fire Batt Boarding. Intumescent expanding foam shall not be acceptable. The fire stopping shall be of equal or great fire rating than the compartment wall in which it is installed.

V21 – General Lighting

System Description
The contractor shall supply, deliver, off-load, protect, position, install, connect, test, commission and set to works a complete lighting system including all necessary luminaires, lighting control sensors, wall and ceiling mounted switches, emergency lighting luminaires, cabling, control bus-wiring, containment, frames, brackets, LED module sources, drivers, batteries/inverters, fixings, co-ordination, energy meters, electrical circuit distribution, connection, protection and all necessary ancillary items to provide a complete functioning lighting and emergency lighting installation in accordance with Electricity at Work Regulations 1989, EMC Regulations 2006, BS 7671 (18th edition) and local Kenyan standards.

Lighting shall be provided to the internal and external spaces of both buildings.

To avoid confusion and to aid the client's future maintenance, a single lighting manufacturer shall be utilised for the entire lighting installation across both buildings. As fewer makes/types/sizes of light fittings shall be used across the buildings.

Interior surfaces as well as notional working planes will be illuminated to satisfy the requirements of key design guidance documents including, but not limited to:

- CIBSE Lighting Guides
- BS EN 12464. Parts 1 and 2.

All lighting shall utilise LED sources, with regulated output drivers and LED boards, in accordance with the control parameters detailed throughout the entire project.

Lighting Control
Lighting control shall generally be in the form of Presence Detection and Absence Detection with daylight dimming. A number of rooms such as plantrooms shall utilise local manual control.

The contractor shall ensure each of the rooms are wired using the control equipment within the room itself, i.e. no flexible cables shall pass through full height partitions within ceiling voids from one room to another.

The lighting control strategy shall be as follows:-

- Open plan offices, offices with more than one occupant. – Presence detection.
- Cellular offices with only one occupant. – Absence detection.
- Corridors, stairwells, toilets and lobbies etc – Presence detection.
- Risers, plant rooms, comms rooms, switch rooms etc – Manual control

External Lighting
External building perimeter lighting shall be provided to illuminate a 1m wide walkway immediately adjacent to the external walls of all buildings. This external lighting shall be provided as per the layout drawings and schematics.

Perimeter lighting shall be supplied and controlled from the building on which it is mounted. The lighting shall be operated from light sensing photocells combined with time clock control and manual override. Each photo-cell shall be mounted to the external wall of the respective plant room. Each timeclock and manual override shall be located within the respective plant rooms.

Column lighting and bollard lighting shall be utilised to illuminate the surrounding walkways, roadways and car parking areas.

Testing and Commissioning

Testing and Commissioning of the lighting systems shall be undertaken in accordance with the 16th edition of BS 7671 Requirements for Electrical Installations (the IET Wiring Regulations), the appropriate Kenyan Standards and Codes of Practice and the requirements contained in IET Guidance Notes Number 3 Inspection and Testing.

The contractor shall ensure all of the emergency lighting systems are tested in full; this includes full and concise illuminance tests that shall be carried out during hours of darkness to ensure daylight is not factored into the results.

V22 – General Power

System Description

The contractor shall design, supply, deliver, off-load, protect, position, install, co-ordinate, connect, test, commission and set to works a complete LV electrical small power system including all necessary distribution boards, cabling, containment, frames, brackets, fixings, co-ordination, electrical circuit distribution, connection, protection and all necessary ancillary items to provide a complete functioning small power installation in accordance with Electricity at Work Regulations 1989, BS EN 7671 (18th edition) and relevant Kenyan Building Standards.

The contractor shall allow for all power supplies as shown in the AECOM drawings.

The new electrical supplies shall be installed, tested and commissioned in accordance with the current revision of the IET wiring regulations. The contractor shall provide full NICEIC certification and test results for all new circuits within the project.

Generally small power circuits will be wired in Low Smoke Zero Halogen cable installed within a dedicated galvanised metal lighting & power trunking with dado trunking/metal conduit for final connections.

Socket outlets shall be surface mounted metal clad 13 Amp switched outlets complying with BS 1363. Small power electrical outlets shall be surface mounted metal clad versions. Back boxes shall be metal clad and designed to be surface mounted. Conduits serving the surface mounted outlets shall generally be 20mm diameter galvanised steel versions and shall be mounted using appropriate surface mounting brackets.

Circuit cabling serving small power outlets shall generally be in the form of single core XLPE copper cabling. CPC's shall be of the same size as the phase cable and shall be installed for all circuits; conduit or trunking shall not be used as a sole CPC.

All accessories shall be from a common manufacturer.

All final outlets shall include full and concise circuit labels. All items of equipment and outgoing ways shall be clearly labelled.

The contractor shall allow for all power supplies as shown in the indicative AECOM drawings and described in broad terms below:

- Cleaners sockets located within each room, corridor etc. to ensure leads do not have to pass under doors and the socket outlet locations ensure the distance between the cleaning outlets do not exceed a 10m radius.
- All mechanical equipment including but not limited to fused connection units for fixed equipment, such as wall mounted mechanical equipment, or within ceiling voids, for example, fan coil units, heaters, heater batteries etc. This includes all mechanical equipment located on the rooftop plant area where all power supplies shall be suitably IP rated.
- Dedicated fused connection units for all fire alarm equipment, including all dampers etc.
- Wall mounted outlets at low level switched via double pole switches above the equipment – such as the supply serving dish washers, fridges, freezers etc.
- Direct power supplies to misc. single and three phases isolators and commando outlets (BS EN 60309).
- Metal clad double socket outlet within each plant room space.
- TPN supplies to specialist equipment.
- Disabled alarm system to relevant toilets

The server rooms shall be provided with 2 No wall mounted 230V, 16A switched commando style socket outlets (BS EN 60309) per data cabinet. They shall each have individual wall mounted isolation. Each server room shall also be provided with 4 No metal clad twin socket outlets.

The contractor shall provide all fire and acoustic barriers where services pass through fire and acoustic partitions; the contractor must ensure the barriers are provided within the containment as well as protecting the exterior of the containment.

All accessories shall be from a common manufacturer.

All final outlets will include full and concise circuit labels (not adhesive as the labels drop off over time).

CPC's shall be installed with all circuits; conduit or trunking shall not be used as a sole CPC.

Protective Devices

To ensure compliance with the current edition of the IET wiring regulations (BS7671), all socket outlets will be protected by RCBO/RCD's (residual current devices) and AFDDs (Arc Fault Detection Devices).

The RCD's and electrical circuits serving power supplies will be arranged to ensure nuisance tripping is minimised by minimising the number of outlets on each circuit by limiting the earth leakage current to no more than 25% of the RCD trip rating, or worst case, up to a maximum 50% i.e. approx. 8mA and 15mA from a typical 30mA RCD. These figures are based on each piece of electronic equipment (computer, printer) having an inherent leakage of 1mA – figures taken from ECA guide to the 18th Edition of the IET regulations.

Socket Outlets

All accessories shall be from a common manufacturer.

The outlets shall be 13 Amp twin switched outlets complying with BS 1363, of plastic moulded pattern in dado trunking and metal clad where surface mounted. These general-purpose outlets shall be supplied on high integrity ring main circuits connected to 32 Amp RCBOs.

The contractor shall ensure the final circuits are arranged to comply with regulation 543.7.1 with regards to earthing requirements for the installation of equipment having high protective conductor currents. The circuits serving the small power supplies – in particular to ICT rich areas prone to earth leakage shall be based on dual earth / high integrity socket outlets and cabled appropriately. The contractor shall ensure all sockets are high integrity earth compliant.

Generally, no more than 10No. twin switched socket outlets shall be connected to a ring circuit.

All final outlets shall include full and concise circuit labels. All items of equipment and outgoing ways shall be clearly labelled. The labels shall be made from Traffolyte or similar sandwich material with White / Black laminations for normal supplies and White / Red laminations for essential circuits such as fire. Inscriptions shall be formed by engraving through the top white layer to the red / black layer beneath and not ticker tape or similar.

The final location of all ceiling / wall / floor outlets (devices etc.) shall be determined in conjunction with the Architects ceiling, wall and floor plans. The contractor shall ensure access is provided to all aspects of the electrical installation requiring access/maintenance. The contractor will be responsible for ensuring services are coordinated (with other contractors) to ensure the accessible components can be reached from an access panel. The contractor shall issue clear and concise drawings showing the proposed locations (and dimensions) of access panels to the Architect and the design team for comment /approval.

Containment

As defined within V20 and on AECOM's drawings certain areas of the building shall have small power installed within perimeter dado trunking.

Dado trunking shall be CAT 6a compliant 3 compartment dado trunking, such as MK Prestige 3D 170mm x 57mm.

In the majority of cases the upper section for small power cabling and the lower section of the dado will be utilised for the Clients data cabling.

The transition from ceiling void basket and trunking into the dado trunking shall be in the form of flexible galvanised streel conduits. These flexible steel conduits stall be a maximum of 600mm long. They shall only be used for the transition from ceiling void primary containment to the end of the dado trunking. To each individual dado trunking drop there shall be a minimum of 2 No conduits for the power cabling and 2 No conduits for the data cabling.

V40 – Emergency Lighting

System Description

The contractor shall supply, co-ordinate, install, test (including factory tests), commission and leave in full and proper working order a complete emergency lighting installation as detailed below and shown indicatively on the layout and schematic drawings and in accordance with the Employers Requirements.

The emergency lighting will be provided on (virtual) escape routes and / or to provide 1 lux in general areas to permit safe movement and escape from the building at times of power outages.

In general, the emergency lighting installation shall comprise of self-contained emergency versions of the normal light fittings. Emergency luminaires shall be provided complete with 3-hour integral battery packs. These fittings shall be fed from the local lighting circuit and shall illuminate if power to that circuit is lost.

The emergency lighting shall be installed such that upon restoration of the mains supply the luminaire automatically switches back to normal operation and recharges the battery.

The Contractor shall refer to the additional sections within this performance specification to determine the factors applicable to the emergency lighting (as per the general lighting systems), such as the electrical circuit requirements, containment, ceiling details etc. In particular all of the details described within V21 Lighting are fully applicable to the emergency lighting installation.

Stand-alone emergency luminaires shall be wired in LSZH singles in galvanised conduit from the nearest general lighting circuit so in the event of a local mains failure emergency illumination is provided to the localised area.

Illuminated LED exit signage (Running Men) will be provided at various internal locations e.g. final exits, stairs and corridors to guide people to the nearest exits. Illuminated exit signs shall be a combination of drop-down fittings and wall mounted versions. Illuminated signage shall be fed from the local lighting circuit. Illuminated exit signage shall be maintained.

The Contractor shall be responsible for determining the emergency directional and exit signage in conjunction with the architect fire strategy drawings. i.e. the point of direction for the signage or the direction of each running man in relation to its location within the space and how the sign has been mounted.

External IP65 bulkhead lighting shall be provided at the final exits and shall be maintained versions.

Testing

The emergency lighting system shall be provided with manual key-testing facilities alongside the DB feeding the lighting circuits.

Testing and Commissioning

Testing and Commissioning of the lighting systems shall be undertaken in accordance with the current version of BS 7671 Requirements for Electrical Installations (the IET Wiring Regulations), the appropriate British Standards and Kenyan Standards and Codes of Practice and the requirements contained in IET Guidance Notes Number 3 Inspection and Testing.

The contractor shall ensure all of the emergency lighting systems are tested in full; this includes full and concise illuminance tests that shall be carried out during hours of darkness to ensure daylight is not factored into the results.

W11 – Staff Paging/Location

System Description
The contractor shall supply, deliver, off-load, protect, position, install, connect, test, commission and set to works complete facilities for the Nurse Call systems including all necessary power supply/transformers, activation pull cords, push buttons, audio-visual annunciators, reset units, audio-visual alarm indicating panels, and control/receiver units, induction loops, amplifiers, outlet plates, switches, fixings, co-ordination, electrical circuit distribution, connection, protection and all necessary ancillary items to provide a complete functioning installation in accordance with Electricity at Work Regulations 1989, EMC Regulations 2006, BS 7671, relevant Building Regulations (England and Wales) and all relevant Kenyan Standards.

General Description

The system shall comprise of the following:

- Room call with assistance/staff assistance calls via flush bedhead trunking mounted push buttons. Bedhead call buttons shall include 3.5mm jack to accept the patient hand-held call units.
- Corridor Indicator lights to indicate room and call type in the room
- Master Panel at Nurse Call
- Repeater Panel at Medical Centre Reception
- Duty Station or Satellite Display (mimic panels)
- Nurse Call rack server / PC in main IT hub rooms

The Nurse Call system shall be capable of sharing an IP network with other manufacturer's systems.

Combining Systems
It may be simpler and more cost effective for a single system to run both the Disabled Alarm Call System and the Nurse Call system in the Medical centre. This approach is acceptable and shall be confirmed as part of the Contractors Technical Submittals and Construction Drawings submittals.

W15 – Facilities for the Disabled

System Description
The contractor shall supply, deliver, off-load, protect, position, install, connect, test, commission and set to works complete facilities for the disabled systems including all necessary power supply/transformers, activation pull cords, panic buttons, audio-visual over door annunciators, reset units, audio-visual alarm indicating panels, refuge communication call units and control/receiver units, induction loops, amplifiers, outlet plates, switches, fixings, co-ordination, electrical circuit distribution, connection, protection and all necessary ancillary items to provide a complete functioning installation in accordance with Electricity at Work Regulations 1989, EMC Regulations 2006, BS 7671, relevant Building Regulations (England and Wales) and relevant Kenyan Building Standards.

Disabled Alarm Call System
Each accessible WC shall be provided with a disabled alarm system, comprising ELV power supply unit, pull cord(s), reassurance light, wall mounted reset unit, and over-door audio-visual annunciator. The over door audio visual annunciator shall be located in the ceiling tile above the door.

The Disabled Alarm Call system in the Headquarters building shall be provided with a head end display and control unit located within the reception area.

The Disabled Alarm Call system in the Medical Centre shall be provided with a head end display and control unit located within the Nurse call.

Combining Systems
It may be simpler and more cost effective for a single system to run both the Disabled Alarm Call System and the Nurse Call System in the Medical centre. This approach is acceptable and shall be confirmed as part of the Contractors Technical Submittals and Construction Drawings submittals.

W50 - Fire Detection and Alarm

System Description

General
The contractor shall design, supply, deliver, off-load, protect, position, install, co-ordinate, connect, test, commission and set to works a complete Fire Detection and Alarm system including all necessary
control panels, detectors, sounders, call points, interfaces, cabling, containment, frames, brackets, fixings, co-ordination and all necessary ancillary items to provide a complete functioning Fire Alarm system in accordance with Electricity at Work Regulations 1989, BSEN 5839 (fire detection and alarm systems for buildings), BS EN 7671 (18th Edition) and relevant Kenyan Building Regulations.

The new fire alarm and detection system shall comprise of fire alarm analogue addressable panels, fully, automatic high performance point detectors, manual call points, audible and visual alarms and associated ancillary fire alarm interface equipment, generally as indicated on the drawings.

The fire alarm system within all areas of both buildings shall be a category L1 and shall comply with BSEN 5839. The system shall be analogue addressable allowing specific points of alarm to be identified via an alpha numeric text screen. To maintain the system performance and compatibility, all equipment shall be provided by a single manufacturer.

Extent of Works
Each building shall be provided with its own stand-alone fire alarm system with its own individual fire alarm control panel. The panels shall have the functionality to be networked together at a future date. Both panels shall be provided with networks card to allow future connection by others.

The installation shall include;

- The supply and installation of a fully distributed networked analogue addressable multi-looped and zoned fire alarm and detection system serving the HQ building.
- The supply and installation of a fully distributed networked analogue addressable multi-looped and zoned fire alarm and detection system serving the Medical Centre.
- 2 No. Spare network connections, including network cards, at each individual Fire Alarm Panel to allow future connection of new buildings.
- Production of Cause and Effect Matrices for each building.
- Evacuation signals shall be provided by the use of electronic loop powered sounders.
- Testing and commissioning.
- Record Documentation, Maintenance Manuals and Windows based Colour Graphics System.
- Training of site personnel.

The Contractor shall include for sufficient detection/alarm/interface loops to provide a complete system with 10% spare loop card capacity provided for future use. In addition to the loop card capacity, 20% minimum loop addresses shall be provided as spare and being retained for future use on each loop installed under the contract.

Control and Indicating Equipment
The Main Fire Alarm panels shall form the central processing units of the fire alarm systems. They shall receive and analyse signals from fire detection sensors, provide audible and visual information to the user, initiate automatic alarm response sequences and provide means by which the user interacts with the system.

The control and indicating equipment installed throughout the project shall be microprocessor based and shall operate under a multitasking software program, which must be in easily up-datable non-volatile memory (EEPROM).

The systems shall operate from a 230V 50HZ mains supplies in operation via a key switched fused connection unit to each individual panel.

The fire alarm panels shall have the following main indications/functions: -

a) Isolate Sounders
b) Power fault/failure
c) Evacuate signal
d) Test Lamps
e) Silence fault
f) Silence alarm
g) Reset alarm
h) System fault
i) Power healthy
j) Control key switch
k) In panel printer
l) Alpha numeric electronic text display

In addition to the above main indications / functions the main fire alarm control panel in each building shall log the following:

(a) The last 100 fire events on a last in first out basis. This information can be both printed and displayed. The fire information shall be presented in the following form:
- Date and time of fire.
- Device number and loop number.
- Status of Initiation Device to sense "Fire Condition" i.e. "Optical Sensor".

(b) The previous 200 panel events, all relevant events excluding the operation of the fault buzzer being cancelled, all events being made available via a PC port for laptop connection.

(c) The previous 200 supervisory (non-fire) events. This information to be provided in the following form:
- Time activated.
- Time de-activated.
- Supervisory action label or number.

All events shall be made available via a PC port for laptop connection.

All fire, fault and warning events shall be logged immediately with the illumination of an array of appropriately coloured LED's. (Red-Fire, Amber for fault and warning) and an internal buzzer to give an appropriate audible signal.

All control and indicating equipment shall be modular in construction to allow for future extension to the system and shall be easily configurable to meet the exact detection zone and output mapping of the development. Control and indicating equipment shall monitor the status of all devices on the addressable loops for fire, short-circuit faults, open-circuit faults, incorrect addressing, unauthorised device removal or exchange, pre-alarm condition and contaminated detector conditions.

The control and indicating equipment software shall have the ability to annunciate a pre-alarm condition designed to provide the earliest possible warning of a potential fire condition without raising a full alarm condition. The control software shall be capable of adjusting the alarm and pre-alarm threshold levels to compensate for changes in detector sensitivity due to contamination over a period of time.

Each individual fire alarm panel shall include an integral charger and two sets of individually maintenance free monitored sealed lead acid cells. The charger shall be present a nominal DC output. The batteries shall be provided to maintain a standby period of 48-hours (minimum) with a further 30 minutes under full/alarm/control load conditions. The charging current shall be automatically adjusted according to the batteries ambient temperature. Should a full discharge of the cells take place then the system shall be capable of completely re-charging them within a 24-hour period.

Adjacent to each fire alarm panel shall be a graphical mimic diagram as part of the common display screen, which shall provide a graphical representation of the building and shall describe the fire alarm zones.

Automatic Fire Detectors
Detection equipment shall be provided throughout all buildings, in accordance with BS 5839. The devices identified and are shown on layout drawings.

Every loop-connected device shall contain an integral circuit isolator to ensure that no part of the system is lost through a single open or short circuit loop cable fault.

Each sensor shall possess 1 integral LED giving a flashing indication for a fire signal or a continuous indication for certain fault indications.

Sensors shall be white in colour (RAL9010) and manufactured from ABS Plastic. All electronics and associated sensing elements shall be housed within this unit, these components being hermetically sealed to prevent their operation from being impaired by dust, dirt and humidity.

The systems shall use combined heat and smoke detectors.

Combined Heat & Smoke detectors shall be designed to have a high resistance to contamination and corrosion. The smoke detection sensors shall combine two individual sensing elements to provide excellent cover for both "types" of fire (slow smouldering and fast free burning). The heat detection sensors shall be configured not to generate an alarm condition from a rate of rise of temperature or absolute temperature alone.

Each building system shall have the functionality to select & deselect the active sensing elements for the entire system from the Fire Alarm Control Panel. I.e. It will be possible to change from Heat detectors to Smoke detectors and then to Combined Heat & Smoke detectors from the FACP simply through reprogramming which elements of the sensors are active.

This will allow a future commissioning engineer to change the system of each building from combined heat and smoke to just heat if the Clint has issue with false alarms.

Site Alarm Devices
Analogue addressable electronic sounders shall be provided throughout all buildings and shall be loop powered. The electronic sounders shall be complete with suitable software technology to produce a bell output noise level to meet site requirements.

The sounders shall generally be integral to the detection bases. The electronic sounders shall be configured to produce audibility noise levels of 65 dB(A), 75 dB(A) at bedheads, or 5 dB(A) above the notional noise.

Visual alarm indicators shall be provided within less-able WC areas. In addition visual alarm devices shall be provided within plantrooms to supplement audible sounders, as indicated on the layout drawings.

Associated Ancillary Equipment
Manual Call Points (MCP) shall be provided as per BSEN 5839. These shall monitor and signal to the control equipment the status of a switch operated by a ‘break glass’ assembly.

All electronic devices contained within the MCP’s shall be hermetically sealed to prevent damage from hostile environment conditions: i.e. dust, up to a rating of IP32. For additional protection from environmental conditions a weatherproof version of the MCP shall be available to provide a rating of IP44.

Upon operation of the MCP the integral LED will flash to denote operation, this being cancelled upon the operation of a reset procedure. The system shall not allow a "Fire" reset to take place until the MCP has

been reset. Should a "Fire" reset be operated with an MCP still being in the operated mode, the panel shall inform the user of the situation.

Mounting heights of manual call points shall be 1200 AFFL. The travel distance between manual call points should be a maximum of 30 metres. All MCPs shall be complete with hinged protective flaps to help avoid accidental operation. The MCPs shall be surface fixed. MCPs shall be fully resettable via a key.

System Wiring
The fire alarm installation shall be installed using approved enhanced fire resisting soft skin PH120 cabling throughout. All cable sizes/lengths shall be confirmed with the fire alarm manufacturer prior to installation and shall meet the manufacturers minimum requirements. They shall have a minimum conductor size of 1.5mm².

The fire alarm cabling shall be generally installed within cable tray and steel conduit. The Contractor shall supply and install all necessary secondary containment and make allowance for co-ordination of this containment.

Interface Requirements
Fire alarm interfaces shall be capable of receiving and initiating / providing fire alarm signals to specific items of plant and equipment.

The interface units shall be directly connected to the fire alarm loop and shall be Loop Driven Units.
The fire alarm specialist shall ascertain and select the most suitable type of interface unit applicable for the application. Loop driven interface devices shall be capable of accepting 2 input signals, providing 2 output signals or any combination of either.

Loop driven interface units shall accept and or supply clean contact signals only, either normally open or normally closed. No switched voltage outputs or inputs shall be accepted. Loop driven interface units shall not require any form of external power supply and shall be fully maintained under mains failure condition by the main control panel's standby batteries.

Commissioning Requirements
The fire alarm system shall be commissioned by the Fire Alarm contractor in conjunction with the specialist equipment manufacturer. The commissioning activities shall be undertaken as a single continuous operation.

The Contractor shall be responsible for providing and completing a schedule of all devices which require programmable address labels with their site location indicated on a drawing for approval to the Services Engineer four weeks prior to commissioning.

The fire alarm system shall be tested in accordance with the BS guidelines and the testing instruction provided by the manufacturer. The fire alarm system and all associated interfaces / connecting systems shall be tested in their entirety as one system. The commissioning programme for the fire and all related / integrated systems shall be prepared by the contractor to meet the overall construction / completion programme.

The contractor and fire alarm specialist shall utilise the following documents to record test results and details of commissioning tests:-

- Cable Test Sheets
- Installation Check Report
- System Layout Drawings
- System Schematic Diagram
- Power Supply Tests
- Audibility Tests
- Product Commissioning Records

The Contractor and fire alarm specialist shall be responsible for inspecting and testing the complete system, including:-

- Detectors
- Manual Call Points
- Sounders
- Ancillary Devices
- Auxiliary Equipment (i.e. Plant Interface Modules)
- Operating and Control Software

The Fire Alarm specialist shall undertake audibility tests during which the sounders may be operated continuously over a period to ensure that the systems operate correctly.

The standby battery supply shall be tested for the full battery backup rating to ensure that a sufficient 30-min capacity remains to activate an alarm after completion of the trial period.

W51 – LV Earthing and Bonding

System Description

The contractor shall design, supply, deliver, off-load, protect, position, install, co-ordinate, connect, test, commission and set to works a complete LV earthing and bonding system including all necessary earth bars, cabling, containment, fixings, co-ordination, connection, protection and all necessary ancillary items to provide a complete functioning earthing installation in accordance with Electricity at Work Regulations 1989, BS EN 7671 (18th Edition), BS 7430 (Code of Practice for Earthing) and all relevant Kenyan Building standards.

The proposed earthing arrangement is TN-C-S (The Neutral Earth link within the Client's low voltage switchboard) The max disconnection time shall be 5 seconds.

The contractor shall bond and connect to earth all exposed conductive parts of the electrical installation and all extraneous conductive parts so that in the event of a fault of negligible impedance, disconnection will take place in a manner and in such time as to ensure no danger arises.

The Contractor shall bond all services entering the building as close to the entry point as possible Telecommunication service bonding to be agreed with service provider.

The main earth bar shall be fixed to the building structure by two-hole brass clamps or alternative approved methods. The Contractor shall provide main equipotential bonding from each earth bar using LSF/Cu conductor supported on ladder rack or cable tray to the following points: -

1. Incoming water supply
2. Incoming Comms IT comms
3. Lightning protection system
4. Structural reinforcement steelwork – bond to nearest column
5. Main items of mechanical plant / control panels

The Contractor shall supply and install an earthing installation, comprising LV earthing arrays and LV earth bars. Earth bars shall be not less than 50mm x 6mm flat tinned copper appropriately labelled, including labelling of all bonds. The earth bars shall be provided with test links to allow external earth fault loop impedance testing.

All main earthing conductors shall be identified at each end by unique reference, using a similar format to the sub-main cable marking system. Where connections to incoming services or extraneous conductive parts are made, the conductors shall be lugged and bolted. Any surface treatment of the conductive part shall be removed to ensure a good low resistance connection. All main equipotential bonding conductors must be provided with a robust label, affixed below the lug in a secure manner. These labels shall indicate the purpose of the bond.

Supplementary bonds shall be provided to each item of mechanical equipment in plantrooms, etc.

Sub-main XLPE/SWA/LSF distribution cables shall be fixed to gland plates at each end.

All final circuit earthing shall have full sized CPCs. Where these are separate cables, they shall be LSZH and will run in the same containment as the phase and neutral conductors.

The Contractor shall bond and connect to earth all exposed conductive parts of the electrical installation and all extraneous conductive parts so that in the event of a fault of negligible impedance, disconnection will take place in a manner and in such time as to ensure no danger arises.

All services entering the building shall be bonded as close to the entry point as possible.

Each building shall be provided with its own feeder pillar mounted to a temporary-generator concrete foundation. Each feeder pilar shall be provided with its own earth bar and 2 No earth rods. The feeder pillar earth bar shall also be connected to the reinforcement bars of the generator foundation concrete pad.

A separate Earth Bar shall be provided to the main server room of each building with direct connection to the respective main earth bar terminal. The comms earth bar shall be a heavy-duty copper earth bar with test link and a minimum of 10 ways. The comms earth bar shall be connected to the main earthing terminal via a 35mm^2 green & yellow single core XLPE/LS0H earth cable.

W52 – Lightning and Surge Protection Systems

System Description

The Contractor shall employ a specialist Sub-Contractor to design, co-ordinate, supply, deliver, off-load, protect, install, connect test, commission and set to works a complete lightning and surge protection system. This shall include all necessary air termination network tapes, fixings, co-ordination, connection, earth rods, earth tapes, earth bars, physical protection and all necessary ancillary items to provide a complete functioning installation in accordance with Electricity at Work Regulations 1989, EMC Regulations 2006, BS 7671 (18th Edition), relevant Kenyan Building Regulations and BS EN 62305.

The contractor shall employ a lightning specialist to carry out a full and concise risk assessment to evaluate the lightning protection system required for the buildings in accordance with BS EN 62305:2006.

For the purpose of tender, the Contractor shall base the lightning protection systems on the higher classification defined within the British Standard, LPL1. AECOM drawings and specifications are based upon this higher classification. It should be noted that both buildings will be given the same classification of Lightning Protection system. I.e. The most onerous grading shall be used throughout the project.

The Contractor shall liaise with the architect and the structural engineer to agree the lightning protection system in full. The contractor shall ensure any cross bonds are provided between the various structural and architectural elements to ensure continuity is provided in accordance with the standards.

The lightning protection installation shall include all necessary localised bonding to building steelwork, flue stack, roof plant, roof platforms handrails, roof structures, canopies, main electrical installation earth bar and connections that are required in accordance with current British Standards.

The lightning protection systems shall be installed utilising copper and not aluminium.

A connection to the main electrical installation earth bar shall be made using 25x3mm copper tape.

All equipment provided within the contract shall have a minimum parts availability of 10 years and not be an end of line product.

The lightning protection systems shall be connected to all of the various architectural, structural and Mechanical elements as required to meet the standards, including but not limited to:

- Mechanical plant;
- Primary steel;
- Secondary steel;
- Cladding systems;
- Rainwater systems
- Handrails, barriers and walkways;
- Reinforcement bars (concrete);
- Television and radio equipment;
- Metallic flues and ventilation systems;
- Building services;

Air Terminations

The system shall use an air termination network of 25mm x 3mm bare copper conductive tapes on the roofs and have connections to metallic roofs and other equipment. Roof mounted plant and exhaust flues shall be bonded to the lightning protection system. Where the plant is higher than the adjacent lightning protection system, vertical air terminations shall be used. All external metal cladding, handrails, escape stairs and metal rainwater pipes shall be bonded to the LPS.

Where a building element (e.g. metal roof) is to be used, ensure connections are detailed and obtain approval from the architect and/or structural engineer.

Down Conductors

The preferred solution is to use separate down conductors as required, they shall be coloured PVC coated to suit aesthetic considerations. The contractor shall observe the requirements for adequate separation distance to comply with BS 62305-3 and BS 62305-4 against flash-over and EMC risks.

Surge Protection

The contractor shall employ a specialist to carry out a full and concise risk assessment to evaluate the surge protection system required for the buildings in accordance with BS EN 62305:2006. For the purpose of tender the contractor shall allow for Class I ESP on all main panels. A saving to the client is expected if the lightning specialist can provide via calculation the class of protection is less.

The contractor shall provide appropriate Electronic Surge Protection (ESP) or Surge Protective Devices (SPD) on the main LV panel to each building. The contractor shall install equipotential SPD's on all metallic electrical services entering the buildings (for all power and telecoms cabling). For the purpose of tender, the Contractor shall ensure each Type I SPD (lightning current SPD) is fully rated to 25kA and installed on the incoming electrical and telecoms cabling to each building.

W70 – Structured Cabling System

The structured cabling system including all passive and active equipment shall be provided by the client as part of their Data & Comms installation.

The Client's installation shall include data outlets, copper cabling, fibre optic cabling, cabinets, servers, network switches, modems, routers, wireless access points and any form of in rack UPS.

The only aspect of the Data& Comms installation provided as part of this installation/Contract shall be

- The primary containment,
- The secondary containment
- Back Boxes for outlets.

It should be noted that data outlets are shown indicatively on the small power layouts. They are shown simply to aid coordination, they shall not be installed as part of this Contract. Only the back boxes shall be installed as part of this Contract.

Containment
The contractor shall provide and install all primary and secondary containment for the IT installation.

The AECOM tender design drawings show only primary containment routes. The Contractor shall design and install all secondary containment. Data cabling shall be routed around the building via a network of galvanised steel cable basket, supported using unistrut cradles.

All cable tray and baskets shall be complete with 45° gusseted corner pieces at tee junctions, crossovers and changes of direction. This is a requirement to achieve minimum bending radii of cables.

Within suspended ceilings/bulkhead areas the cable tray/basket shall be supported from purpose made unistrut channel and drop rods or wall mounted top hat brackets.

The containment installation shall include all of the Data & Comms outlet back-boxes. The back boxes shall be provided as per AECOM layout drawings. In the majority of cases the back boxes shall be provided within dado trunking or floor boxes.

Dado Trunking
3 compartment dado trunking shall be installed as per AEOM drawings to house small power, data and other equipment. The top section of the dado trunking shall be utilised to house the LV power and lighting cabling. The lower section of the dado trunking shall be utilised to house the ELV data cabling. The centre section of the dado trunking shall be utilised to house the outlets.

The dado trunking shall rise-up the walls of rooms into the ceiling voids as shown in AECOM layout drawings.

The transition from ceiling void basket and trunking into the dado trunking shall be in the form of flexible galvanised streel conduits. These flexible steel conduits stall be a maximum of 600mm long. They shall only be used for the transition from ceiling void primary containment to the end of the dado trunking. To each individual dado trunking drop there shall be a minimum of 2 No conduits for the power cabling and 2 No conduits for the data cabling.

** End of Scope Sections **

V11 – HV Supply/Distribution/Public Utility Supply

Incorporates:
V11 (HV Supply / Distribution / Public Utility Supply)
Clauses from V12 (Fuse pillars and cable distribution cabinets and LV overhead lines and ariel cables)

PART 1 SYSTEM OBJECTIVES

100.011 PERFORMANCE OBJECTIVES

To provide:
The distribution of high voltage electricity from the supply authority's main to the on-site transformer sub-station or user points or LV supply / public utility supply.

100.021 DESIGN PARAMETERS / STANDARDS:

Standards

BS EN 61936-1
PD IEC/TS 61936-2
Relevant Electricity Networks Association (ENA) engineering recommendations and standards

PART 3 SPECIFICATION CLAUSES SPECIFIC TO V11

300.000 GENERAL

300.002 GENERAL REQUIREMENTS:

Ensure that High Voltage electrical systems are designed, installed and commissioned so that they may be managed, operated and maintained in accordance with the Electricity at Work Regulations and relevant guidance including the Health & Safety Executive Guide HSG85 “Electricity at work: Safe working practices”.
Provide adjustable mimic diagrams of the High Voltage system, including the first Low Voltage switch.
Provide all required locks and keys, and Warning, Caution and all other required notices to enable correct operational use of the system. Ensure notices comply with BS EN ISO 7010.

300.010 HV SWITCHGEAR STANDARDS:

NA

300.021 TRANSFORMER STANDARDS AND ECODESIGN REQUIREMENTS:

NA

300.025 SF6 EQUIPMENT:

NA

300.030 TYPE TEST:

NA

300.040 SITE BUILT ASSEMBLIES:

Ensure that components of site assemblies are part of a proprietary system and type tested as appropriate. Install assemblies in accordance with manufacturer's drawings and instructions.

300.050 SITE MODIFICATION:

Do not make site alterations unless authorised. Where site modifications to assemblies are authorised make in accordance with manufacturer's certified drawings and instructions. Ensure that modifications made comply with type test certificate obtained for arrangement of components.

300.060 ELECTRICAL CHARACTERISTICS:

Ensure that electrical characteristics of component parts of assemblies are as indicated and apply when components are mounted in enclosures. Allow appropriate de-rating factors for effect of enclosures, other components and inter-connections.

300.071 SERVICE CONDITIONS:

NA

300.081 CO-ORDINATION STUDY
NA

300.091 CONTROL, MONITORING AND INTEGRATION:
NA

310.000 PRODUCTS/MATERIALS

310.011 SWITCHBOARD SCHEDULE:
Supply switchboards as schedule or as indicated on the drawings.

310.021 HV SWITCHGEAR AND CONTROLGEAR ENCLOSURES:
NA

310.022 ASSEMBLY CONSTRUCTION:
Supply floor standing, metal clad, separately compartmented structure comprising switchgear, controlgear and components as indicated on the schedule or on the drawings.
Material of enclosure to be steel. Supply doors with fastenings and provision for locking in closed position. Use covers which require special tools or mechanical key interlock for removal. Large removable covers to be provided with lifting handles and location brackets. Provide means of fixing to foundation or structure.
Ensure all switches and circuit breakers are operated by independent mechanisms and have a facility for manual operation.
Provide an enclosure to house voltage transformers and associated protection fuses where indicated. Secure access to enclosure by a padlock and mechanical interlocks to prevent access at all times that the transformer is in service. Provide engraved danger notices detailing the switching procedure for safe isolation and earthing of the equipment before gaining access to the enclosure.
Screw labels to outside of switchboards. Ensure that fixed panel or cubicle of withdrawable type units are fitted with label to identify circuit with wording identical to that on the withdrawable portion..
Provide cable termination chambers and terminals to accommodate cross-sectional area of cables as shown on the drawings.
Parallel cabling to be provided with individual terminal for each cable core.
Securely fix a copper earthing bar complying with BS EN 13601 the full length of the enclosure so that exposed conductive parts may be connected to the protective conductors. Ensure earth connection can be made to the assembly without damage to the finish coating. Make provision for armouring and metal sheath of all incoming and outgoing cables, including common and individual glanding plates, to be bonded to earthing bar.
Accessibility for inspection

Arrange for following operations to be performed when assembly is in service and under voltage.
Visual inspection of switching devices and other apparatus; settings and indicators of relays and releases; conductor connections and markings.
Adjusting and re-setting of relays, releases and electronic devices.
Replacement of fuse links.
Replacement of indicating lamps.
Fault location by voltage and current measuring.

Accessibility for maintenance.

Provide space between functional unit or group and adjacent functional units or groups. Provide retainable fastening means for parts likely to be removed for maintenance.

Short-circuit protection and short-circuit withstand strength as drawings. Co-ordinate short-circuit protective devices and short-circuit current arising from rotating machines as detailed in this section. For motor control centres this information is detailed in Work Section W60.
Ensure all equipment is fully interlocked for safe operation. Fit warning notices to all devices that can be damaged or cause harm to personnel or equipment if operated incorrectly.

310.031 ENCLOSURES FINISH:

Apply high standard finish to enclosure and supporting metalwork. Degrease metal and remove rust prior to applying finish.
Comply with paint manufacturer's recommendations regarding preparation, stoving times, temperatures, mixing of finishes, application and coat thickness.
Finish and colour as Manufacturer's standard unless otherwise stated in the schedules. When other than manufacturer's standard finish is specified samples of each paint system and for each colour shall be provided.

310.041 SWITCHGEAR:
Supply floor standing, metal clad, separately compartmented structure comprising switchgear, controlgear and components as follows.
Ensure all switches and circuit breakers are operated by independent mechanisms and have a facility for manual operation.
Standard – BS EN 62271-200
Enclosure

Provide an enclosure to house voltage transformers and associated protection fuses and current transformers where indicated.
Secure access to enclosure by a padlock. Provide engraved danger notices detailing the switching procedure for safe isolation and earthing of the equipment before gaining access to the enclosure.

Earthing bar

Securely fix an earthing bar made of copper to BS EN 13601 through full length of switchgear. Connect each end of bar to an earthing terminal. Bond all metalwork other than current carrying parts to earthing bar. Make provision for armouring and metal sheath of all incoming and outgoing cables to be bonded to the earthing bar.
Ensure continuity of protective circuits at all times.
Provide facilities to allow future extension of switchboard

Ensure all equipment is fully interlocked for safe operation. Fit warning notices to all devices that can be damaged or cause harm to personnel or equipment if operated incorrectly.

310.051 BUSBARS:
Busbar design
Supply triple pole, fully insulated as indicated on drawings.
Provide busbars having electrical characteristics to match switchgear and with a nominal current rating as shown on drawings.
Material

High conductivity solid copper in accordance with BS 159 and BS EN 13601. or
Tinned high conductivity solid copper in accordance with BS 159 and BS EN 13601.

Insulation

Insulate busbar unit length with non-hygroscopic insulation. Insulate busbar joints and connections to circuit-breakers and other units in accordance with BS 159.

Install busbars in separate compartment of switchgear with removable access covers along length. Provide identification and warning labels on access covers.

310.061 CIRCUIT-BREAKERS
Provide circuit-breakers of type and application as indicated on the schedule or drawings.

Standard – relevant parts of BS EN 62271, BS EN IEC 62271, BS IEC/IEEE 62271 and PD IEC/TR 62271 co-ordinated values.
Withdrawal

Provide automatic shutters to cover high voltage contact spouts when circuit breaker is removed from fixed compartment.

Operating mechanism

As indicated on the schedule.

Contact position indicator

Provide a mechanical indicator of contacts open or closed visible through window aperture in circuit breaker enclosure. Provide status indication of the circuit breaker by mimic on the front of the circuit breaker or relay display.

Trip mechanisms

Provide circuit breakers with manual trip facilities
Provide shunt trip mechanism, operating voltage as indicated.

Earthing

Provide an integral fault making earth switch with rated short-time withstand current as indicated for switchboard for circuit earthing and/or busbar earthing as indicated on the drawings.

Locking facilities

Provide facilities to padlock breakers and switches in the ON, OFF and EARTHED positions.

Testing facilities

Ensure the operation of the circuit breaker closing, tripping, interlocking, intertripping, protection devices, indicator lights, remote control, indication and alarm systems can be tested.

Provide facilities for secondary circuits to be operationally tested with circuit breaker isolated from main circuit.

310.062 H V MOTOR STARTERS

NA

310.063 CONTACTORS:

Provide contactors of type and application as indicated on the schedule or drawings.

Standard BS EN 62271-1

Withdrawal

Provide automatic shutters to cover high voltage contact spouts when contactor is removed from fixed compartment.

Operating mechanism

Electrically held with manual trip facility unless otherwise specified

Contact position indicator

Provide a mechanical indicator of contacts open or closed.

Earthing

Provide an integral fault making circuit earthing switch with rated short-time withstand current as indicated for switchboard

Locking facilities

Provide facilities to padlock contactor and earth switch in the OFF and EARTHED positions.

Testing facilities

Ensure the operation of the contactor closing, tripping, interlocking, protection devices, indicator lights, remote control, indication and alarm systems can be operationally tested with contactor isolated from main circuit.

310.070 SWITCHES:

Standard – relevant parts of BS EN 62271, BS EN IEC 62271, BS IEC/IEEE 62271 and PD IEC/TR 62271.

Manual operated fault making load breaking oil immersed fused switch to BS EN 62271-105 for ON/OFF control of an outgoing circuit with trip-all phase mechanism and striker pin fuses to BS EN 60282-1. Provide an interlock to prevent access to the fuses unless they are isolated from the incoming supply and the out going cable.

Provide neon live indication for ring feeders.

Provide facilities to padlock switches in the closed, open or earthed positions.

Disconnectors to BS EN 62271-102

Earthing switches to BS EN IEC 62271-102 or BS EN 62271-112 as relevant

Provide HV fuses to BS EN 60282-1.

Provide HV fuses for motor circuits to BS EN 60644.

310.071 OIL-IMMERSED RING MAIN UNIT

NA

310.081 SF6 COMBINED RING MAIN UNIT:

NA

310.091 METERING UNIT:

NA

310.092 PREFABRICATED (PACKAGED) SUBSTATION

NA

310.093 FUSE PILLARS AND CABLE DISTRIBUTION CABINETS: (V12.300.010)

Comply with requirements of ENA Technical Specification 37 and BS EN 61439-5.

Provide Housing with a degree of protection to BS EN 60529 IP 45 unless scheduled otherwise.

Material

Cast iron, steel or GRP.

Terminations

Make provision for termination and connection of cables and spare ways as indicated on drawings.

Access

Supply front access pattern fuse pillars with insulated barriers or screens over all live metal and labelled for identification.

Access doors

Fit fuse pillar access doors with internal hinges. Secure doors with quick acting barlock and high security padlock.

Components

As indicated on the drawings

Cartridge fuse links in accordance with relevant parts of BS EN 60269, BS88

Ancillaries

Incoming function device to be provided with means for circuit and busbar earthing.

Test plugs, for attaching test devices to outgoing cables and/or busbars.

Earthing and short-circuitign device for outgoing protective devices, 1No for each type and rating.

Mount inside each fuse pillar

- set of special operating tools.
- spare fuse tray, equipped with spare fuses.

Finish

Treat metal fuse pillars prior to final painting to prevent rust.

Apply Manufacturer's standard finish unless otherwise indicated.

Treat interior with anti-condensation paint to reduce level of condensation by providing a thermal barrier between enclosure metalwork and internal air.

Heater

Equip fuse pillar with an anti-condensation heater rated at 65 watts complete with a switch, fuse, switching thermostat, high limit cut-off thermostat and all necessary wiring.

Base unit

Supply purpose made base unit for cable entry.

310.094 LV OVERHEAD LINES AND ARIEL CABLES (V12.300.020)

Provide erected poles and accessories for supporting aerial/catenary low voltage distribution cables, to suit application.

Poles

Standard BS 1990-1

Insulator fittings and pins for bare conductors

Standard BS 3288 parts 1&2. BS EN 61466 parts 1&2, BS EN 61284 and BS EN 60372

Overhead line conductors

Standard BS 7884	Copper
BS EN 61232	Aluminium clad steel
BS 215-1	Aluminium stranded
BS 215-2	Aluminium - steel reinforced
BS EN 50183	Aluminium Alloy
BS 6485	Covered conductors

310.101 INSTRUMENT PANELS:

Provide a panel to mount the instruments and meters with degree of protection and finish to match the associated switchgear.

310.111 PROTECTION DEVICES INTERPOSING RELAYS AND INTER-TRIPPING RELAYS:

NA

310.121 CURRENT TRANSFORMERS:

Standard

BS EN 61869-2

BS EN 60044-3 or BS EN 61869-4 Combined transformers

Provide where shown on the drawings separate current transformers for each protection device and instrumentation. Ensure current transformers provide appropriate accuracy and are compatible with over current factors, characteristics, performance and VA rating required for satisfactory operation of protection devices, instruments and meters indicated.

Ensure that current transformers are capable of withstanding maximum short-time withstand current of value and duration indicated for the switchgear.

Provide test links in secondary connections of all current transformers to facilitate testing of instruments, meters and protection devices.

310.131 VOLTAGE TRANSFORMERS:

Standard

BS EN 61869-3 voltage transformer.

BS EN 60044-3 or BS EN 61869-4 combined transformer.

BS EN 50482 instrument transformer

Supply fully encapsulated and impregnated dry epoxy resin type or oil-filled type with insulating oil in accordance with BS 148.

Performance

Provide transformer with accuracy class and VA rating to suit application.

Connect the secondary windings to outgoing terminals. Protect the secondary windings with cartridge fuses located outside the transformer enclosure, in an accessible position. Where more than one circuit is connected to the secondary winding, fuse each circuit separately.

Connect the star point of the 3 phase and one side of the single phase secondary windings of the transformer to the switchgear earth bar through removable bolted links.

310.151 INSTRUMENTS AND METERS:

Standards

Comply with BS EN 60051-1 for voltmeters, ammeters, watt meters, frequency indicators and power factor indicators.

Comply with relevant parts of BS EN 62053 or BS 7856 for kWh meters, kVA and kW maximum demand meters and polyphase reactive kVA meters and BS EN 62053-23 or BS EN 60253-24 for VAR meters. Where a meter is to be used to measure the amount of electricity supplied for billing purposes, the meter must be of an approved type for electricity, by OFGEM. In addition, meters for domestic use shall be certified.

Protect wiring to voltmeters by separate fuses. Protect potential coils of watt meters, frequency indicators, power factor indicators and kWh meters, kVA and kW maximum demand meters and polyphase reactive kVA meters by separate fuses.

Supply instruments and meters suitable for flush mounting and type, size and accuracy as indicated on drawings or schedule.

Ensure that indicating scales for all other instruments comply with BS 3693. Supply so that normal indication is 50% to 75% of full scale deflection.

Completely segregate all instruments and meters in instrument compartments.

Provide test link for energy meter testing within instrument compartment.

310.161 INDICATOR LAMPS:

Standard BS EN 60947-5-1

Supply lamps of same type throughout. Provide indicator lamps with lamp test facility

Alternating current indicator circuits- include integral double-would transformer for all indicator lamps on all a.c. indicator circuits.

Direct current indicator circuits - 24 V d.c.
Ensure indicator lamps of the same voltage are interchangeable.
For LED indicators, include a voltage suppressor on each LED.

Usage	Lamp Type
Switchboard	LED
Motor control centres	LED

Protect wiring to indicator lamps by separate cartridge fuses.

Ensure lens colours are selected in accordance with BS EN 60073.

310.165 AUDIBLE ALARMS:
Provide audible alarm system where specified.

310.181 TRIP/CLOSE SWITCHES AND CONTROL SELECTOR SWITCHES:
Provide isolation during repair and maintenance work in accordance with BS EN 62626-1.
Standard BS EN 60947-5-1

Provide a panel mounted heavy duty, spring return key operated trip/close switch on each circuit breaker fitted with electrically operated closing mechanisms.
Ensure contacts have a continuous rating of 10A minimum at between 30V to 250V ac and dc, and make and break duty rating of 30A at 250V ac or dc for a minimum period of 3 secs.
Where remote trip/close is required supply a panel mounted selector switch to select circuit-breaker for local or remote operation. Ensure that selection of remote or local closing does not prevent circuit-breaker tripping under fault conditions.

310.191 EMERGENCY TRIP, TEST AND AUDIBLE ALARM SILENCING PUSH BUTTONS:
NA

310.201 HV CABLE BOXES AND CABLE TERMINATION:
NA

310.211 CONTROL, INSTRUMENTATION AND INDICATION CABLE TERMINATION BOXES:
Provide separate cable termination boxes or a segregated cable termination box for the termination and connection of remote control, instrumentation, intertripping, alarm and indication cabling associated with each circuit-breaker or motor-starter. Where a segregated cable termination box is provided ensure the terminals within the box for each system are segregated. Ensure the terminals in each box are voltage segregated.

Locate the boxes at the back of the assemblies, ensure the boxes are clearly identified.
Group all remote control and indication wiring within the assemblies and connect to terminal blocks in the respective box.
Supply rail mounted type terminals blocks.
Provide the boxes with undrilled removable glanding plates.

310.221 COILS - VARIOUS APPLICATIONS:
Ensure coils for switching relays, contactors and other applications are capable of operating with a 20% drop in voltage without the armature or switching apparatus dropping out of position.

310.231 BATTERY CHARGER AND BATTERY UNIT:
NA

310.241 FUSES:
Supply cartridge fuse links including fuse carrier, bases and associated components that comply with the following:-

For HV supplies BS EN 60282-1
For HV motor circuits BS EN 60644
For LV controls BS 88 / BS EN 60269 / BS HD 60269, fusing factor Category gG, unless otherwise indicated.

Use motor circuit fuses where indicated.

310.251 PADLOCKS:
Where specified provide each switchboard with sets of padlocks.
Provide non-interchangeable, high security five-lever type padlocks, unless otherwise indicated.
Provide each padlock with two keys complete with disc and ring. Engrave disc and padlock with suitable legend.
Provide wall mounted steel cabinet with hinged door for storing padlocks and keys on hooks. Supply case with finish to match switchboard.

310.261 TOOLS:
Supply a complete set of special tools, including a torque spanner, necessary for maintaining all the equipment, in a lockable hardwood case.

310.271 TRANSFORMER:
NA

310.272 TRANSFORMER:
NA

310.281 TANKS:
NA

310.291 ENCLOSURES: TRANSFORMERS
NA

320.000 WORKMANSHIP

320.011 FIXING:
Provide all fixing materials including where appropriate Unistrut or similar channels to ensure accurate alignment of switchgear. Provide such materials for incorporating into building works to meet the contract programme. Use cadmium or zinc electroplated bolts, nuts, washers and screws.

320.021 ACCESS AND SAFETY
Ensure that clearance in front of switchgear, withdrawn circuit-breaker or control gear is compatible with operations and maintenance safety.
Ensure that access for maintainability, including access when equipment is withdrawn or otherwise opened for maintenance, is assessed, relevant to the maintenance activities to be performed, for conformity with a suitable standard for accessibility such as BS EN 547-1, BS EN 547-2 and BS EN 547-3.
Ensure appropriate screening and warning signs are provided were a safety hazard is anticipated.

320.030 MARKING:
Number terminals, cables and component parts to correspond with manufacturer's certified drawings.

320.040 INSTALLATION OF BUSBARS:
Tighten busbar joints and connections with a torque spanner in accordance with manufacturers recommendations. Allow for expansion due to operating temperature conditions and load.

320.050 INSTALLATION GENERALLY
Install equipment in accordance with manufacturer's recommendations.

10000 NES VERSION V11 TEXT Dec 19 and V12 Dec 16

Incorporates V12 (public utility supply)

PART 1 SYSTEM OBJECTIVES

100.011 PERFORMANCE OBJECTIVES

To provide the distribution of low voltage electricity from the supply authority's source to the building main switchboard and from the building main switchgear panel to and including the area distribution boards, sub-distribution board, motor control centres and specific items of mechanical plant.

To provide three phase power supplies to user points.
Refer to scope of works for primary and secondary sources of power.

100.021 DESIGN PARAMETERS FOR HEALTHCARE PREMISES:

NA

PART 3 SPECIFICATION CLAUSES SPECIFIC TO V20

300.000 PRODUCTS/MATERIALS

300.012 SWITCHBOARDS, DISTRIBUTION BOARDS

Refer to Y71

300.013 CABLES and SUPPORTS

Refer to Y61 and Y63

300.014 EARTHING

Refer to W51, which incorporates Y80 clauses for earthing and bonding components.

300.015 BUSBAR TRUNKING

NA

300.020 LV OVERHEAD LINES AND ARIEL CABLES (V12.300.020)

Provide erected poles and accessories for supporting aerial/catenary low voltage distribution cables, to suit application.

Poles

Standard BS 1990-1

Insulator fittings and pins for bare conductors

Standard BS 3288 parts 1&2. BS EN 61466 parts 1&2, BS EN 61284 and BS EN 60372

Overhead line conductors

Standard BS 7884		Copper
BS EN 61232		Aluminium clad steel
BS 215-1		Aluminium stranded
BS 215-2		Aluminium - steel reinforced
BS EN 50183		Aluminium Alloy
BS 6485	Covered conductors	

300.081 CO-ORDINATION STUDY

NA

310.000 WORKMANSHIP

310.011 INSTALLATION:
Install equipment in accordance with manufacturer's recommendations.

310.012 TESTING and COMMISSIONING
Refer to Y81

10000 NES Version V20 Dec 18

V21 – General Lighting

Incorporating V41 (Street / Area / Floodlighting)

PART 1 SYSTEM OBJECTIVES

100.010 PERFORMANCE OBJECTIVES

To provide sub-circuit installations from the sub- distribution boards to provide general illumination and, where appropriate, emergency escape lighting.

100.021 DESIGN PARAMETERS

Standards

BS EN 12464-1 - Indoor workplaces.
BS EN 12464-2 – Outdoor work places
BS EN 17037 for daylight in buildings
BS 5489-1 - Roads and public amenity areas

Illuminance levels

Where not stated in the Schedule of Common Design Criteria (Schedule A13) or scope of works, ensure that the maintained illuminance levels meet but do not significantly exceed the CIBSE Code for Lighting (latest edition).

Dependant on Contractor design work required by the scope of works, comply with guidance in latest editions of appropriate SLL guides.

Ensure the initial circuit luminous efficacy for fixed lighting installations is in excess of:

- Ensure minimum colour rendering (R_a) is as CIBSE Code for Lighting.
- Ensure limiting glare rating is as CIBSE Code for Lighting.
- Ensure luminance limits as Table 2.4 of CIBSE Code for Lighting are not exceeded on DSE.
- Ensure the illuminance levels in offices achieve but do not significantly exceed 350-400 lux.
- Ensure the initial circuit luminous efficacy for fixed internal lighting installations is in excess of the following;
  - In office, industrial and storage areas 60 luminaire-lumens/circuit-Watt.
  - Install in dwellings light fittings which can only accept lamps of luminous efficacy more than 45 lumens per circuit-Watt and in excess of 400 lamp lumens.
- Install in dwellings, fixed external lighting fitting;
  - Of lamp capacity not more than 100 Watt with automatic switching off when there is enough daylight and when not required at night or
  - With sockets that can only be used with lamps of efficacy greater than 45 lumens per circuit-Watt.
- Ensure that the installed lighting has an average initial (100 hour) lamp plus ballast efficacy of not less than 50 lamp lumens per circuit-Watt.
- Ensure display lighting has an initial (100 hour) efficacy of not less than, including any transformers or ballast 22 lamp lumens per circuit Watt.

Ensure lighting scheme complies with the Building Regulations Approved Documents (AD) L1A, L1B, L2A, L2B and M and associated Building Services Compliance Guides as appropriate or equivalent in Scotland, Wales and Northern Ireland.

Calculate initial circuit efficacy as AD L2A or L2B, as appropriate.

Contractor to commission the lighting installation in accordance with CIBSE Commissioning Code L : *Lighting* and allow for measuring illumination levels of installation prior to Handing Over, Measurements shall be carried-out in accordance with the SLL Code for Lighting, sections on Instruments and Field Surveys. Commissioning and measurements of lighting installations shall be performed by persons who have demonstrated their competence by passing the 'lighting industry commissioning scheme' operated by the Society of Light and Lighting, Electrical Contractors' Association or National Inspection Council for Electrical Installations.

Unless otherwise stated final lighting circuits shall be radial. Protective device rating and conductor size shall be based on the following:

	Protective device and rating (A)					
MCB	10			16		
Cable size (mm^2)	1.5	2.5	4.0	1.5	2.5	4.0
Maximum circuit length (metres)	20	30	50	10	20	30

Circuit maximum cable lengths reduced. Cable lengths based upon maximum voltdrop of 2% with Ib=0.75In.

Emergency lighting to BS EN 50172, BS 5266, BS EN 1838 and ICEL 1003
Maintain specified illumination level for a period of 3 hours without the use of mains electricity.

100.041 CONTROL REQUIREMENTS:
Refer to scope of works for control lighting systems / requirements for digital addressable lighting interface; comply with relevant parts of BS EN 62386 and BS EN IEC 62386.

Occupancy detection – refer to scope of works

Dimming
- Refer to scope of works and or schedules for details
- Ensure dimming system reduces rather than diverts the energy supply.
- Provide dimming photoelectric lighting controls to all areas where daylighting levels are sufficient to provide a significant proportion of the required design illuminance levels. Ensure that the sum of daylight and electric lighting always reaches the design level by sensing the total illuminance in the controlled area and adjusting the level of artificial light to meet the design requirements.
- Lighting control interface for dimming (Analogue voltage dimming interface for electronic current sourcing control gear) to BS EN IEC 63128

Ensure display lighting has separate dedicated circuits with controls separate from general lighting.

PART 3 SPECIFICATION CLAUSES SPECIFIC TO V21

300.000 GENERAL

300.011 SYSTEM REQUIREMENTS:
Select lighting equipment suitable to meet system objectives and as indicated on the drawings and schedules.
Provide all emergency lighting circuits with local test key switch.
Emergency lamps to energise on failure of local lighting circuit unless otherwise stated.
Illuminate exit, emergency exit and escape route signs so that they are legible at all times, by lamps external to sign or lamps contained within sign as indicated on the drawings.

300.030 ELECTROMAGNETIC COMPATIBILITY
Ensure all equipment and systems are installed to provide electromagnetic compatibility within the systems and with any other systems installed in the same location.

300.050 INTEGRATED SYSTEM:
Where indicated provide integrated system as detailed in the scope of works.

310.000 PRODUCTS/MATERIALS

310.001 WIRING AND CONTAINMENT SYSTEM
Wiring within buildings to be carried out in single core insulated cable enclosed in conduit and or trunking as scheduled.
Trunking routes shown on drawings are primary routes only and all subsidiary trunking and conduits to be provided to form a complete containment system.

310.002 DISPLAY LIGHTING / FLEXIBLE LIGHTING SOURCES:

Refer to scope for project specific requirements
Standards
Relevant parts of BS IEC 62595 and BS EN 62595 for display lighting units and LCD backlight units.
PD IEC TR 62595-1-3 for lighting units with arbitrary shapes such as flexible lighting sources.

310.003 LUMINAIRES AND FIXTURES
Provide luminaires as scheduled and detailed in Y73 complete with means of fixing or supporting. Where installed in suspended ceiling ensure method of fixing is compatible with ceiling type.
Where luminaires incorporate thermoplastic diffusers comply with Building Regulations.

310.011 LIGHTING CONTROL EQUIPMENT
See also clause 100.041 and scope of works.
Where lighting control equipment is specified engage lighting controls specialist to develop the design, supply, install, commission and set to work the lighting control system.
Infrared systems to comply with BS 7693, IEC 61147.

320.000 WORKMANSHIP

320.010 WORK ON SITE:
Ensure all building works are complete and service connections provided.

320.021 INSTALLATION:
Install, commission and to set to work lighting equipment in accordance with manufacturer's recommendations, BS 7671, BS 5266-1 and CIBSE Commissioning Code L : L*ighting*.
Install infra-red transmission systems and co-ordinate the installation of infra-red systems in the same area in accordance with BS 7693.
Ensure luminaires are not installed where temperatures are likely to exceed manufacturers recommended maximum.
Ensure fluorescent luminaires are not used at temperatures below that specified by manufacturer.
Where batteries or indicators are located remote from the emergency luminaire the interconnecting wiring shall be fire-rated. Comply with BS 8519 and BS 5266-1.

320.031 QUALITY CONTROL:
Handle, store and install equipment and components of the lighting system in accordance with manufacturers recommendations. Obtain all equipment and components from a single source.
Inspect all equipment and components on delivery, before fixing and after installation, and reject and replace any that are defective. Record all commissioning, measurements and tests.

10000 NES VERSION TEXT V21 Dec 19 & V41 Dec19

PART 1 SYSTEM OBJECTIVES

100.010 PERFORMANCE OBJECTIVES
To provide sub-circuit power installations from the sub-distribution boards terminating with socket outlets, fuse connection units and other outlet accessories.

100.020 DESIGN PARAMETERS
Unless otherwise indicated all final circuits for general LV power circuits shall comprise:

	Protective device and rating (A)						
MCB	20A		32A		20A		
Circuit type	Ring				Radial		
Cable size (mm^2)	2.5	4.0	2.5	4.0	2.5	4.0	6.0
Maximum circuit length (metres)	35	60	20	35	25	40	60

(Cable sizes are based upon a maximum volt drop of 2% with the circuit loaded to 50% of the cpd rating. For ring circuits a 0.67 current diversity has been used.)
Circuit lengths are taken to the furthest point of utilisation of the circuit for radial circuits or for the route length of the circuit for ring circuits.

PART 3 SPECIFICATION CLAUSES SPECIFIC TO V22

300.000 GENERAL

300.010 SYSTEM REQUIREMENTS
Select equipment suitable to meet system objectives and as indicated on the drawings and schedules.

300.030 ELECTROMAGNETIC COMPATIBILITY
Ensure all equipment and systems are installed to provide electromagnetic compatibility within the systems and with any other systems installed in the same location.

310.000 PRODUCTS/MATERIALS

310.005 WIRING AND CONTAINMENT SYSTEM
Wiring to be carried out in single core insulated cable enclosed in conduit and or trunking as scheduled.
Trunking routes shown on drawings are primary routes only and all subsidiary trunking and conduits to be provided to form a complete containment system.

310.006 POWER USING EQUIPMENT AND FIXTURES
Provide equipment as scheduled complete with means of fixing or supporting.

310.007 POWER TO MECHANICAL PLANT
Refer to W60 for details.
Provide fused connection unit adjacent to each item of local plant that is not fed from an MCC, final connection to be by the Controls Specialist.
Provide power to all MCC's, distribution boards etc supplied by the Controls Specialist.

320.000 WORKMANSHIP

320.010 WORK ON SITE:
Ensure all building works are complete and service connections provided.

320.021 INSTALLATION:
Install, commission and to set to work equipment in accordance with manufacturer's recommendations and BS 7671 IET Wiring Regulations.

320.031 QUALITY CONTROL:
Handle, store and install equipment and components in accordance with manufacturers' recommendations. Obtain all equipment and components from a single source.
Inspect all equipment and components on delivery, before fixing and after installation, and reject and replace any that are defective. Record all commissioning, measurements and tests.

V22 – General Power

10000 NES VERSION V22 Text Dec 19

V40 – Emergency Lighting

PART 1 SYSTEM OBJECTIVES

100.010 PERFORMANCE OBJECTIVES
To provide temporary illumination to escape routes, walkways, selected areas and signs by means of separate lighting systems in the event of failure of the normal lighting systems.

100.020 DESIGN PARAMETERS
Minimum lighting level to conform to the requirements of BS EN 1838 and BS EN 50172 (BS 5266-8).
Maintain specified lighting level for a period of 3 hours without the use of mains electricity
Unless otherwise indicated all final lighting circuits shall comprise

	Protective device and rating (A)					
MCB	10			16		
Cable size (mm^2)	1.5	2.5	4.0	1.5	2.5	4.0
Maximum circuit length (metres)	20	30	50	10	20	30

Circuit lengths are taken to the furthest point of utilisation of the circuit, plus the length of switch lines.

100.040 CONTROL REQUIREMENTS
Provide all emergency lighting circuits with local test key switch.
Emergency lamps to energise on failure of local lighting circuit unless otherwise stated.

PART 3 SPECIFICATION CLAUSES SPECIFIC TO V40

310.000 GENERAL

300.011 EMERGENCY LIGHTING SYSTEM:
Standards
- BS EN 50172 (BS 5266-8) for emergency escape lighting systems.
- BS 5266-2 for low mounted way guidance systems for emergency use.
- BS 5266-4 for design, installation, maintenance and use of optical fibre systems.
- BS 5266-5 for component parts of optical fibre systems.
- BS 5266-6 for photoluminescent systems for emergency way guidance.
- BS EN 13032-3 for photometric data
- BS EN 1838 for emergency lighting applications.
- BS EN 50171 for central power supply systems.
- BS EN 62034 for automatic test systems for battery powered emergency escape lighting.
- BS 5266-1 for general recommendations and guidance for the emergency lighting in premises other than dwellings.
- SLL CIBSE LG12/15 for emergency lighting in general.
- BS EN 12193 for additional considerations for emergency lighting in sports venues
- Any Local Authority specific requirements.

300.020 ILLUMINATION OF SIGNS:
Illuminate exit, emergency exit and escape route signs so that they are legible at all times, by lamps external to sign or lamps contained within sign as indicated on the drawings.

300.030 INTEGRATION, CONTROL AND MONITORING:
Provide an integrated system where detailed in the scope of works / schedules.
Equipment to be controlled / monitored should interface with BMS, the fire detection and alarm system or the building's Supervisory control and data acquisition system via:
- Local outstations / control panels

Supervisory control and data acquisition system via:
- Local outstations / control panels

Fire detection and alarm system:
- Ensure interfaces to fire detection and alarm system comply with the relevant parts of BS 5839 and BS 7273.
- Ensure relevant equipment complies with BS EN 50130-4.

300.040 SOFTWARE:
Where appropriate, obtain on behalf of the end users all appropriate licences, permissions, copyright waivers, rights of use and the like from the owners of the software rights. Ensure that the end user is properly registered with the software supplier for support and appropriate updating. Provide documentation for application software in accordance with BS ISO/IEC 26513 and BS ISO/IEC 26514.
Ensure that, as far as practicable, all software is commercially available off-the-shelf.
Ensure that any programmable configuration, customisation, and bespoke software, is developed, tested and commissioned using relevant processes and procedures complying with BS ISO/IEC/IEEE 12207 or BS ISO/IEC/IEEE 15288, supported by a quality management system meeting the requirements of BS EN ISO 9001.

310.000 PRODUCTS/MATERIALS

310.011 LAMPS FOR EMERGENCY LIGHTING:
As indicated on the drawings and schedules.

310.021 SELF-CONTAINED EMERGENCY LUMINAIRE SYSTEM AND EQUIPMENT
Provide green LCD luminaire healthy and red LCD luminaire fault (where specified) indicator in accordance with BS EN 60598-2-22 and BS EN 60073 (coding principles for indicators).

310.026 LOW MOUNTED WAY GUIDANCE SYSTEMS FOR EMERGENCY USE
Standards BS 5266 Parts 1, 2, and 5, BS EN 50172, and BS EN 60598-2-22.

310.027 OPTICAL FIBRE EMERGENCY LIGHTING SYSTEM
NA

310.030 CENTRAL BATTERY EQUIPMENT:
NA

310.040 BATTERY CHARGERS:
Standards - BS EN 60335-2-29, (battery chargers for household and similar applications), relevant parts of BS EN 60146, (semiconductor converters), BS EN IEC 62485-2 (stationary secondary batteries and battery installations - safety requirements), BS EN 50171 (central power supply systems) and ICEL 1009:2000
Type - as scheduled.

310.050 MAINS FREQUENCY CENTRAL INVERTERS:
NA

310.060 ANCILLARIES:
Provide ancillaries in accordance with the appropriate standards and regulatory authority requirements.

320.000 WORKMANSHIP

320.011 INSTALLATION:
Install, test and commission emergency lighting system and luminaires in accordance with the relevant parts of BS 5266, BS EN 50172 (BS 5266-8), BS EN 1838 and BS 7671 (IET Wiring Regulations).

320.012 REMOTE BATTERY AND INDICATOR CONNECTIONS
NA

320.020 SELF-CONTAINED LUMINAIRES:
Ensure self-contained luminaires are not installed where temperatures are likely to exceed manufacturers recommended maximum.
Ensure fluorescent luminaires are not used at temperatures below that specified by manufacturer.

320.030 EQUIPMENT:
Install equipment in accordance with manufacturer's recommendations.

320.040 QUALITY CONTROL:

Record all commissioning measurements and tests and site modifications to hardware or software, and revise operating and maintenance instructions accordingly.

Manage configuration of software settings, data and design, in accordance with an appropriate Configuration Management Plan (CMP), complying as necessary with BS EN ISO 9001, BS ISO 10007, BS ISO/IEC/IEEE 12207 and BS ISO/IEC/IEEE 15288.

Provide configuration details along with the operation and maintenance manual on hand-over.

Manage information security of systems, software and data during design, implementation and commissioning in line with BS EN ISO/IEC 27001.

10000 NES VERSION V40 TEXT May 19

W11 – Staff Paging/Location

PART 1 SYSTEM OBJECTIVES

100.010 PERFORMANCE OBJECTIVES
To provide systems of local and or distant audio, verbal or visual communication to locate staff away from their work places.

PART 3 SPECIFICATION CLAUSES SPECIFIC TO W11

300.000 GENERAL

300.020 EQUIPMENT APPROVAL:
Use only equipment that is type approved by Ofcom and, when applicable, which complies with BS EN 62949 for safety requirements and BS 6701.

300.030 ELECTROMAGNETIC COMPATIBILITY:
Ensure all equipment and systems are designed and installed with due consideration to good electromagnetic compatibility practice and in line with electromagnetic compatibility requirements of relevant standards including BS 7671, BS 6701, BS EN 50310 and BS EN 50174 series.
Ensure all equipment complies with the Electromagnetic Compatibility Regulations 2016, carries the CE Mark, and is suitable for the electromagnetic environment in which it is to be used, for the service to which it is to be put.
Ensure that all relevant foreseeable sources of disturbance within are taken into account in coverage studies for AFIL and talk-back systems.

300.040 STAFF PAGING/LOCATION SPECIALIST:
Engage a specialist to develop the design, supply, install, commission and set to work the staff paging/location systems.

300.050 SITE COVERAGE REQUIREMENTS:
Ensure system gives full and effective coverage over area and buildings indicated.

300.120 INTEGRATED SYSTEM:
Where specified on the Drawings or Schedules or in the scope of works / system description, combine with other systems to provide an integrated system.

320.000 WORKMANSHIP

320.010 WORK ON SITE:
Ensure that all building works are completed and service connections are proved,

320.020 INSTALLATION:
Install, commission and set to work staff paging/location systems in accordance with the manufacturer's recommendations and the appropriate standard.

320.030 QUALITY CONTROL:
Handle, store and install equipment and components of the staff paging/location systems in accordance with the manufacturer's recommendations.
Obtain all equipment and components from a single source unless otherwise instructed.
Inspect all equipment and components on delivery, before fixing and after installation and reject and replace any which are defective.
Record all commissioning measurements and tests.

320.040 SITE COVERAGE DEMONSTRATION:
When installation is complete demonstrate coverage meets requirements indicated and satisfies all regulations and standards.

W11 – Staff Paging/Location

320.050 AERIAL INSTALLATION:
NA

10000 NES VERSION W11TEXT May 19

W15 – Facilities for the Disabled

PART 1 SYSTEM OBJECTIVES

100.010 PERFORMANCE OBJECTIVES
To provide alarm or communication systems to enable disabled persons to summon assistance, whilst using designated facilities.
Install all switches, controls, outlets and meters to ensure compliance with BS 8300 Parts 1&2 as appropriate (Design of an accessible and inclusive built environment. Buildings. Code of practice).
The systems for facilities for the disabled shall be provided in compliance with relevant legislation. In particular, compliance with the Equality Act 2010 as amended.

PART 3 SPECIFICATION CLAUSES SPECIFIC TO W15

300.000 GENERAL

300.010 ELECTROMAGNETIC COMPATIBILITY:
Ensure all equipment and systems are designed and installed with due consideration to good electromagnetic compatibility practice and in line with electromagnetic compatibility requirements of relevant standards including BS 7671
Ensure all equipment complies with the Electromagnetic Compatibility Regulations (2006), carries the CE Mark, and is suitable for the electromagnetic environment in which it is to be used, for the service to which it is to be put.

300.020 DISABLED ALARM SPECIALIST:
Engage a specialist to develop the design, supply, install, commission and set to work the disabled alarm systems.

300.031 INTEGRATED SYSTEM:
Where specified on the Drawings, Schedules or described in the scope of works, combine with other systems to provide an integrated system.

300.040 STANDARDS
Ensure accessibility of user controls, including labelling, conforms to BS 8300 Parts 1 and 2.
Ensure equipment is selected and installed in accordance with BS 7671

300.050 SOFTWARE
Obtain on behalf of the end users all appropriate licenses, permissions, copyright waivers, rights of use and the like from the owners of the software rights. Ensure that the end user is properly registered with the software supplier for support and appropriate updating. Provide documentation for application software in accordance with BS ISO/IEC 26513 and BS ISO/IEC 26514.
Ensure that, as far as practicable, all software is commercially available off-the-shelf.
Ensure that any programmable configuration, customisation, and bespoke software, is developed, tested and commissioned using relevant processes and procedures complying with BS ISO/IEC/IEEE 12207 or BS ISO/IEC/IEEE 15288, supported by a quality management system meeting the requirements of BS EN ISO 9001.

310.000 PRODUCTS/MATERIALS

310.101 CONTROL & INDICATING EQUIPMENT
The disabled alarm system shall comprise disabled alarm control unit, power supplies, call and reset units, slave indicators and over door/corridor lamp and local sounder units, as detailed on the Drawings and Schedules.

320.000 WORKMANSHIP

320.010 WORK ON SITE:
Ensure that all building works are completed and service connections are proved,

320.020 INSTALLATION:
Install, commission and set to facilities for the disabled in accordance with the manufacturer's recommendations and the appropriate standard.

320.030 QUALITY CONTROL:

Handle, store and install equipment and components of the facilities for the disabled in accordance with the manufacturer's recommendations.

Obtain all equipment and components from a single source unless otherwise instructed.

Inspect all equipment and components on delivery, before fixing and after installation and reject and replace any which are defective.

Record all commissioning measurements and test and site modifications to hardware or software, and revise operating and maintenance instructions accordingly.

Manage configuration of software, settings, data, and design, in accordance with an appropriate Configuration Management Plan complying as necessary with BS EN ISO 9001, BS ISO 10007, BS ISO/IEC/IEEE 12207 and BS ISO/IEC/IEEE 15288.

Provide configuration details along with the operation and maintenance manual on hand-over.

10000 NES VERSION W15 TEXT Sept 18

PART 1SYSTEM OBJECTIVES

100.011 PERFORMANCE OBJECTIVES

To provide detection and alarm systems serving to enhance safety and reduce loss by the detection of fire, enabling an audio/visual alarm to be given so that emergency actions may be taken.
The fire alarm system shall provide detection and alarm functions in overall conformity of the premises to BS 9999.
The fire alarm system shall provide detection and alarm functions in overall conformity of residential buildings to BS 9991.

100.020 DESIGN PARAMETERS

Comply with the following as appropriate to the particular project requirements
BS 5839-1 - non domestic premises
BS 6266 - Fire protection for electronic equipment installations

Voice Alarm Systems

NA

PART 3 SPECIFICATION CLAUSES SPECIFIC TO W50.

300.000 GENERAL

300.011 TYPE OF SYSTEM:

See scope of works and / or schedules for Type, Detection Category (or Grade for domestic systems) and Voice Alarm Type
Provide means of testing wiring of each zone, detection loop or alarm circuit of system.
Provide means of disabling zones or individual detectors as specified.
Provide a fully monitored system in accordance with the relevant parts of BS 5839 and BS EN 54. Include all end of line and other necessary circuit elements to facilitate monitoring.

Refer to schedules for project particular details

300.015 ELECTROMAGNETIC COMPATIBILITY:

Ensure all equipment is compatible and does not adversely affect, nor is adversely affected by any other equipment installed in the same location.
Ensure all systems are designed and installed with due consideration to good EMC practice and in line with EMC requirements of relevant standards including: BS 7671; BS EN 50310; BS EN 50174-series.
Ensure all equipment complies with the EMC Regulations (2016), carries the CE Mark and is suitable for the EM environment in which it is to be used, for the service to which it is to be put.
Ensure all relevant fire alarm equipment complies with BS EN 50130-4.

300.017 SOFTWARE:

Obtain on behalf of the end users all appropriate licences, permissions, copyright wavers, rights of use etc. from the owners of the software rights. Ensure that the end user is properly registered with the software supplier for support and appropriate updating. Provide documentation for application software in accordance with BS ISO/IEC 26513 and BS ISO/IEC 26514.
Ensure that, as far as practicable, all software is commercially available off-the-shelf.
Ensure that any programmable configuration, customisation and bespoke software is developed, tested and commissioned using relevant processes and procedures complying with BS ISO/IEC/IEEE 12207 or BS ISO/IEC/IEEE 15288, supported by a quality management system meeting the requirements of BS EN ISO 9001.

300.041 CONTROL SYSTEM:

Standard

BS 5839-6 Annex B.
BS EN 54-2
BS EN 54-4

BS EN 54-25 for components using radio links
See Scope of Works and Schedules for type of control system.

300.045 VOICE ALARM SYSTEM
NA

300.046 EMERGENCY VOICE COMMUNICATION (EVC) SYSTEM
NA

300.050 EXPLOSIVE OR FLAMMABLE ATMOSPHERES:
NA

300.081 REMOVAL OF TRIGGER DEVICE:
NA

300.100 REMOTE CENTRE:
NA

300.110 FIRE ALARM SPECIALIST:
Engage a specialist to develop the design, supply, install, commission and set to work the fire alarm system.

300.115 VOICE ALARM SYSTEM SPECIALIST:
NA

300.120 INTEGRATED SYSTEM
Where specified on the Drawings or Schedules, combine with other systems to provide an integrated system.
Security detection and alarm / social alarm in dwellings in accordance with clause 9.1.5 of BS 5839-6.
Ensure interfaces comply as necessary with relevant parts of BS 5839 and BS 7273.

310.000 PRODUCTS/MATERIALS

310.011 MANUAL CALL POINTS:
Standard
BS EN 54-11
Mounting as scheduled

Degree of Protection to BS EN 60529 as scheduled
Operation
Manual Call Point activation response within 3 seconds.
Manual operation
Key switch.
Break glass with anti-fragmentation film.
Thumb pressure

310.021 AUTOMATIC DETECTORS
Provide automatic fire detectors from the same manufacturers and with common facilities.

Plug in bases.
Common base for all detector types.
Visible activation indicator.
Visible remote indication for detectors concealed in roof spaces etc.
Label detector bases with address number (where static addressing is used)
Mount detectors in floor voids on brackets to facilitate proper functioning of these detectors.

Position detectors in accordance with BS 5839 to take account of air movement

For combined sounder/sensors, removal of sensor not to inhibit sounder.

310.031 HEAT DETECTORS:
Standard
Point type BS 5446-2 - heat alarms for dwellings
BS EN 54-5 - heat detectors

Line type BS EN 54-28 - non-resettable line-type heat detectors

310.041 SMOKE DETECTORS:
Standard
Point type
BS EN 14604 (Residential applications)
BS EN 54-7 - using scattered light, transmitted light or ionization
BS ISO 7240-15 - using smoke and heat sensors
Aspirating type
BS EN 54-20
Optical beam type
BS EN 54-12

310.051 RADIATION (FLAME) DETECTORS:
NA

310.061 MULTI-SENSOR FIRE DETECTORS:
Standard
Point detectors with a combination of smoke and heat sensors: BS EN 54-29
Point detectors with a combination of carbon monoxide and heat sensors:
BS EN 54-30
BS ISO 7240-8
Point detectors using a combination of smoke and carbon monoxide, and optionally heat sensors: BS EN 54-31
Carbon monoxide fire detectors to use an electro-chemical cell in combination with a heat sensor.

310.071 SOUNDERS:
Standard
Comply with BS 8456 - code of practice for design and installation of directional sounder evacuation systems
BS EN 54-3

310.081 FIRE ALARM CONTROL AND INDICATING EQUIPMENT (CIE):
Standard
BS 5839-1 and BS EN 54-4
BS 5839-6 Annex B (Residential applications).
BS EN 54-2
Functional requirements
Standard functions and additional functions as scheduled.

310.083 SLAVE STATUS UNITS (EXTINGUISHING SYSTEMS):
NA

310.085 VOLT FREE CONTACTS (EXTINGUISHING SYSTEM CIE):
NA

310.086 HOLD OFF FACILITY (EXTINGUISHING SYSTEMS):
NA

310.091 REPEATER PANEL:
NA

310.101 MIMIC PANEL:
Standard
BS EN 54-2

310.110 ANCILLARY SERVICES CONTROL:
Make provision to open or close circuits of ancillary services by means of relay or similar device as scheduled.
Standard
BS EN 54-2

310.115 INPUT/OUTPUT DEVICES
Standard
BS EN 54-18

310.121 POWER SUPPLIES:
Standard
BS 5839-1
BS EN 54-4

310.131 REMOTE INDICATOR MODULE
NA

310.141 LINE ISOLATOR MODULE
Standard
BS EN 54-2

310.145 SHORT CIRCUIT ISOLATORS
Standard
BS EN 54-17

310.151 VISIBLE ALARMS:
Standard
BS EN 54-2
BS EN 54-23

310.161 ZONE MONITORING UNIT:
Standard
BS EN 54-2

310.171 AUTOMATIC RELEASE MECHANISM:
Standard
BS 5839-3
BS 7273-4 - actuation of release mechanism for doors
BS EN 14637 - electrically controlled hold-open systems for fire/smoke door assemblies.

310.191 VOICE ALARM LOUDSPEAKERS:
311 NA

310.201 VOICE ALARM MICROPHONES :
NA

310.211 VOICE ALARM MESSAGE GENERATORS:
NA

310.221 VOICE ALARM AND INDICATING CONTROL EQUIPMENT:
NA

310.231 VOICE ALARM POWER SUPPLIES:
NA

310.241 EMERGENCY VOICE COMMUNICATION MASTER STATIONS:
NA

310.251 EMERGENCY VOICE COMMUNICATION OUT STATIONS:
NA

310.261 EMERGENCY VOICE COMMUNICATION SYSTEM POWER SUPPLIES:
NA

310.271 RADIO FIRE DETECTION AND ALARM SYSTEMS
NA

320.000 WORKMANSHIP

320.010 QUALITY CONTROL:
Handle, store and install equipment and components of the fire detection and alarm system in accordance with BS 5839 and the manufacturer's recommendations.
Obtain all equipment and components from a single source.
Inspect all equipment and components on delivery, before fixing and after installation and reject and replace any which are defective.
Record all commissioning tests and provide the certification required by BS 5839-1.
Provide manufacturers certificates of equipment design to an approved quality management system and CIE component selection.
Record all commissioning measurements and tests, site modifications to hardware or software, and revise operating and maintenance instructions accordingly.
Manage configuration of software, settings, data and design, in accordance with an appropriate Configuration Management Plan complying as necessary with BS EN ISO 9001, BS ISO 10007, BS ISO/IEC/IEEE 12207 and BS ISO/IEC/IEEE 15288.
Provide configuration details along with the operation and maintenance manual on hand-over.
Manage information security of systems, software and data during design, implementation and commissioning in line with BS EN ISO/IEC 27001.

320.020 SMOKE DETECTOR INDICATORS:
Fit smoke detector indicators external to doors, where zone is divided into rooms.

320.031 MANUAL CALL POINTS:
Wire manual call points to initiate zone alarms as indicated on drawings

320.041 RECORD DRAWINGS AND OPERATING INSTRUCTIONS:
Provide instructions on use of installation to person responsible for use of premises. Supply the user with a logbook and certificate of installation and commissioning in accordance with BS 5839-1, Appendix F and G.
Provide record drawings for maintenance and record purposes, showing locations of equipment and accessories, sizes and routes of cables, and connection diagrams for junction boxes and distribution cases.
Provide circuit diagrams of fire alarm system and its components.

320.050 CABLE INSTALLATION:
Plan and install all fire detection and alarm system cables in accordance with BS 5839-1 and the cable manufacturer's recommendations.
Run cables point to point without tees or spurs.
Design loop load (current and device count) not to exceed 80% of cable / loop capacity.
Mark all terminals with polarity and loop / circuit reference.

10000 NES VERSION W50 TEXT Dec 19

Incorporates Y80 (Earthing and Bonding Components)

PART 1 SYSTEM OBJECTIVES

100.010 PERFORMANCE OBJECTIVES

To provide systems for the transfer of electric current to earth, to protect personnel, buildings, structure, plant and equipment in the case of an electrical fault within the supply system and from interference from electro-magnetic fields and electro-static forces.

300.000 PART 3 SPECIFICATION CLAUSES SPECIFIC TO W51

300.010 STANDARDS

As defined in the scope of works, carry out or complete the design, installation, inspection and testing of an earthing and bonding system for the low voltage electrical installation in accordance with Electricity Safety, Quality and Continuity Regulations 2002, Electricity at Work Regulations 1989, BS 7671, BS 7430 and local Distribution Network Operator (DNO) requirements.

Confirm with the DNO that, in the event of a fault in the high voltage network, the resulting transfer Earth Potential Rise (EPR) to the low voltage electrical installation can be achieved at a safe level. If the safe level cannot be met, control measures should be provided to eliminate risk of injury.

Ensure the potential rise in telecommunications circuits due to power system earth faults is limited, as per BS 6701

For requirements of separate or combined high voltage and low voltage electrical installation earthing, see W56.

For functional requirements of information technology and telecommunication systems, to be installed within the building (now or in the future), see BS EN 50174-1, BS EN 50174-2 or BS EN 50174-3 and BS EN 50310.

Ensure that the integrity of the structural steelwork will not be subject to any detrimental influences by any stray DC current flowing in the earthing and bonding system or suitable measures have been taken to avoid it.

300.030 PME INSTALLATIONS:

Provide protective conductors for TN-C-S (PME) Systems where specified

300.032 COMMON BONDING NETWORK (CBN):

Where appropriate, form a Common Bonding Network for information technology equipment by equipotential bonding of metalwork throughout the building. Carry out work to the Common Bonding Network in accordance with BS 7671, BS EN 50174-1, BS EN 50174-2 or BS EN 50174-3 and BS EN 50310. Include in the CBN but not limited to

- Steel structural frames.
- Reinforcement bars in concrete.
- Metallic roof coverings.
- Ceiling grids.
  - Services
  - Dry risers.
  - Water pipes.
  - Air ductlines.
  - Gas services.
  - Power cable containment

300.034 USE OF BUILDING ELEMENTS:

Ensure that building and structural elements used as items in or bonded to the Common Bonding Network are designed and erected in accordance with BS EN 50174-1, BS EN 50174-2 or BS EN 50174-3 and BS EN 50310 as well as their appropriate constructional specification or code of practice. Ensure that all connections to building and structural elements are waterproof and corrosion protected to a degree appropriate to their exposure. A risk assessment on detrimental influence in weather and corrosion protection would be required.

300.036 MESH-BONDING NETWORK (MESH-BN)

Where appropriate, carry out work to achieve a MESH-BN in accordance with BS EN 50174-1, BS EN 50174-2 or BS EN 50174-3 and BS EN 50310.
Form MESH-BNs in areas indicated on the drawings or detailed in the scope of works

300.040 EXISTING INSTALLATIONS:
Check earth continuity conductors and loop impedance values of existing installation. Report defects and elements not in accordance with BS 7671 (IET Regulations) before connecting new or modified installations to existing supply.

300.050 SOIL TESTS:
Where specified carry out soil tests in accordance with BS 1377 to establish soil electrical resistivity and soil analysis as required.
Apply one or more acceptable industry practice testing method to carry out soil resistivity tests in accordance with the requirements of BS 7430.

300.060 RISE IN POTENTIAL IN TELECOMMUNICATIONS CIRCUITS:
NA

300.070 EXCHANGE OF INFORMATION:
Consult with the electricity supply company regarding the earthing arrangements of the installation. Construct the earthing system to the requirements of BS 7430 and BS 7671 /electricity supply company. Ensure any part of the earth fault current path provided by the electricity supply company or others is suitable for the operation of the earth fault protection to be installed. Obtain the agreement and permission of undertakings providing services which are to be bonded to the earthing system.

300.081 EARTH FAULT RELAYS:
Ensure system compatible with earth fault relays on electrical system as specified elsewhere.

310.000 PRODUCTS AND MATERIALS

310.010 CLEAN (LOW NOISE) EARTH DISTRIBUTION (Y80 3010)
NA

310.020 MAIN EARTH TERMINAL:
Provide earth bar at incoming electrical service position, for each switchboard.
Bond earth terminals and metallic structure of switch and control gear and plant.
Connect each earth terminal to all other earth terminals by a ring conductor sized as BS 7430 and BS 7671.
Location
Adjacent to main switch panel.
Mounting
Mount earth bar on insulated supports located at 300mm centres for 25mm bar and 450mm centres for 50mm bar, giving 50mm clearance at rear of bar.
Material
Manufacture earth busbars from hard drawn, high conductivity copper bar.
Substation Earth busbar
75 x 13mm cross section 600mm minimum length.
Building Earth bar
25 x 6 mm minimum for incoming live conductor not exceeding 50mm2 and 50 x 6 mm minimum for incoming live conductor over 50mm2.
Drill clearance holes, one for each cable plus 30% spare holes (two minimum) at 50mm minimum centres through bar for connection of cable lugs. Ensure clearance holes are minimum necessary size to maintain adequate lug/bar contact.
Size the MET and protective earthing conductors in accordance with BS 7671

310.030 MAIN EARTH TERMINAL CONNECTIONS / SUBSTATION EARTH BAR:
NA

310.060 NEUTRAL/EARTH CONNECTION:
NA

310.070 CLEAN (LOW NOISE) EARTH BAR:
Where specified provide clean earth bar.
Mounting

Mount earth bar on insulated supports located at 300mm centres for 25mm bar and 450mm centres for 50mm bar, giving 50mm clearance at rear of bar.

Material

Manufacture earth busbars from hard drawn, high conductivity copper bar.

Drill clearance holes, one for each cable plus 30% spare holes (two minimum) at 50mm minimum centres through bar for connection of cable lugs. Ensure clearance holes are minimum necessary size to maintain adequate lug/bar contact.
Terminations

Connect each conductor and tape separately to earth bar.

Connect telecommunications and data equipment in accordance with BS 6701.

310.075 PARALLEL EARTH CONDUCTORS (PEC):
NA

310.080 TRANSFORMER OR GENERATOR EARTH ELECTRODE SYSTEMS:
Provide separate electrode systems which each low voltage generator or transformer to achieve an earth electrode resistance that is as low as practicable. The earth electrode system for LV transformers or generators not interconnected with HV systems shall be designed to achieve a target resistance of 10Ω (but not exceeding 20Ω) in accordance with BS 7430, with separate main earthing conductors for each transformer or generator, and an additional spare electrode system for test purposes.
Where a common HV/LV earthing system is provided, the combined earthing system shall ensure the stress voltage and touch voltage requirements of BS EN 61936-1, BS EN 50522 (including National Annex NA.2) and BS 7671 are met in respect of the earthing arrangement(s) of LV system(s) to be supplied. Bond all electrode systems together using a ring conductor. Connect electrode systems to ring conductor via links or disconnecting joints for test purposes.

310.090 INSULATED ISLAND GLANDS:
On cables to switchboards provide insulated island glands to facilitate testing.

310.100 MICS CABLE TERMINATIONS:
Provide manufacturer's seals incorporating protective conductors at each termination, where glands are used or not, and connect conductors to conduit box, adaptable box or equipment box earth terminals.

310.110 FRAME EARTH LEAKAGE:
Where frame earth leakage devices are used for phase to earth protection, connect two earthing conductors as BS 7430, one to the framework of the switchgear and main earth bar via current transformer or other devices, the other to cable sheaths and earthing devices, insulated where necessary.

310.120 PORTABLE EARTH CONNECTIONS:
Provide tape loops for the connection of portable earths where appropriate

310.130 CEILING SUPPORTS:
Bond main supports to exposed conductive parts of electrical installation where appropriate (based on risk assessment).
Holes

Drill or punch holes in main supports in positions indicated to receive terminal screws.

Use holes in main supports for terminal screws.

Terminals

Connect bonding conductors to supports through holes with tinned copper cable lugs or tags secured to support with brass screws, washers, nuts and locking device.

Connection
Connect bonding conductors to supplementary bonding conductors in cable trunking:
Using crimp type connectors.
Include ceiling supports in CBN.

310.135 RAISED FLOOR SUPPORTS:
NA

310.140 SAFETY EARTHING:
Provide safety earthing in accordance with BS 6626, and HSE guides INDG 372 & HSG 230

310.150 TELECOMMUNICATIONS FUNCTIONAL EARTH:
NA

310.210 CONDUCTORS: (Y80 2010)
Use earthing conductor-Minimum dimension to BS 7430, BS EN IEC 62561-2 Table 1

Current density 50A/mm^2.
Form Strip generally or rod.
Stranded conductor where appropriate
Material
Copper
Use Aluminium only where agreed with Contract Administrator
Coverings
Generally none.
Use LS0H or where thermoplastic wiring systems are employed PVC may be used.
Colour as indicated where specified
Accessories
Use proprietary cast gun metal accessories, fixings, clamps and couplings with phosphor-bronze bolts, nuts and washers. Use adhesive fixings only when approved by Contract Administrator.

310.220 CONDUCTOR JOINTS: (Y80 2020, 3040)
Provide waterproof protection at joints subject to moisture.
Joint copper tapes by
tinning before assembly and riveting with two minimum copper rivets. Overlap straight joints by length equivalent to twice (minimum) tape width. Overlap both sides of main tape at tee joints or
naval brass bolts or copper rivets (two minimum) and sweat solid whole joint or
Brazing, using zinc-free brazing metal with melting point at least 600^{o}C or
Thermic welding or
Cold pressure welding.
Joint aluminium tapes by
Welding to BS EN 1011-4
Joint circular rods as tapes using through coupler.
Joint stranded conductors with compression joints to BS EN 61238-1.
For bolted connections use crimp type lugs compressed by automatic tool to achieve correct pressure and crimp depth.
Use phosphor bronze bolts, nuts and washers to make connections between conductors and equipment

310.230 TAPE FIXING DEVICES: (Y80 2030)
Standard - BS EN 62561-4 for lighting protection system conductor fasteners.

Secure bare copper tape to structure with corrosion resistant proprietary fixing devices which avoid piercing tape and ensure 3mm (minimum) clearance of tape from structure. Space fixings at 450 mm maximum centres for vertical conductors, 1,000mm for horizontal.

310.240 EARTH ELECTRODES: (Y80 2040A-E)
Standards as appropriate to the particular specification:

BS 7430 and BS 7671 (IET Wiring Regulations).
Relevant parts of BS EN 62305 where a lightning protection system is present.
BS EN IEC 62561-2 for lightning protection earth electrodes
Material, minimum size as BS 7430, BS EN IEC 62561-2
Form /types as described in the scope of works
Rods - use high tensile strength steel cored molecularly bonded copper sheathed rods with threads rolled on to rods. Sheath thickness 0.25mm (minimum).
Rod Diameter - 15 mm – nominal
Building or structural element earth electrodes
Foundation earth electrodes
Earth electrode couplings
Use silicon bronze alloy, counter bored to completely enclose rod threads. Ensure rods meet in centres of coupling.
Use high strength driving cap in contact with driven rod.
Strip.
Stranded conductor.
Plates - Proprietary item.
Earth electrode tape
Interconnect electrodes using bare copper tape or stranded copper cables.
Location
Locate electrodes not less than 2m distant from building/structure protected, and away from telecommunication and pilot cables and metallic fences.
Barriers
Provide permanent non-conducting barriers to BS 7430 at 2m radius around any electrode liable to produce a voltage gradient of more than,
(V/m) as indicated.
Driving
Drive rods vertically into ground with purpose designed electric hammer. (Where impenetrable strata encountered at shallow depth, drive at 30^{o} to horizontal).
Depth of rod
2.4 m (2 x 1.2) minimum below finished ground surface.
Depth of Electrode heads
Locate electrode heads just below ground level.
Spacing
Where electrodes are installed in a group ensure minimum distance between electrodes is twice depth of rods. Where rods for 'clean' earth are installed ensure distance from any other system rods is six times depth of 'clean' rods.
Tape Depth
Install interconnecting or electrode tape 750mm below finished ground level or as ground conditions allow, rising vertically at each electrode.
Connect groups of electrodes to main earth conductor via bolted link in inspection pit as BS 7430 for test purposes.
Earth electrodes in draw pits
Provide concrete cover, permanently labelled, for electrodes installed through cable draw pit bases
Main earth conductor cover tiles
Provide plastic identification tape over complete external lengths of main earth conductors.
Permanent test electrodes
Provide permanently located test electrodes where indicated
General
Ensure that materials and dimensions of earth electrodes have adequate mechanical strength and are selected to withstand corrosion such that the mechanical integrity of the structural element is not impaired, and the possible increase in earth electrode resistance is minimised.
Where an earth electrode consists of parts that must be connected together, ensure connections are made by welding, pressure connectors, clamps or other suitable mechanical connectors.
Ensure earth electrodes intended to minimise touch voltage, to exposed-conductive-parts and extraneous-conductive-parts, in the event of a broken protective earth and neutral (PEN) conductor in the public supply network, are designed with consideration of, as a minimum, the

likely loads in the installation, the relevant network conditions, and the design guidance in IET Guidance Note 5: Protection Against Electric Shock.

310.245 SOIL CONDITIONING AGENT (Y80 2040)
Provide soil conditioning agent only where design indicates necessary
Conditioning agent to be suitable for application.

310.250 EARTH ELECTRODES FOR CATHODICALLY PROTECTED STRUCTURES: (Y80 2050)
Provide earth electrode for cathodically protected structures to BS EN 13636 for buried metallic tanks and related piping and BS EN 15112 for well casings as indicated.

310.260 EARTH ELECTRODE CLAMPS: (Y80 2060)
Connect conductor 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.
Standard BS EN 12163

310.271 EARTH ELECTRODE INSPECTION FACILITIES: (Y80 2070, 2080)
Provide enclosure for each connection between earth conductor and associated earth electrode system. Install so that top of removable inspection cover is flush with finished ground or floor level. For internal locations where the electrode passes through water retaining structure provide puddle flange and sealing gland to BS EN 62561-5 suitable for anticipated water pressure, to prevent moisture penetration and duct from enclosure to adjacent wall for conductor. Ensure enclosure provides adequate access for testing purposes. Inscribe cover with legend `EARTH'.

Provide pit details for builder's work.

After installation of electrode drain all water from pit.

Use concrete, galvanised steel embedded in concrete or polycarbonate as indicated on drawings. Cover to suitable for anticipated loading and to accept finish, where applicable.

310.272 BUILDING ELEMENTS:
Ensure reinforcing bars are in good electrical contact by welding, unless otherwise indicated on the drawings.

310.310 CIRCUIT PROTECTIVE CONDUCTORS: (Y80 2110)
Material as appropriate

Insulated cable
Use LS0H insulated single core cables or
PVC single core cables (where thermoplastic wiring systems are employed)
XLPE Single core to BS 7211.
Metallic screwed conduits (excluding flexible).
Metallic trunking with tinned copper links.
Armouring and/or metallic sheathing of armoured cables.
Armouring of armoured cables where armouring includes copper strands to improve earth conductance.
Integral conductor of multi-core cable.

Size Provide protective conductors sized in accordance with BS 7671 (IET Regulations) 543.1.4 and Table 54.7 or as indicated.

310.320 EARTHING CLAMPS:
Use clamps complying with BS 951, for bonding pipes and lead sheathed cables.

310.340 TEST LINKS: (Y80 2140)
Provide two test links, in connections between main earth conductors and earth busbar. Fabricate each from two additional sections of earth busbar. Mount one section on stand-off insulators matching earth busbar; use remaining section as removable test link. Secure 12mm high tensile brass studs to fixed sections of busbar and drill corresponding clearance holes in test links and provide brass washers, nuts and locking devices to secure frame/neutral earthing and test links.

310.350 LUGS/TAGS: (Y80 2150)

Provide lugs or tags to enable connection of bonding conductors to equipment earth terminals.

310.361 PROTECTIVE CABLE TERMINATIONS: (Y80 2160, 3030 and 3040)
For bolted connections use crimp type lugs compressed by automatic tool to achieve correct pressure and crimp depth.
Make connections between tape and equipment using high tensile grade brass bolts with brass nuts, washers and locking devices or phosphor bronze bolts, nuts and washers where connections are liable to corrosion.
Provide waterproof protection at joints subject to moisture. Joint stranded conductors with compression joints to BS EN 61238.

310.380 MAIN EARTH CONDUCTOR – WARNING TAPES: (Y80 2180)
Provide green/yellow PVC tapes labelled "EARTHING CONDUCTOR" over complete external lengths of main earth conductors at 300mm depth below finished ground.

320.000 WORKMANSHIP

320.010 INSTALLATION OF EARTHING SYSTEM:
Carry out installation of earthing system in accordance with BS 7671 (IEE Regulations), BS 7430 and BS EN 50310.

320.015 DISSIMILAR METALS: (Y80 3020)
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 following guidance when earthing and bonding connections comprise dissimilar materials.
BS 7430 Table 9.
BS EN 62368-1 Annex N.

320.020 WORK ON SITE:
Ensure that all building works are completed and service connections are provided,

320.030 QUALITY CONTROL:
Handle, store and install all equipment and components of the earthing system in accordance with the manufacturers recommendations.
Inspect all equipment and components on delivery, before fixing and after installation and reject and replace any which are defective.
Test and commission the system in accordance with BS 7430, BS 7671 and BS EN 50310 and as specified elsewhere in the scope of works. Record all test measurements.

320.040 MAIN AND SUPPLEMENTARY PROTECTIVE BONDING:
Bond to main earth terminal all extraneous-conductive-parts of the installation in accordance with BS 7430, BS 7671, BS EN 50310 and relevant parts of BS EN 50174, and BS EN 62305 as appropriate.
Ensure that any of the following services are bonded for each building or equipotential zone:-

- Water installation pipes.
- Gas installation pipes.
- Fuel oil installation pipes.
- Air ductlines.
- Heating pipework.
- Chilled water pipework.
- Exposed metallic structural parts of the building.
- Lightning protection systems
- The metallic sheath of telecommunications cables entering the building.

Connection of the lightning protection system to the protective equipotential bonding system shall be made in accordance with BS EN 62305.
The consent of the owner / operator of telecommunications services shall be obtained prior to making connections to metallic sheaths of cables.

In locations that supplementary equipotential bonding is specified bond all simultaneously-accessible exposed-conductive-parts of fixed equipment and extraneous-conductive-parts in accordance with BS 7671 as applicable.
Bond bathrooms and shower rooms to BS 7671, Section 701.
Extraneous-conductive-parts may be used as supplementary bonding conductors where they satisfy BS 7671
Bond to non-current carrying parts of electrical installation in associated spaces to BS 7430.
Use strip or stranded conductor as appropriate.
Use clamps to BS 951 for bonding of pipes.

320.060 LOW VOLTAGE SHEATHS AND ARMOUR:
Bond the sheaths and armour of low voltage cables solidly to earth at both ends unless otherwise indicated in accordance with BS 7671 and BS 7430.

320.070 METALLIC FENCING:
Bond to earth any metallic fencing enclosing earth electrical system in accordance with BS 7430.

320.080 IDENTIFICATION: (includes Y80 2170 and Y80 2190)
Ensure the function of each protective and functional earthing and bonding conductor is identifiable at its termination points.

Use an appropriate cable marking system, to mark conductors in accordance with the cable schedule.

For circuit protective conductors:

Use numbered and/or lettered plastic cable sleeves to indicate circuit numbers and phases of corresponding phase conductors.

Ensure conductors are connected to earth bar in same sequence as phase and neutral conductors.

Identify at substation, switchboard and building earth bars each protective, bonding and earthing conductor to appropriately identify the function of the conductor.
Label earth bar "SAFETY ELECTRICAL CONNECTION - DO NOT REMOVE" with wall mounted laminated plastic tablet engraved in 10mm high red letters on white ground.
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.

320.090 GENERATORS:
NA

320.100 EARTHING OF MOBILE GENERATOR:
Bond the generator frame, all exposed metalwork, underframe or chassis and all protective conductors, to BS 7430, to form common reference point. Connect generator star point to this common reference. Provide a separate connection from this reference to the load by a fifth cable core or separate single cable.

320.110 EARTHING OF LV/LV TRANSFORMERS:
NA

320.120 EARTHING OF MOBILE UNITS OR TRANSPORTABLE PLANT:
NA

320.130 EARTHING OF CONSTRUCTION SITE ELECTRICAL SYSTEMS:
NA

320.140 EARTHING OF CARAVAN PARK ELECTRICAL SYSTEMS:
NA

320.150 EARTHING OF MARINA ELECTRICAL SYSTEMS:

NA

320.155 EARTHING OF ELECTRICAL SYSTEMS FOR ONSHORE UNITS OF ELECTRICAL SHORE CONNECTIONS FOR INLAND NAVIGATION VESSELS:
NA

320.170 EARTHING OF ELECTRICAL SYSTEMS IN HAZARDOUS AREAS:
NA

320.180 OVERHEAD LINE EARTHING:
Earth overhead line plant in accordance with BS 7430 and the Electrical Safety, Quality and Continuity Regulations 2002. Do not earth or bond insulator steelwork unless so directed.

320.190 EARTHING OF PHOTOVOLTAIC (PV) SYSTEMS:
Earth PV electrical systems to BS 7671, Section 712.

320.200 EARTHING OF MEDICAL LOCATION SYSTEMS:
NA

10000 Based on NES VERSION W51 TEXT May 19 and Y80 TEXT Dec 18.

Incorporates Y80

PART 1 SYSTEM OBJECTIVES

100.010 PERFORMANCE OBJECTIVES
To provide systems for the protection of buildings, structures, towers, exposed metal work and any projection above the general roof level from lightning.

PART 3 SPECIFICATION CLAUSES SPECIFIC TO W52

300.000 GENERAL

300.010 STANDARDS:
Provide risk assessments in accordance with relevant part of BS EN 62305, state the results for Human Life, Services to the Public, Cultural Heritage and Economic Values where applicable.
Provide an external lightning protection system (LPS) in accordance with the risk assessment results and BS EN 62305 and BS 7671 (IET Wiring Regulations).
Provide an internal lighting and surge protection system (LSPS) in accordance with the risk assessment results and BS EN 62305 and BS 7671 (IET Wiring Regulations).
Provide lightning protection connection components complying with BS EN 62561-1, BS EN 62561-2 and BS EN 62561-3. Surge protection to achieve an Installation Overvoltage Category of CAT II or CAT I as appropriate to the connected equipment, in accordance with BS 7671 (IET Wiring Regulations) and BS EN 62305-3.
Provide lightning protection earthing enhancing components complying with BS EN 62561-7.
Provide lightning protection system for churches in accordance with the recommendations of the English Heritage and Ecclesiastical Insurance Group, Lightning Protection for Churches.

300.020 USE OF BUILDING ELEMENTS:
Ensure that building and structural elements used as items in or bonded to the lightning protection system are designed and erected in accordance with BS EN 62305 as well as their appropriate constructional specification or code of practice. Ensure that all connections to building and structural elements are waterproof and corrosion protected to a degree appropriate to their exposure. Use BS EN 62305-3 Annex E as a code of practice for the design and construction of the LPS.
Where building structural and/or foundation steelwork are to be used as lightning current conduction paths, the electrical continuity, EMC separation distance and cross-section area of the element shall meet the requirements of BS EN 62305.

300.030 LIGHTNING AND SURGE PROTECTION SPECIALIST:
Engage a specialist to carry out the design, installation, testing and commissioning of the lightning and surge protection system (LSPS). Refer to scope of work for detail requirements.

300.040 APPROVALS:
Where applicable obtain the approval of all authorities concerned for the installation of the lightning and surge protection system. Comply with the regulations of all concerned authorities for the installation and connection of public utility services to a common earth termination network, comply with agreements made with bodies concerned with adequate separation distance from other services connected to a common earth termination network.

300.050 REGULATIONS AND AGREEMENTS
Comply with the regulations of all concerned authorities for the installation and connection of public utility services to a common earth termination network, comply with agreements made with bodies concerned with adequate separation distance from other services connected to a common earth termination network.
For telecommunication services comply with relevant part of BS EN 50174

300.060 EARTHED EQUIPOTENTIAL BONDING OF SERVICES:
Provide Earthed Equipotential bond for relevant metallic services in or on the structures in accordance with BS 7671 and BS EN 62305-1, BS EN 62305-3 and as indicated in the Schedules and Drawings.

300.070 PROTECTION OF ELECTRONIC EQUIPMENT:

W52 – Lightning and Surge Protection

Protect electronic equipment against lightning induced EMC and over-voltage surges in accordance with BS 7671 and relevant parts of BS EN 62305.

300.110 EXISTING INSTALLATIONS:
Check soil resistivity and earth electrode resistance of existing installation. Report defects and elements not in accordance with BS EN 62305 before connecting new or modified installations.

310.000 PRODUCTS/MATERIALS

310.001 MATERIALS GENERALLY:
Use materials and installation methods in accordance with BS EN 62305, BS 7671, and BS 7430.

Conductors shall be annealed copper strip (unless specified otherwise) or hard drawn copper rod, unless specified otherwise.

310.005 AIR TERMINATIONS: (Y80.2010A)
Standard BS EN IEC 62561-2 (other than natural conductors)
Horizontal or self-supporting air terminations, material, type (strip or rod) and covering as indicated on drawings.
Where appropriate use building elements (natural conductors) as part of the air termination in accordance with BS EN 62305-1, BS EN 62305-3, and BS EN 62305-4.

310.006 DOWN CONDUCTORS:
Standard BS EN IEC 62561-2 (other than natural conductors)
Materials as indicated on drawings.
Where appropriate use building elements (natural conductors) as down conductors, main terminations in accordance with BS EN 62305-1, BS EN 62305-3, with non-ferrous bonding points built as Figure E.7 for reinforcing bars.
Ensure reinforcing bars are in good electrical contact by welding, unless otherwise indicated on the drawings.

310.007 TAPE FIXING DEVICES: (Y80.2030A)
Standard BS EN 62561-4 for lighting protection system conductor fasteners.
Secure lightning protection tape to structure with corrosion resistant proprietary fixing devices which avoid piercing tape and ensure 3mm (minimum) clearance of tape from structure.
Space fixing 450 mm max on vertical conductors, 1,000 mm horizontally.
Material for lightning protection systems - non-conducting.
Material for system earthing - bronze

310.008 CONDUCTOR JOINTS: (Y80.2020, 3030, 3040)
Standard BS EN 62561-1
Provide waterproof protection at joints subject to moisture.
Joint copper tapes by
tinning before assembly and riveting with two minimum copper rivets. Overlap straight joints by length equivalent to twice (minimum) tape width. Overlap both sides of main tape at tee joints or
naval brass bolts or copper rivets (two minimum) and sweat solid whole joint or
Brazing, using zinc-free brazing metal with melting point at least 600^{o}C or
Thermic welding or Cold pressure welding.
Dimensions - To BS EN IEC 62561-2 minimum for lightning protection system
Joint aluminium tapes by
Welding to BS EN 1011-4.
Joint circular rods as tapes using through coupler.
Joint stranded conductors with compression joints to BS EN 61238.
For bolted connections use crimp type lugs compressed by automatic tool to achieve correct pressure and crimp depth.
Use phosphor bronze bolts, nuts and washers to make connections between conductors and equipment.

310.011 TEST JOINTS: (Y80.2020)

Standards - BS 7671, BS EN 62561-1, relevant parts of BS EN 62305

Provide test joint at each down conductor readily accessible from ground level.

Use proprietary components of cast gun-metal with phosphor-bronze bolts, nuts and washers.

310.012 EARTH ELECTRODES: (Y80 2040)

Standards - BS 7430, relevant parts of BS EN 62305, BS EN IEC 62561-2 and BS 7671 (IET Wiring Regulations) as appropriate to the particular specification. Form - Roll threaded rod.

Earth electrodes in draw pits

Provide concrete cover, permanently labeled, for electrodes installed through cable drawpit bases.

Material, minimum size as BS EN 62561-2

Molecularly bonded copper clad steel rods to BS EN IEC 62561-2.

Accessories

Rod to tape clamp or U-bolt clamp. Accessories sized to suit earth rod and connector.

Rods

Use high tensile strength steel cored molecularly bonded copper sheathed rods to BS EN 62561-2 with threads rolled on to rods. Sheath thickness 0.25mm (minimum).

Rod Diameter 15 mm - nominal.

Earth electrode couplings

Use silicon bronze alloy, counter bored to completely enclose rod threads. Ensure rods meet in centres of coupling.

Use high strength driving cap in contact with driven rod and couplings of compatible material fully enclosing the rod threads.

Earth electrode tape

Interconnect electrodes using 25x3mm bare copper tape or stranded copper cables.

Location

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

Locate electrodes as indicated on drawings.

Driving

Drive rods vertically into ground with purpose designed electric hammer. (Where impenetrable strata encountered at shallow depth, drive at 30° to horizontal).

Depth of rod 2.4m (2 x 1.2) minimum below finished ground surface.

Depth of Electrode heads

Locate electrode heads just below ground level.

Spacing

Where electrodes are installed in a group ensure minimum distance between electrodes is twice depth of rods. Where rods for 'clean' earth are installed ensure distance from any other system rods is six times depth of 'clean' rods.

Tape Depth

Install interconnecting tape 750mm below finished ground level, rising vertically at each electrode unless ground conditions dictate otherwise.

General

Ensure that materials and dimensions of earth electrodes have adequate mechanical strength and are selected to withstand corrosion such that the mechanical integrity of the structural element is not impaired, and the possible increase in earth electrode resistance is minimised.

Where an earth electrode consists of parts that must be connected together, ensure connections are made by welding, pressure connectors, clamps or other suitable mechanical connectors.

Ensure earth electrodes intended to minimise touch voltage, to exposed-conductive-parts and extraneous-conductive-parts, in the event of a broken protective earth and neutral (PEN) conductor in the public supply network, are designed with consideration of, as a minimum, the likely loads in the installation, the relevant network conditions, and the design guidance in IET Guidance Note 5: Protection Against Electric Shock.

310.013 EARTH ELECTRODE CLAMPS: (Y80 2060)

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 BS EN 12163.

310.014 EARTH ELECTRODE INSPECTION FACILITIES: (Y80 2070, 2080)
Standard BS EN 62561-5
Provide enclosure for each connection between down conductor and earth electrode. Install so that top of removable inspection cover is flush with finished ground level. For internal locations where the electrode passes through water retaining structure provide puddle flange and sealing gland to BS EN 62561-5 suitable for anticipated water pressure, to prevent moisture penetration and duct from enclosure to adjacent wall for conductor. Ensure enclosure provides adequate access for testing purposes. Inscribe cover with legend `Lightning Protection Earth'

Provide pit details for builder's work.

After installation of electrode drain all water from pit.

Use concrete, galvanised steel embedded in concrete or polycarbonate as indicated on drawings. Cover to suitable for anticipated loading and to accept finish, where applicable.

310.015 SOIL CONDITIONING AGENT (Y80 2040)
Provide soil conditioning agent only where design indicates necessary.
Conditioning agent to be suitable for application.

310.021 BUILDING ELEMENTS:
Use building elements as natural conductors in accordance with BS 7671 and BS EN 62305-3 using Annex E as a code of practice for design, construction and test.
Ensure reinforcing bars are in good electrical contact by welding, unless otherwise indicated on the drawings.

310.031 LIGHTNING PROTECTION SYSTEM BONDS:
Standard BS EN 62561-1
Provide bonds between lightning protection conductors and building elements, exposed structural steelwork, and external plant using corrosion resistant proprietary components and fixings.

310.041 DECORATIVE FINIALS:
Provide proprietary solid copper air terminals with cast gun-metal terminal base or purpose made finial as drawings.

310.051 SURGE PROTECTION DEVICES:
Standard BS EN 62305.
Enclosure protection BS EN 60529, IP31 for internal applications and IP54 externally.
Protect equipment against the risk of permanent failures or damage due to surges by considering the withstand voltage Uw as defined by BS EN 60664-1 (see BS 7671 Table 443.2)
Standard - PD IEC/PAS 60099-7, DD CLC/TS 50539-22 and BS EN 61643-11.
Selection method DD C LC/TS 50539-22, DD CLC/TS 61643-12.
Select SPD type and association protective devices in accordance with BS 7671 (IET Wiring Regulations)
Refer to scope of works for – System earthing type, location category, system exposure, transient performance, passive state performance and other details.
Classification of SPD to DD CLC/TS 50539-22, BS EN 61643-11

320.000 WORKMANSHIP

320.010 INSTALLATION:
Install the lightning and where applicable the surge protection system and its element in accordance with the manufacturers recommendations and BS EN 62305, BS 7671 (IET Wiring Regulations) and the earthing and bonding elements to BS 7671 and BS 7430.
In churches install in accordance with recommendations in the English Heritage and Ecclesiastical Insurance Group, Lightning Protection for Churches.
Health
320.016 DISSIMILAR METALS: (Y80.3020)
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 9 and BS EN 62368-1 Annex N when bonding dissimilar materials.

320.020 WORK ON SITE:
Ensure that all building works are completed and service connections are provided.

320.030 QUALITY CONTROL:
Handle, store and install all equipment and components of the lightning protection system in accordance with the manufacturers' recommendations and BS EN 62305, BS 7430, BS 7671 and appropriate parts of BS EN 62561.
Inspect all equipment and components on delivery, before fixing and after installation and reject and replace any which are defective.
Test and commission the system in accordance with BS EN 62305 BS 7430, BS 7671 and as specified.
Record all test measurements.

320.040 EARTHED EQUIPOTENTIAL BONDING:
Bond or isolate building structural elements and metallic services as BS EN 62305, BS 7430 and BS 7671.
Refer to scope of works and drawings for further details.

320.050 LABELLING:
Provide and fix system labels as required by BS EN 62305, BS 7671, BS 7430 and relevant parts of BS EN 50174 (IT cabling installation).

320.055 SURGE PROTECTION DEVICES:
Install surge protection devices in accordance with BS 7671, BS EN 50174, DD CLC/TS 50539-22 and BS EN 61643-11 and the manufacturer's recommendations.

320.056 RESIDUAL CURRENT DEVICES:
Install residual current devices suitably coordinated with surge protection devices in accordance with BS 7671, BS EN 50174, DD CLC/TS 50539-22 and BS EN 616143-11 and the manufacturer's recommendations to avoid nuisance tripping.

320.060 INSTALLATION RECORDS:
Prepare system records to BS EN 62305, BS EN 50174 and BS 7430 including the following items:

- As installed drawings detailing:-
- Nature of soil
- Earth resistivity measurement.
- Earth electrode resistance.
- Details of earth electrodes and lightning earth termination network

320.070 MAINTENANCE:
The Lightning and surge protection system (LSPS) shall be designed and installed with ease of carrying out maintenance - test points and access to lightning and earthing elements should be provided.
Carry out maintenance as required by BS EN 62305 for the defects liability period and provide proposal for continuing maintenance

10000 NES VERSION W52 and Y80 TEXT Dec 18.

W70 – Structured Cabling System

PART 1SYSTEM OBJECTIVES

NA

Y60 – Conduit & Cable Trunking

1010 STANDARDS / GENERAL:

Provide conduit and cable trunking in accordance with the relevant British Standards and in particular the requirements of BS 7671 Requirements for Electrical Installations (The IET Wiring Regulations).

Any conduit or trunking must support the function of the cabling system and provide protection, adequate separation distance and presentation as required by the cabling and EMC design.

1012 TRUNKING LAYOUT

Set out cable trunking as indicated on the drawings, making due allowance for any diagrammatic presentation. Provide all necessary offsets, bends, tapers, transformation pieces etc. required as trunking manufacturers standard accessories whether or not these are detailed.

2000 PRODUCTS/MATERIALS

2011 CONDUITS:

Use surface conduit or conduit concealed in building finishes as described in the Work Sections, Schedules or shown on the drawings. Minimum size of conduit shall be 20mm unless otherwise indicated.

Comply with relevant parts of BS EN 61386 including parts 1, 21, 22, and 23 as appropriate.

Buried conduit systems to BS EN 61386-24.

Use conduit from one manufacturer throughout. Use fittings to match conduit grade and finish.

For metal conduit use solid couplers to join lengths of conduit up to 25mm diameter, use oblong 'draw in' boxes to join lengths of conduit of 32mm, 1 1/2" and 2" diameter.

Electrical characteristics for metal conduit shall be electrical continuous.

For plastic conduit do not use slip joints, use expansion couplings where required.

Electrical characteristics for non-metallic conduit shall be electrical insulating.

Temperature classification of conduits shall be -5°+60°C

Conduits shall be non-flame propagating.

Resistance against ingress of water and solid foreign bodies shall be rated to BS EN 60529. minimum IP 31 for indoor use, IP65 for exterior.

2051 CONDUIT FITTINGS AND ADAPTABLE BOXES-METALLIC

For metal conduit use malleable iron conduit fittings, for external areas use malleable iron adaptable boxes and for internal areas use steel adaptable boxes.

Do not use factory made bends, inspection bends or inspection couplers except with 32 mm, 1½" and 2" conduits. Ensure fittings are same class and finish as associated conduit system. Supply covers for circular or adaptable boxes in the same material and finish as boxes. Use steel dome or cheese headed screws to secure covers for Class 2 finish. Use brass dome or cheese headed screws to secure covers with rubber gaskets for Class 4 finish. Limit number of entry holes within loop-in boxes to four.

The minimum size of an adaptable box shall be 100 mm x 100 mm x 50 mm.

Connections use couplers and externally screwed brass bushes to connect conduit to loop-in circular conduit boxes, switchgear, distribution boards, and adaptable boxes. Use flanged couplers with washers.

2061 CONDUIT FITTINGS AND ADAPTABLE BOXES - INSULATING :

Do not use factory made bends, inspection bends or inspection couplers. Use boxes and connections to suit size of conduit and method of jointing. Use heavy gauge, high impact rigid PVC conduit fittings.

Provide all boxes for supporting luminaires or other heavy devices with metal brackets or insert clips to provide a support independent of the box. Provide boxes for flexible conduit, accessories and luminaire connection with a brass earthing terminal and/or steel circular earthing ring.

2080 CABLE TRUNKING AND FITTINGS:

Comply with relevant parts of BS EN 50085. Use trunking of each type from one manufacturer.

2091 METAL SURFACE TRUNKING:

Type / finish – as scheduled

Steel Trunking - Comply with relevant parts of BS EN 50085

Extruded aluminium - Comply with relevant parts of BS EN 50085

Supply partitions and covers same material as trunking. Use trunking manufactured with inward return edge flanges and fitted with flange couplers which ensure that when the cover is removed a minimum of 80% of the nominal trunking or compartment width is available for access.

Resistance against ingress of water and solid foreign bodies shall be rating IP31 to BS EN 60529 for internal use.

Colour to be Manufacturers standard or to BS 4800 standard as scheduled.

Electroplated zinc having a minimum thickness of zinc coating of 0.0012mm inside and outside with additional coating of stoved or air drying paint, applied at least to the external surface.
Hot dip zinc coated steel to BS EN BS EN 10346 or BS EN 10143.

Fixings

Use purpose made brackets to fix to structural steel or suspension rods. Provide external fixing lugs where specified protection for the installation is IP44 or greater.

Fittings

Use bends, tees and angles of similar gauge, type and finish as trunking body and supplied by same manufacturer. Use standard fittings where possible. Where site fabricated fittings are necessary ensure they are comparable in construction and finish with system. Obtain prior approval in writing before site fabricating any fittings or special accessories.

Partitions and Covers

Ensure partitions are electrically continuous with the body of the trunking or provide a connector for a circuit protective conductor. Ensure gap between partitions and lids maintains segregation of circuits.

Joints

Use purpose made jointing pieces fixed with screws into captive nuts. Ensure screws do not protrude through the nuts. Ensure rigidity of trunking is maintained across joint. Ensure external dimensions of trunking are maintained and not reduced by more than 4% across joints between trunking lengths and/or fittings. Use purpose made fittings of the same manufacture where trunking connects to switchgear and distribution boards.

Provide flanges for connection of flush floor trunking to vertical trunking to maintain the cross sectional area of compartments with 50 mm minimum radius.

Maintain electrical continuity at each joint by a copper link, (tinned copper for galvanized trunking), fixed on outside of trunking, secured by screws, nuts and shake proof washers. Screws must not project through the nut. Make provision for continuity to be achieved without need to remove paint from ferrous metal where trunking has a painted finish.

Screws, Nuts, Washers

Do not use self-tapping screws. Use cheese or round head screws except where provision is made for the use of counter-sunk heads. Screws, nuts and washers to be made of brass or steel zinc coated to BS 7371-3 or BS 7371-6

Cable supports

Provide horizontal trunking with removable cable retainers or bridges to retain cables in situ. Provide vertical trunking with pin racks to support cables at 3000 mm maximum spacing. Use insulated pins or insulation sleeved pins on pin racks.

Lighting Trunking Cover
Provide cover strip to prevent ingress of foreign materials, locate cabling in place and act as closure strips between luminaires. Use trunking cover strip clipped into place in trunking body. The Cover strip is to match lighting trunking body or high quality colourfast extruded plastic as scheduled. Colour and shade to BS 4800 as indicated.

2101 FLUSH FLOOR STEEL TRUNKING:
NA

2102 UNDERFLOOR STEEL TRUNKING

Trunking material Sheet steel trunking to BS 4678- 2, gauge of metal - relevant parts of BS EN 50085.

Degree of Protection Class 3.

Provide flanges for connection of vertical trunking and temporary blanking plates.

Unless specified otherwise, trunking shall be manufactured from 1.5mm minimum thickness body sections with 3mm double thickness walls and 3mm lid section.

The trunking body shall be provided with a return flange to facilitate fixings and 'key' the trunking into the screed.

All bends, tees, intersection and other accessories shall be factory manufactured and finished by the trunking manufacturer. All bends shall be of the accessible type unless specified otherwise. Accessories shall be of a similar construction and finish to the main trunking.

Trunking joints shall be provided with a saddle type coupler to prevent the ingress of screed, which shall screw fix to the base flange each side of the joint.

All bends, tees, intersections and service outlet boxes shall be of the dimensions and type specified, the depth of the box shall suit the minimum screed depth. The boxes shall be provided with an adjustable frame and recessed lid (suitable to accept floor finish). Lids shall be manufactured from 1.5 mm minimum gauge zinc coated steel and comprise of a pan plate forming the recess for the finish with a welded re-enforcing plate. Lids at service outlet boxes shall be hinged and lids at bends, tees and intersections shall be screw fixed with screws located in the corners of lids. At trunking connections a 'spout' coupler shall be provided which shall screw fix to the trunking body.

Boxes and frames / lids shall be supplied separately and all boxes shall be fitted with a blank plate to prevent ingress of screed during installation.

Rising bends shall be provided with an 50mm internal radius or gusset.

2103 SKIRTING AND DADO TRUNKING (STEEL)
NA

2111 SERVICE OUTLET BOXES:
Provide service outlet boxes and junction boxes constructed from sheet steel with same finish as trunking. Maintain continuity and segregation of compartments through boxes and fit flyovers where necessary. Provide service outlet boxes with separate and segregated access to outlets associated with each wiring compartment. Fit cable guard or grommet to each section. Incorporate spigots or adaptors on boxes for connection to trunking or conduit as appropriate. Make frames adjustable on each corner, recess lids as indicated. Manufacture frame and lids for service outlet boxes and junction boxes and suitable to accept type of floor covering specified.

Provide outlet plates for each low voltage compartment equipped as indicated on the drawings.
Provide outlet plates for each information technology compartment that ensures the IT compartment and its outlet plate conform to the requirements of relevant parts of BS EN 50174 and of the IT system installer.
Provide blank outlet plates for any unused compartments.

2121 SERVICE POWER POLES:

NA

2131 SURFACE TRUNKING OF INSULATING MATERIALS:

Trunking to relevant parts of BS EN 50085. Material as indicated.
Material – as scheduled or described in scope of works or on drawings
Mechanical properties - trunking for medium mechanical stress.
Minimum storage and transportation temperature, minimum installation and application temperature and maximum application temperature - BS EN 50085-1, Tables 1-3
Electrical characteristics shall be electrical insulating.
Resistance to ingress of water and solid objects shall be minimum rating IP31 to BS EN 60529 for internal use.
Resistance against corrosive or polluting substances - medium protection.
Trunking shall be Non flame propagating.
Fittings

Use fittings from same manufacturer of trunking.
Use `snap-on' covers.
Use trunking fittings and accessories suitable for jointing by solvent welding.
Use proprietary cable retaining clips at 500 mm maximum intervals on trunking that exceeds 1.8 m in length. Where junctions occur ensure first clip is not more than 300 mm from junctions.

2141 UNDERFLOOR TRUNKING OF INSULATING MATERIALS:

Material Heavy gauge, PVC trunking to relevant parts of BS EN 50085.
Minimum storage and transportation temperature, minimum installation and application temperature and maximum application temperature - BS EN 50085-1, Tables 1-3

2151 SEPARATE OR MULTI-COMPARTMENT TRUNKING:

Use separate trunking or multi-compartment trunking for segregation of services. Ensure steel partitions have a provision for connecting a circuit protective conductor.

Provide separation of wiring as required by BS 7671 and the following:
low voltage circuits.
extra low voltage circuits.
communications/data.
emergency lighting.
fire alarm circuits.
incoming telephone circuits supplied by others.

2171 SUPPORTS AND FIXINGS:

Provide proprietary suspension systems comprising channel sections with return lips and compatible fixing accessories of materials to BS EN 10162 or BS EN 10210 and/or slotted angles to BS 4345.
Ensure support components for Class 4 conduit have the same finish method as the conduit carried out after manufacture. Ensure components in direct contact with conduit match profile of conduit.

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 after manufacture. Do not use metal fixing components likely to deteriorate and/or cause damage through electrolytic action.

2176 WIRE ROPE SUSPENSION SYSTEM:

Where specified within the Scope of Works or Schedules, use proprietary Wire Rope Suspensions Systems which comply with BS EN 12385-1, BS EN 13411-3, BS EN 13411-4, DIN 3093, and BSRIA COP 22/2002. Wire Rope Suspensions to be suitable for the safe working load and comprise Stainless Steel grade 316 wire rope, Stainless steel grade 302 Spring fasters with fixings by loops, stud (permanently fixed to wire rope length) or toggle as appropriate. The installation shall comply with BSRIA COP 22/2002 and 'solid' stud type suspensions shall be provided at maximum spacing of 20m, with a minimum of one in any straight run.

3000 WORKMANSHIP

3011 GENERAL:

Ensure entire system is electrically and/or mechanically continuous, to BS 7671.

Fire barriers

Comply with the requirements of BS 7671 wherever the conduit or trunking passes through the perimeter of a fire compartment (wall, floor or ceiling).
Install all fire stopping systems in accordance with the manufacturer's written instructions.
Install and inspect fire stopping systems in accordance with Building Regulations and ASFP Code of Practice TGD 17.

Appearance

Arrange conduit, trunking and ducting to present neat appearance, parallel with other service runs and lines of building construction, except where in screed or in-situ concrete. Ensure plumb vertical runs.

Cable installation

Install cable in conduit, trunking or equipment enclosures only when completely erected throughout its length.
Do not use framework of partitions or similar unless indicated.

Building expansion and settlement

Make provision in conduit and trunking at expansion and settlement joints to allow for movement of building structure. Provide circular through or adaptable boxes no more than 300 mm either side of expansion or settlement joints for conduit crossing. Join boxes with flexible steel conduit.

Quality

Cut conduit clean and square with axis. Remove any burrs prior to erection. Site form 90o in conduit wherever practical or use circular or adaptable boxes. Construct bends and sets cold with a bending machine. Do not apply heat when forming sets or bends. Use bending tools complying with British Standards appropriate to conduit material. Ensure no indentation or reduction in cross sectional area occurs during installation. Use correct tools to assemble conduit. Ensure no tool marks or damage to components occurs.

3021 LAYOUT:

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 manufacturer's recommendations, BS 7671 (IET Wiring Regulations), and latest edition of Guidance Note 1 Selection and Erection published by the IET.

3031 SPACING:

Install conduit, trunking and equipment clear of other services. Measure distance from external surface of any thermal insulation. Notify instances where minimum clearance cannot be achieved and bond items concerned.
Minimum general spacings between conduits, trunking and equipment and
insulated steam services - 300 mm.
other services excluding steam - 150 mm.
above central heating radiators - 1000 mm.

Ensure separation is in accordance with manufacturer's recommendations, BS 7671 (IET Wiring Regulations), latest edition of Guidance Note 1 Selection and Erection published by the IET and relevant parts of BS EN 50174 for InformationTechnology cabling installation.

3040 CONDENSATION PREVENTION:

Install conduit and trunking systems to ensure internal condensation does not affect operation of associated circuits. Provide drainage points in accordance with BS 7671.
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.

3051 PROTECTION AND REPAIR OF STEEL COMPONENTS:

Paint joints of conduit and minor damages to finish of conduit and trunking, including metal support systems, immediately after erection or after damage occurs.
Use paint compatible with finish as follows:-
For galvanised finish, use two coats zinc rich paint.
For black enamelled finish, use two coats of good quality, air drying, black enamel paint.
Remove grease, oil, dirt and rust before applying protective paint.
Notify serious damage and repair or replace as instructed.

3060 EQUIPMENT CONNECTIONS:

Where surface mounted equipment is installed in conjunction with concealed conduit work, terminate concealed conduit at flush mounted conduit or adaptable box. Drill back of equipment, bush for back entry and mount equipment to conceal back box.
Connect to fixed equipment via conduit box located adjacent to termination point, using either solid or flexible conduit as indicated for final connection to equipment terminations.
Use conduit box as cable change point to facilitate changed wiring locally to adjacent equipment.
Connect trunking to equipment by specially fabricated connectors or by couplers and externally screwed brass bushes.

3070 CLEANING BEFORE WIRING:

Clean inside of conduits and trunking with swabs immediately before wiring.

Inspect all components and remove any foreign matter, fit temporary plugs to open ends of conduit and trunking to prevent ingress of water and solid material.

3081 WIRING:

Comply with BS 7671 when wiring installations. Segregate circuits as indicated.
Ensure draw wires are left within empty conduits for use of specialist installers. Use draw wires comprising galvanized soft iron wires or nylon tapes with fitted eyelets.

For concealed conduit ensure system is installed to enable re-wiring to be carried out from boxes for fittings or accessories only. Draw-in boxes will only be permitted with prior permission in writing.
Do not use tallow or any other substances to facilitate drawing-in of cables.

3090 BUILDERSWORK:

Ensure conduit is not concealed until work has been inspected and approved.
Obtain permission before horizontally chasing walls.
Ensure that conduit and fittings buried in concrete or behind plaster are protected against corrosion or electrolytic action prior to rendering.
Ensure conduit concealed in wall chases is covered by plaster and/or rendering to minimum depth of 12 mm.

4000 WORKMANSHIP FOR CONDUIT

4010 DRAW-IN BOXES:

Provide draw-in boxes in conduit at maximum intervals of 10 metres or after bends and/or sets totalling 180 degrees.

4020 INSTALLATION OF CAST IN OR BURIED CONDUIT:

Ensure cast-in conduits are firmly secured to reinforcing steelwork and that accessory and/or conduit boxes are secured so they do not move during subsequent building operations.

Ensure there is no blockage immediately shuttering is removed. Check there is no mechanical damage to conduit in floor screed prior to screeding. Fix securely before screed is poured. Provide temporary protection to conduits until screeds are laid. Ensure minimum amount of cross-overs occur dependent upon screed depth. Do not install draw boxes in floors.

Do not install conduits in screeds in areas indicated, within site blinding or in main structural slabs unless prior permission in writing is obtained.

4030 CONDUIT BOXES:

Ensure that wherever conduit boxes are cast in, the face of the box is flush with the face of the concrete or plaster. Fit circular conduit boxes with extension rings to ensure a flush face with plaster or concrete or where terminal blocks are to be accommodated.

Ensure fixing holes are countersunk where material thickness allows or use round head screws to prevent damage to cables and remove burrs before cables are drawn in. Use a minimum of two screw fixing for standard circular conduit boxes and four screws for large conduit boxes and adaptable boxes up to 150 mm x 100 mm. Use back outlet boxes where surface conduits pass through walls, to outside accessories or lighting points.

Secure switch boxes and socket boxes using countersunk steel screws where provision is made for them or if not use round head screws, along with plug inserts. Recessed boxes shall be finally grout in position prior to plastering or screeding.

4040 FIXING CONDUIT:

Support conduit in accordance with manufacturer's recommendations, BS 7671 (IET Wiring Regulations), and latest edition of Guidance Note 1 Selection and Erection published by the IET. . Ensure conduit is not under mechanical stress. Fix conduit boxes independently of conduit. Make allowance for any additional mechanical loading supported by conduit boxes. Where protection is specified as IP44 or greater ensure fixings of conduit boxes are suitable to maintain degree of protection.

Use following methods of fixing conduit:-

LOCATION	TYPE OF FIXING
Floor screeds	Saddles or crampets
Buried in plaster or render	Saddles or crampets
Above false ceilings	Saddles
Surface	Saddles

4050 FLEXIBLE AND PLIABLE CONDUIT:

Use flexible 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. Use sufficient length between equipment and circular through box at end of conduit run (minimum 450 mm) to allow necessary full range of withdrawal, adjustment or movement.

Use solid type adapters to terminate flexible conduit. Use PVC covered flexible conduit where installed externally, exposed to weather or in any position where ingress of moisture or condensation may occur.

4060 SCREWED STEEL CONDUIT:

Use materials clean and free from defects, rust, scale and oil. Obtain prior permission in writing for use of materials subject to remedial work before erection. Repair any damage caused by threading, bending or erection by painting with zinc rich paint before any rust occurs.

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. Use lubricant when cutting threads.

Use minimum number of running couplings
For running couplings in Class 2 conduit, use coupler and locknut. Paint exposed thread with zinc rich paint.
For running couplings in Class 4 conduit, use three piece conduit unions.

4070 NON-METALLIC CONDUIT:

Comply with manufacturer's instructions for bending, setting and jointing of conduit.
Use plastic conduit only where indicated. Do not install conduit when ambient working temperature is or will be below -5°C or above 60°C.
Use solvents recommended by manufacturer of conduit when using solvent welded joints and ensure spigots enter full depth of sockets. Hold joints rigid and in position until weld sets. Remove excess solvent before surface damage occurs.
Use slip joints as necessary, but not exceeding 6 metres on straight lengths to allow for expansion and contraction over temperature variation as indicated. Use semi-mastic adhesive where expansion joints are formed.
Where fitments do not have shaped or smooth conduit entries connect with male bushes and external couplings. Ensure special care is taken to prevent mechanical damage or warping to conduit where mechanical loads are imposed on conduit system, e.g. lighting fittings.

4080 UNDERGROUND INSTALLATION:

Where 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.

5000 WORKMANSHIP FOR TRUNKING

5010 MANUFACTURE OF TRUNKING:

Take measurements on site before producing drawings for manufacture of trunking.

5020 ACCESS:

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.

5031 FIXING TRUNKING:

Ensure trunking is independently fixed and supported from building fabric. Obtain approval for proposed fixings/supports.
Support trunking in accordance with manufacturer’s recommendations, BS 7671 (IET Wiring Regulations), and latest edition of Guidance Note 1 Selection and Erection published by the IET. Use two fixings minimum at intervals, not exceeding 800mm or 225 mm from accessories, which shall be independently fixed.

5041 STEEL TRUNKING:

Install steel trunking in accordance with the manufacturers requirements and those of BS 7671. 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.

Use folding bars when bending trunking fabric to site form junctions and angles. Ensure corners are neat and metal on either side of corners is not distorted. Do not form flanges by cutting or bending trunking material.
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.

5051 UNDERFLOOR AND FLUSH FLOOR TRUNKING INSTALLATION:

Trunking shall be cut to length by the manufacturer where possible, however, site cutting by the Electrical Trade Contractor may be necessary to suit site installation conditions (using a bench mounted saw / disc, to ensure a square cut). Trunking lengths and accessories shall be provided complete with coupling pieces and aluminium earth links.

Lay underfloor and flush floor trunking straight and level, flush floor trunkings shall be laid on a levelling screed. Adjust height of services outlets, junction boxes and flush floor trunking to suit top of screed level. Ensure that spaces below trunking are free from voids and correctly packed. Prevent ingress of screed by masking where necessary.
Ensure trunking levelling and alignment is carried out in co-operation with person(s) responsible for confirming location and finish of floor levels.
Immediately following installation of trunking fit temporary covers to service outlets, junction boxes and flush floor trunking, joints between lids, and lids and body shall be sealed by an approved tape. Fit temporary blanking plates over open connections to vertical trunking. Retain temporary covers until permanent covers are installed.
At trunking ends a suitable end cap shall be provided.

Trunkings shall be thoroughly cleaned of steel and brass particles and swabbed through prior to the installation of cables.
Ensure underfloor trunking systems are fully rewirable to final circuit outlets.
Connect conduits only at inspection or other easy access points.

5052 SKIRTING AND DADO TRUNKING

Skirting trunking shall be cut to length by the manufacturer where possible, however site cutting by the Electrical Sub Contractor may be necessary to suit site installation conditions conditions (using a bench mounted saw / disc, to ensure a square cut).. Trunking lengths and accessories shall be provided completed with coupling pieces and tinned copper earth links.
The trunking body shall be placed direct onto the wall and fixed into place with roundhead screws at top and bottom at regular intervals not exceeding 800mm or 225mm from accessories which shall be independently fixed.
Prior to wall and floor finishes outlet plates shall be fitted with blanking plates. On completion of the finishes the blank plates shall be removed and the accessories (i.e. socket) fitted.
At trunking ends a suitable end cap shall be provided.
The trunking shall be thoroughly cleaned of steel and brass particles and swabbed through prior to the installation of cables.

5060 TRUNKING OF INSULATING MATERIAL:

Comply with manufacturer's instructions. Do not install trunking where ambient temperature is below -5^{o}C or working temperature is above 60^{o}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.

Y60 – Conduit & Cable Trunking

10000 NES Y60 TEXT Dec 19

1011 CABLE MANUFACTURER / CABLES CERTIFICATION:

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, fire classification to BS EN 50575 and BS EN 13501-6, length, grade and date of manufacture.

Ensure all cables are certified in accordance with the Construction Products Regulation (CPR) as required by BS 7671 (IET Wiring Regulations) and BS 6701. (Applicable to all 2000 series Products /Materials clauses)

For power and auxiliary cables, and other cables outside the scope of BS 6701

Ensure all cables meet at least either BS EN 60332-1-2 or BS EN 13501-6 EuroClass E_{ca}, or higher rating as indicated on the relevant cable schedule

Ensure cables to be installed where the risk of flame propagation is high (for example, cables that are bunched or are used in long vertical runs), or in a fire propagating structure, or run in a fire segregated compartment, meet at least either BS EN 60332-1-2 plus the relevant part of the BS EN 60332-3 series, or BS EN 13501-6 EuroClass D_{ca}, or higher rating as indicated on the relevant cable schedule.

Ensure cables encroaching on or run in escape routes meet at least either BS EN 13501-6 EuroClass D_{ca-s2}, or the relevant part of BS EN 60332-3 series plus achieve at least 60 % light transmittance when tested to BS EN 61034-2, or higher rating as indicated on the relevant cable schedule.

For telecommunications, information technology, communications and similar cables

Ensure all cables within the scope of BS 6701 and BS EN 50575 meet BS EN 13501-6 EuroClass E_{ca}, or the requirements of BS EN 60332-1-2, except for cables intended for installation into pathways that are hidden below floors, behind walls, or to which access is limited, which are to meet at least BS EN 13501-6 EuroClass C_{ca}-s1b,d2,a2.

All power cables shall have an independent CENELEC cable certification by the designated body for the country of manufacture to confirm their compliance with Harmonised Standards, British Approvals Service for Electric Cables (BASEC) is the preferred designated body, alternatively fire rated cables may be certified by the LPCB.

1020 CABLE CERTIFICATION MARKING:

Mark all types of power cable with CENELEC cable certification marking or if included in British Approvals Service for Cables (BASEC) in accordance with BASEC Regulations.

1031 CABLE RECORDS:

Keep records of cable drum numbers and supporting information, mark information on record drawings, indicating precise location of each length of cable, and submit copies of manufacturer's cable test certificate.

1032 CABLE DESCRIPTIONS IN SCHEDULES

See Y61 Schedules for particular requirements of cables.

2000 PRODUCTS/MATERIALS

2005 LSOH SHEATHING:

Supply cables with Low Smoke Zero Halogen (LSOH) sheathing, tested in accordance with relevant parts of BS EN 60754 (parts 1 and 2) and relevant parts of BS EDN IEC 60332 and BS EN 60332.

2011 FLEXIBLE MULTI-CORE CABLES AND INDUSTRIAL CABLES:

All flexible cables and industrial cables shall have copper conductors and be rated at 300/500V for single phase and standard duty applications and 450/750V for three phase and industrial/heavy duty applications, unless otherwise indicated. Performance characteristics shall be suitable for the application.

Standard – relevant parts of BS EN 50525 to suit types scheduled.

2021 STANDARD WIRING AND POWER CABLES:

All wiring and power cables shall have copper conductors unless otherwise indicated. All cables shall have a voltage rating and performance characteristics suitable for the application. For

multicore cables the conductors shall be circular up to 16mm^2 and shaped over 16mm^2 unless otherwise indicated. LSF means Low Smoke and corrosive gas emission compound.
Standard BS 7211 - thermosetting insulated and thermoplastic sheathed cables for voltages up to and including 450/750 V for electric power and lighting and having low emission of smoke and corrosive gases when affected by fire (class 1 solid copper conductors)

2031 STANDARD MEDIUM VOLTAGE (MV&HV) POWER CABLES:

All power cables shall have copper conductors unless otherwise indicated. All cables shall have a rated voltage and performance characteristics suitable for the system.
Unless indicated otherwise, voltage ratings cables shall be selected for Category A in accordance with BS 6622 (phase to earth faults shall be disconnected from the system within 1 minute).

2041 MINERAL INSULATED WIRING AND POWER CABLES:

Standard – BS EN 60702-1
All conductors shall be copper unless otherwise indicated. All cables shall have an outer sheath as indicated. 500V light duty cables shall be used for sizes up to 2.5mm^2, 750V heavy duty cables for sizes over 2.5mm^2 to 25mm^2 and 750V heavy duty single core cables for over 25mm^2 unless otherwise indicated. Outer sheath colours shall be:-

Red	-	Fire Alarms
White	-	Emergency Lighting
Orange	-	Other Services

Fire performance standards - BS 5839-1, BS 6387 BS 8519 as appropriate.

2051 CONTROL AND AUXILIARY CABLES:

All conductors to be copper unless otherwise indicated.
Standards - BS EN 50288-7, BS 5467, BS 6346, BS 6724, BS 7211, BS 7629, BS 7846, BS 7870, BS EN 50288-7 as appropriate to the particular project / schedules.

Fire performance standards - BS 5839-1, BS 6387, BS 8519, BS EN 50200 as appropriate to the particular project / schedules.

2071 STANDARD COMMUNICATION CABLES:

NA

2075 CABLES FOR RESIDENTIAL TELECOMMUNICATION:

NA

2080A STANDARD COAXIAL CABLES:

NA

2080B STANDARD RADIATING COAXIAL CABLES (LEAKY FEEDER) FOR WIRELESS NETWORKING (WIFI):

NA

2091 OPTICAL FIBRE CABLES:

NA

2101 INFORMATION TECHNOLOGY OR SPECIALIST SYSTEMS CABLES

NA

2170 PRE-FABRICATED WIRING SYSTEMS – SYSTEM REQUIREMENTS AND MANUFACTURING

NA

3000 ACCESSORIES

3011 CABLE GLANDS:

Standard BS 6121-1, BS EN 62444

Cable glands shall be suitable for the type of cable, environment and mechanical forces present all glands shall incorporate a method of cable retention. Metallic glands to be brass except where aluminium gland plates are provided where nickel plated brass glands shall be used, include shroud (LSOH for cables with LSOH sheath) and for metallic sheathed or armoured cables shall incorporate armour locking ring and earth tag for protective connection to earth.

Cable type	**Application**	**Cable type**	**Gland type**				
			Material	**Cable retention**	**Ingress Protection to BS EN 60529**	**Type to BS EN 6121-5 Annex A**	**Environment**
Unarmoured, Flexible;	Indoors	Wiring and power; control and auxiliary; and communications	Non-metallic	Class A	IP54	Type A1	Indoor
	Outdoors			Class A	IP66	Type A2	Outdoor
Armoured cables	Dry Indoors	Wiring and power; control and auxiliary;	Metallic	Class A	IP54	Type B	Dry Indoors
	Indoors				IP54	Type B	Indoors
	Outdoors		Metallic	Class A	IP66	Type C	Outdoor

Where a cable gland or armour gland is required which has resistance to extreme conditions not covered by the requirement specified in BS EN 62444 or BS 6121 (e.g. resistance to chemical attack, resistance to ingress of water in deluge conditions, resistance to strong ultraviolet light), advice should be sought from the gland manufacturer.

Cable glands used with fire performance cables shall be such as to minimize the probability of early failure in the event of fire.

Cable glands shall be certified to relevant parts of BS EN IEC 60079/BS EN 60079 for hazardous areas.

3021 CABLE SEALS AND GLANDS - MINERAL INSULATED CABLES:

Comply with BS EN 60702-2

Use seals and glands for mineral insulated cables in accordance with BS EN 60702-3, recommended or supplied by cable manufacturer for the type and temperature rating of the installation classification.

Gland type shall be cable grip type, externally threaded with lock washer and nut. Seal type shall be Self-threading pot and the pot closure shall be as manufacturer's standard for type of seal specified.

Pot sealant compound / glazing flux shall be suitable for the temperature rating required and environment.

Use Medium Temperature seals (150°C) for terminations associated with life safety equipment.

Cable glands shall be certified to BS EN 60079-14 for hazardous areas.

Gland shroud material and shroud colour to match cable sheath.

3031 VOLTAGE SURGE SUPPRESSORS FOR CABLES:

Provide voltage surge suppressors in accordance with cable and equipment manufacturer's recommendations. Suppressors shall be suitable for the rated voltage, connection arrangement and characteristics for the load concerned.

Standard
BS CECC 42200

3035 CABLE CLEATS AND CABLE TIES:
Use cable cleats to BS EN 61914.
Use cable ties to BS EN 62275.

3041 CABLE TERMINATING AND JOINTING SOCKETS:
Unless otherwise indicated all cables shall be terminated using approved cable lugs, ferrules, and spade type connections to suit the terminal arrangements of all devices, instruments and equipment.
Standard
Compression to: BS EN 61238-1
Clamping units to: BS EN 60999
Telecommunication and data cable IDC to : BS EN 60352-3

3051 INSULATING TAPE/OVER SLEEVING AND HEAT SHRINK SLEEVING:
Shall be of same material as the cable insulation.
Tape to BS 419
Standard
BS 3858
Relevant parts of BS EN 60454

3061 CABLE JOINTS AND TERMINATIONS:
Use cable joints as supplied and approved by cable manufacturer for the application and installation involved.
Standard
BS 7888
BS 7197 for performance of bonds
BS EN 50393
BS EN 61442
BS EN 60998
Core sleeving – relevant parts of BS EN 60684

3065A LIGHTING INSTALLATION COUPLERS:
Where scheduled or described in the scope of works, use only lighting installation couplers approved by cable manufacturers and to BS EN 61535 of rated voltage 230V and current rating 10A with rewireable or non-rewireable connections suitable for readily accessible locations with earth contact and for rigid or flexible cables.

3065B SMALL POWER INSTALLATION COUPLERS:
Where scheduled or described in the scope of works , use only small power installation couplers approved by cable manufacturers and to BS EN 61535 of rated voltage 230V and current rating 16A with rewireable or non-rewireable connections suitable for readily accessible locations with earth contact and for rigid or flexible cables.

3071 PAPER INSULATED CABLE ACCESSORIES
NA

3081 CONNECTORS FOR COAXIAL CABLES: (NES 261.200)
NA

3091 OPTICAL FIBRE TERMINATIONS :
NA

3101 OPTICAL FIBRE CABLE JOINTS
NA

3111 CABLE DUCTS:

Provide cable ducts as indicated on Schedules and drawings.

Standard

BS EN 61386-24 for conduit systems buried underground

All cable ducts and joints shall have a smooth internal bore.

Cable ducts for electricity cables shall be colour coded black. Cable ducts for other services shall be colour coded in accordance with Table 1 and Table 2 of NJUG Volume 2.

Cable ducts for the Distribution Network Operators shall be to NJUG Volume 2 unless supplied by the Distribution Network Operator.

3121 CABLE SLEEVES:

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. The contractor is responsible for sealing cable sleeves following installation of cabling, method of sealing to be appropriate to prevent water ingress and maintain fire integrity, as applicable. Sleeving to be in accordance with BS EN 60684.

3131 CABLE COVERS AND MARKERS

Cable covers are to be manufactured from concrete indented lettering warning of the danger electricity below.

Cable covers are to be wider than the width of the service cables that they are protecting.

Plastic warning tapes to be yellow with blue legend in accordance with BS EN 12613.

4000 WORKMANSHIP

4011 CABLE INSTALLATION - GENERAL:

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.

Handle, install and dispose of cables on wooden drums in accordance with BS 8512.

Install cables when ambient temperature is 5°C or greater, using cables stored at or above this temperature for not less than 24 hours. (Refer to manufacturers' recommendations for bitumen covered cables etc).

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. Ensure over sheaths are not damaged by abrasion or scuffing.

Ensure wiring systems are supported so that they are not liable to premature collapse in the event of a fire, in accordance with BS 7671 (IET Wiring Regulations).

4012 CABLES INSTALLED EXTERNALLY

Where cables are installed externally and exposed to solar radiation, the Electrical Contractor shall ensure that the cables used are of a type which do not deteriorate as a result ultra-violet radiation. Additionally cable ladders or trays provided for power cables shall be fitted with ventilated covers to provide protection against solar radiation / gains.

4020 CABLE INSTALLATION IN LOW TEMPERATURES:

Install cables at lower installation temperatures when authorised by manufacturer in a written statement.

Ensure wiring systems are supported so that they are not liable to premature collapse in the event of a fire, in accordance with BS 7671 (IET Wiring Regulations).

4030 INSTALLATION OF LSF CABLE:

Install LSF cables in accordance with manufacturer's instructions. Ensure ambient temperature is above 5°C. Ensure oversheaths are not damaged by abrasion or scuffing.

Ensure wiring systems are supported so that they are not liable to premature collapse in the event of a fire, in accordance with BS 7671 (IET Wiring Regulations).

4030A INSTALLATION OF LSZH CABLES:

Install LSZH cables in accordance with the manufacturer's instructions, ensuring the ambient temperatures are above the minimum specified by the manufacturer.
Install LSZH cables so that they are not exposed to concrete or other substances containing products similar to lime.
Where LSZH cables are installed outside containment, directly on concrete floors (e.g. under raised floors in offices, control rooms or data centres) ensure suitable cable mat products with appropriate fire performance are used.
Ensure wiring systems are supported so that they are not liable to premature collapse in the event of a fire, in accordance with BS 7671 (IET Wiring Regulations).

4031 CABLE ROUTING

Minimum spacings between cables and other services;
Insulated Steam Services 300mm
Other mechanical services (excluding steam) 150mm

The minimum spacings (taken from outside surfaces) between LV cables and containment for cables for telecommunications, control and other sensitive circuits (installed in air) shall be in accordance with A444 of BS 7671. For HV cables a minimum separation distance of 1,000mm to LV cables and 1,400mm to telecommunications, control and other sensitive circuits shall be provided.
Where cables are specified as being routed by 'diverse' routes, each cable shall be run along a route of low risk from fire or mechanical damage and where possible within separate fire compartments. Where cables enter common rooms, entries shall be separated by a minimum of 4m. Under no circumstances shall the cables forming both groups, be run on the same containment.

4040 INSTALLATION OF UNARMOURED CABLES

Install and use unarmoured cable to BS EN 50565-1, BS EN 50565-2 or the manufacturers written instructions.
Ensure wiring systems are supported so that they are not liable to premature collapse in the event of a fire, in accordance with BS 7671 (IET Wiring Regulations).

4051 CABLE TRENCHES:

Cable trenches to be by others but supervision of all works is to be carried out by Electrical Contractor.
Work in adopted streets to comply with the New Roads and Streets Works Act 1991.
Carry out walk over survey of trench route, dig trial holes in any area considered to be potentially difficult. Establish location of any other underground service adjacent to cable route.
Re-plan cable routes after survey and trial holes, Submit report of survey and trial holes. Carry out any instructed work to adjacent services. Set out cable trenches, excavate trench carefully setting aside any materials required for backfilling or reinstatement. Excess excavated material to be removed from site.
Minimum cover in cable trenches

HV cables 800mm; LV cables 500mm; communications cables 500mm; all cables 800mm under roadways.

Trench

Common trench for all underground services

Grade trench bottom to a maximum slope of 1:12.
Clear trench bottom of loose stones and place bedding to full width of trench.
Bedding - Riddled earth 6mm grid for cables; riddled earth 12mm grid for ducts; imported soft sand; or pea shingle for ducts.

Bedding thickness – 75mm; or 100mm for ducts.
Install cables or ducts. Haunch cables or ducts in bedding material to a minimum depth of 75mm above highest cable or duct.

Warning tapes to be installed in accordance with the following table :-

WIDTH→	up to 600mm	600-1000mm	1000-1400mm	1400-1800mm
DEPTH up to 500mm	1 tape at 200mm below ground level in the centre of the trench	2 tapes at 200mm below ground level horizontally spaced 400mm apart	3 tapes at 200mm below ground level horizontally spaced 400mm apart	4 tapes at 200mm below ground level horizontally spaced 400mm apart
DEPTH 500-800mm	1 tape at 200mm and 1 tape at 500mm below ground level in the centre of the trench	2 tapes at 200mm and 2 tapes at 500mm below ground level each tape on each level horizontally spaced 400mm apart	3 tapes at 200mm and 3 tapes at 500mm below ground level each tape on each level horizontally spaced 400mm apart	4 tapes at 200mm and 4 tapes at 500mm below ground level each tape on each level horizontally spaced 400mm apart

Backfill trench using two layers 100mm thick hand rammed. Complete backfilling in layers and reinstate trench.
Backfill material – as excavated from trench.

4061 CABLE INSTALLATION IN TRENCHES:

Lay cables on newly prepared bedding. Ensure multiple layers of cable are separated vertically by a 50mm layer of hard rammed bedding material. Cover newly laid cables with 100mm of bedding material.

When using a power winch 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.
During hand pulling cable ensure no kinks are formed and that flaking when used is one in the correct direction.
Do not allow cable to twist during installation. Use swivels to connect pulling bond to cable stocking or equivalent fitting.
Check drum is suitable for jacking before commencing installation. If drum or reel is unsuitable for jacking, flake cable in correct direction in maximum size turns from drum or reel before commencing installation. Use skilled labour to supervise all unreeling, flaking or running of cable from a drum.
Lay cables in the formation shown, ensure spacing is not reduced below that indicated.
Bind trefoil groups at 1m intervals. Bind any associated earth or protective conductor to its cable or trefoil group at 1m intervals.
Space multiple cables in trenches in accordance with BS 7671.
Ensure installation radii and permanent bending radii are not less than those recommended by the manufacturer.
Do not lay cables to BS 7211 or BS EN 50525 direct in the ground

4071 CABLE DUCTS:

Duct work - Carry out all duct laying where specified.
Lay ducts, jointed in accordance with the manufacturer's instructions, in the formation shown on to newly prepared bedding.
Ensure that ducts slope no more than 1:60 vertically or 1:30 horizontally.
Ensure that pre-formed duct bends used at ends of duct routes meet the requirements of the cable manufacture for bending radii.
Construct manholes, draw pits and jointing chambers, as indicated.
Prove alignment of completed duct run by drawing through a mandrel of diameter 7mm less than nominal duct bore of minimum length 250mm. Clean completed duct run by drawing through a circular wire brush of diameter 12mm more than nominal duct bore.
Install in each empty duct a draw wire of corrosion resistant material of minimum breaking strength 550N.
Plug and seal all ducts on completion with proprietary duct plugs.

4080 CABLE INSTALLATION INTO DUCTS:

Install cables into newly proved and cleaned duct. Use lubricants, recommended by the cable manufacturer in writing, to assist drawing process.

Flake cable if drums or reels are not suitable for jacking. At intermediate draw pits with exit duct more than 15° off line of entry duct flake cable before entering or provide comprehensive system of corner plates, roller and blocks. Use the maximum practical size of turns when flaking and ensure direction of flake is correct.

Do 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.

Do 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, binding the two together through manholes, draw pits and jointing chambers. Pull all cables in one duct as a group. Ensure the 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.

Seal between cable and duct ends after cable installation. Ensure cable ends in jointing chambers are temporarily sealed where required.

4091 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 for all wires of the same circuit reference at 2m intervals. Mark ties at 10m intervals with circuit reference number.

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/adaptable boxes to suit cable size.

Where wiring is to be drawn into existing wired conduits, withdraw existing wiring and replace.

Ensure wiring systems are supported so that they are not liable to premature collapse in the event of a fire, in accordance with BS 7671 (IET Wiring Regulations).

4100 CABLE INSTALLATION ON TRAY AND RACK:

Place cables side by side or as indicated, fix using cleats or metallic cable ties so that any cable may be individually removed.

Ensure that any cables not sitting on the top surface of the tray or rack are secured so that they are not liable to premature collapse in the event of a fire, in accordance with BS 7671 (IET Wiring Regulations).

4111 CABLE SURFACE INSTALLATION:

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

Clearance as determined by fixing method unless otherwise indicated. Use metallic clips on cables with specified fire performance. Cable cleats to BS EN 61914.

Ensure wiring systems are supported so that they are not liable to premature collapse in the event of a fire, in accordance with BS 7671 (IET Wiring Regulations).

4121 CABLE EMBEDDED INSTALLATION:

Dress cables flat, free from twists, kinks and strain, and align parallel to building elements. When glands and clamps are not required, take sheathing of cables into accessory boxes and equipment and protect against abrasion using grommets or similar sharp edge protection. Ensure plaster or screed over cable is a minimum of 12mm. Protect embedded cables (not complying with BS 8436) by metal capping.

4131 CABLE INSTALLATION - MINERAL INSULATED CABLES:

Straighten and dress cables using methods and tools recommended by cable manufacturer.

Use thermoplastic or LSF sheathed cables, colour and location indicated and where cables may come into direct contact with any material that may be corrosive to copper.
Fit temporary seals to mineral insulated cable end when cut.
Fit temporary seals to mineral insulated cable if the cable is left unterminated underground, or where the termination is not to be made within 12 weeks.
Allow extra length on installed cables for cutting back of moisture affected ends. Store mineral insulated cables in the form supplied by manufacturer.
Ensure wiring systems are supported so that they are not liable to premature collapse in the event of a fire, in accordance with BS 7671 (IET Wiring Regulations).

4140 CABLE INSTALLATION - 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.
Ensure wiring systems are supported so that they are not liable to premature collapse in the event of a fire, in accordance with BS 7671 (IET Wiring Regulations).
Ensure that any cables not sitting on the top surface of a cable rack or tray are secured so that they are not liable to premature collapse in the event of a fire, in accordance with BS 7671 (IET Wiring Regulations).

4151 CABLE JOINTING AND TERMINATING GENERALLY:

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:
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.
Seal plastic sheathed cables using proprietary shrink on end caps. Seal lead sheathed cables by a plumbed dressed lead cap with an air space to allow conductor movement.
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.
Clean armour thoroughly prior to joining 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. Install and inspect compression and mechanical connectors in accordance with BS EN 60228 and BS 7609.
Bolt core terminations with lugs to equipment using washers or proprietary shakeproof devices. Provide separate bolted connection for each core.
For auxiliary and sub-circuit wiring do not bunch more than three cores at clamping terminals or bolted connections. Individual stranded cores should be twisted together and folded back to form a "U" where entering screw or clamp type terminals.
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. Bond any unused cores of multicore cables to earth at both ends, unless otherwise indicated.

4161 CABLE JOINTING AND TERMINATING - PAPER INSULATED CABLES:

Make cable joints and terminations using the material and methods recommended by the cable manufacturer. Employ only labour certified by cable manufacturer as qualified to make paper insulated cable joints. Cold pour resin and heat shrink joints
Ensure cores are insulated and separated using compatible materials. Keep all materials for paper insulated joints in sealed containers until used. Use only cable manufacturers approved jointing materials for type and application involved. Where proprietary mechanical glands and armour clamps are not used, use tinned brass wiping gland and armour clamp plumbed to sheath.

4171 CABLE JOINTING AND TERMINATING - ELASTOMER AND PLASTIC INSULATED CABLES:

Joint cables using glands of the type indicated, in accordance with the manufacturer's instructions. Use shrouds at all glands unless otherwise instructed, match material and colour of cable sheath.

At core connections to equipment without integral clamping terminals use compression lugs unless otherwise indicated.

4181 TERMINATING - MINERAL INSULATED CABLES:

Use terminations in accordance with BS EN 60702-2 and components and materials recommended or supplied by cable manufacturer.

Use seals of the maximum temperature rating indicated, with stub caps to the largest size available, with drilled caps and headed sleeves for larger sizes.

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

Secure glands at equipment not provided with threaded entries using lock washers and locknuts or brass conduit bush. Use gland shrouds when plastic covered MI cables are used to the same colour and material as cable oversheath.

Using thermoplastic, PIB or LSF material tape to BS EN 60454 to match sheath, tape overall gland any bare copper sheath and form seal to cable sheath, under all shrouds.

Mark core sleeving with appropriate identification.

Install voltage surge suppressors in accordance with manufacturer's recommendations and, to BS 7671 Section 331-01-01 or as otherwise indicated.

4191 CABLE JOINTS - MINERAL INSULATED CABLES:

Joint mineral insulated cables using methods and materials recommended by cable manufacturer. Terminate cables in externally threaded glands using seals of temperature rating indicated. Join conductors using crimped connectors, as required.

Insulate connectors using thermoplastic tape to BS 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, unless otherwise indicated.

4201 COMMUNICATIONS COAXIAL, OPTICAL FIBRE AND DATA CABLE JOINTING AND TERMINATING:

NA

4210 CABLE INSTALLATION – PRE-FABRICATED WIRING SYSTEMS

Ensure that the manufacturer prepares drawings, detailing the installation and identifying each component of the pre-fabricated wiring system, and its location.

Ensure connectors are only installed in dry environments, and not within wet areas such as showers and bathrooms.

Ensure connections are located such that they are accessible after all works are completed, for maintenance and inspection and testing.

Ensure home run cables are fixed directly to the soffit. Where groups of 2 or more cables are run together these shall be run on cable baskets or trays.

Ensure extender cables are clipped to the soffit or structural elements, independent of ceiling supports.

Ensure pre-fabricated wiring systems are supported so that they are not liable to premature collapse in the event of a fire, in accordance with BS 7671 (IET Wiring Regulations).

Ensure home run and extender cables are installed such that they are supported clear from the ceiling and run along the lines of the ceiling grid so that they do not restrict access to the ceiling void or other services.

Ensure all cables without mechanical protection suitable to protect against penetrate by screws, nails and similar, or without protection by and earthed metallic armour or sheath rated as protective conductor for the circuits enclosed, and installed within partitions are routed in accordance with permitted cable routes and, if installed at a depth of less than 50 mm, protected by a 30 mA RCD, in accordance with BS 7671 (IET Wiring Regulations).

Ensure un-used connectors are fitted with end caps.

Ensure all connectors in which protective conductor currents may exceed 10 mA have a label complying with BS EN ISO 7010, incorporating safety sign W012 (electricity warning triangle with lightning bolt) with the following words in black on a yellow background: "WARNING. HIGH PROTECTIVE CONDUCTOR CURRENTS. ISOLATE CIRCUIT BEFORE DISCONNECTING."
Cables are to be continuity and polarity tested at the works and each passed cable assembly is to be serial numbered with the recorded data detailed on the product. Once integrated into the works the pre-fabricated wiring shall be re-tested as part of the initial verification of the fixed installation in accordance with BS 7671 (IET Wiring Regulations).

4211 **CABLE SLEEVES:**

Pack sleeves with fire resistant material after cable installation in accordance with the designated fire rating of the area involved and to comply with Building Regulations.
Cables shall be cleats, cable ties or cable supports shall be installed within 750mm each side of cable sleeves and shall be suitable to withstand the mechanical loads expected following collapse of the supports on the fire side of the sleeve, to the extent that no strain is transferred to the seal.

4212 **MARSHALLING TERMINAL BOXES**

Standard - BS EN 60670-22 and relevant parts of BS EN 60947-7.
Provide steel enclosure to IP 31 (indoor) or IP 65 (outdoor) with lockable hinged lid, DIN rail mounted terminals, 25A minimum, labels and warning signs.
Arrange terminals in single or three phase, or function order groups with spacer plates between groups, end stops and clamps at each end of rail.
Number each terminal and fit each conductor with identification ferrules, cross-referenced to circuit charts and as installed drawings.

10000 **NES** VERSION TEXT Y61 Dec 19

Y63 – Support Components – Cables

1000 GENERAL

1010 APPLICATION:
Cables referred to in this section are only those types that can be installed without further mechanical protection.

1012 LAYOUT AND SEGREGATION
Set out cable support systems as indicated in diagrammatic form on the drawings. Provide all necessary offsets, bends, tapers, transformation pieces etc. required whether or not these are detailed. The layout of the systems and the routing of cables shall ensure maximum circuit lengths and grouping shown on drawing and schedules are not exceeded.

2000 PRODUCTS/MATERIALS

2011 CABLE SUPPORTS:
Support all cables throughout their length using conduit, trunking and enclosures, cable tray, cable racking, special support systems, cleated or clipped fixing direct to building fabric, or aerial catenary suspension systems, as required.
Ensure tray, racking and special support systems are continuous and firmly fixed to building fabric. Allow space for indicated cables + 30% spare, unless otherwise indicated.
Ensure cable support system allows for spacing in accordance with BS 7671 for the design current of the cable.
Ensure cable support system is installed so that cables are not liable to premature collapse in the event of a fire, in accordance with BS 7671 (IET Wiring Regulations).
Cable support systems for fire rated cables shall afford the same resistance to fire as the specification for the cable to ensure continued operation of the circuit during a fire.

2012 FIXINGS FINISHES:
Ensure finish for all support components, fixings, hangers and accessories is galvanized or sherardized finish.

2021 CABLE SUPPORT SYSTEM: (NES 2020 and 2030)
Standard BS EN 61537
Material
Hot rolled steel galvanized after manufacture to BS EN ISO 1461; or bending and profiling quality hot dipped galvanized steel to BS EN 10143, and BS EN 10346.
Finish - Self colour galvanized.

Perforated tray.
Use return flanged type with manufacturer's standard perforations pattern, unless otherwise indicated. The thickness of the tray shall be the Manufacturer's standard thickness for type.

Cable rack (ladder)
Proprietary system of channel sections with return lip and compatible jointing and fixing accessories.

Cable basket.
Cable baskets to have 50 mm square grid and side walls.
Light duty to be 25 mm sides, medium duty 50 mm sides and heavy duty 75mm sides.
For under floor basket tray three independent supports legs shall be provided along each standard section of basket, where legs are required. Support leg depth as indicated. Every section shall have at least one connection point screwed to the floor.
Accessories and fittings shall be as manufacturers' standard items.
Include take-off plates for conduits, trunking etc.

Cable support system fittings
Use factory made fittings throughout of same material, type, pattern, finish and thickness as the cable support system, site modified fittings will only be acceptable on existing installations.
Use reducers, inside angles, outside angles and drop outs as manufacturer's standard. Use

flat bends, equal tees, unequal tees and crosses with gusseted corners. Join lengths of cable support system and fittings using manufacturer's standard shouldered ends, fish plates, or couplers, with galvanised or zinc plated slotted domed head 'roofing' bolts, nuts, washers and shake proof washers.

Each fitting shall have a bonding braid attached across it to form the continuous bonding of the support system.

Tray/rack supports - use threaded rod or proprietary support channel.

Ensure cable support system is installed so that the cables are not liable to premature collapse in the event of a fire, in accordance with BS 7671 (IET Wiring Regulations).

Ensure that any cables not sitting on the top surface of the support system are secured so that they are not liable to premature collapse in the event of a fire, in accordance with BS 7671 (IET Wiring Regulations).

2022 WIRE ROPE SUSPENSION SYSTEM:

Where specified within the Scope of Works or Schedules for the support of cable trays or baskets, use proprietary Wire Rope Suspensions Systems which comply with BS EN 12385-1, BS EN 13411-3, BS EN 13411-4, DIN 3093, and BSRIA COP 22/2002. Wire Rope Suspensions to be suitable for the safe working load and comprise Stainless Steel grade 316 wire rope, Stainless steel grade 302 Spring fasters with fixings by loops, stud (permanently fixed to wire rope length) or toggle as appropriate. The installation shall comply with BSRIA COP 22/2002 and 'solid' stud type suspensions shall be provided at maximum spacing of 20m, with a minimum of one in any straight run.

2026 CABLE CLIPS, TIES AND CLEATS

Standard BS EN 61914 (cable cleats)

Bolted cleats shall be aluminium alloy, galvanised iron or moulded black polythene. Galvanised iron cleats shall be used to fix fire rated cables.

Proprietary cable ties shall be wrap round self-locking releasable pattern. Cable ties may be Nylon except where used to fix power or fire rated cables, where stainless steel ties shall be used. Stainless steel cable ties shall be suitable to withstand the forces exerted by power cables under short circuit conditions, including a safety factor of 3.

Fixings used for fire rated cables shall sustain the same fire conditions as that provided by the cable, without failure.

Cable clips shall be the 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 or two-way saddles (for runs of multiple cables) for unsheathed mineral insulated cables, PVC covered for sheathed mineral insulated cables

Use cable ties to BS EN 62275.

Ensure all wiring system components and cable supports are selected and installed so that wiring systems are not liable to premature collapse in the event of a fire, in accordance with BS 7671 (IET Wiring Regulations).

3000 WORKMANSHIP

3011 CABLE SUPPORT INSTALLATION:

Support from building fabric with minimum clearance behind of 20mm. Install fixings at regular intervals to prevent visible sagging when loaded, with maximum spacing 1.2m and 230mm from fittings.

Keep cutting of cable tray to a minimum. Cut along a line of unperforated metal. Ends of hangers to be cut flush with locking nuts or support brackets. Make good finish with zinc rich paint, primer and topcoat, or two pack epoxy paste, as appropriate to material and finish.

Fit holes cut in tray for passage of cables with grommets, bushes or other lining. Install all bolts, fixings and hangers with threaded portion away from cables.

Ensure all wiring containment systems are selected and installed so that they are not liable to premature collapse in the event of a fire, in accordance with BS 7671 (IET Wiring Regulations).

3022 CABLE CLEATS, TIES, SADDLES AND CLIPS INSTALLATION:

Ensure all cable supports are selected and installed so that wiring systems are not liable to premature collapse in the event of a fire, in accordance with BS 7671 (IET Wiring Regulations).

Single core cables forming part of a three-phase circuit shall be installed in trefoil formation whether installed horizontally or vertically and supported using proprietary trefoil cleats certified for the peak fault current that cable could be subjected. The cleats shall be spaced in accordance with the manufacturer's recommendations for the given fault level. Where necessary the neutral conductor shall be run adjacent to its set of phase conductors using quadrafoil cleats.

Single core cables forming part of a DC circuit or single phase and neutral non-life safety circuit when run horizontally on trays or ladders shall be installed 'flat touching' together with the associated earth cable. Each conductor shall be individually fixed using proprietary metallic cable ties to the cable tray or ladder at the spacings indicated in the table below. Marker ties shall be provided at 3000mm intervals which shall encompass all conductors of the circuit. Where the cables run vertically, they shall be cleated using metallic cable cleats at fixing centres noted in the table below

Non-life safety multi core cables laid horizontally on cable tray or ladder shall be secured by the use of proprietary metallic cable ties or 'P' clips, securing the cables of only one circuit. The ties shall be spaced in accordance with the table below. Additional ties shall also be provided within 100 mm of each bend. Where non-life safety cables run vertically they shall be cleated using metallic cable cleats with spacings in accordance the table below.

Life safety multi core cables laid horizontally on cable tray or ladder shall be secured by the use of proprietary stainless-steel cable ties or 'P' clips, securing the cables of only one circuit. The ties shall be spaced in accordance with the table below. Additional ties shall also be provided within 100 mm of each bend. Where Life Safety cables run vertically, they shall be cleated in accordance with the table below. Cleats utilised for life safety cabling shall be as recommended by the manufacture for that type of cable and shall be manufactured from either cast iron or stainless steel.

Where cables are on inverted tray, they shall be fixed with cable cleats spaced in accordance the table below or the manufactures recommendations should they be more onerous. Cleats for non-life safety cables shall be stainless steel/metallic type, and cleats for life safety circuits shall be as recommended by the manufacture for that type of cable and shall be manufactured from either cast iron or stainless steel.

Where cables are to be installed direct to the structure they are to be supported by cleats bolted to vertical and/or horizontal mild steel galvanised channel supports which in turn shall be bolted to the structural walls or soffit at the required fixing centres for the cable fixings noted in the table below or the manufactures recommendations should they be more onerous. Cleats for non-life safety cables shall be stainless steel/metallic type, and cleats for life safety circuits shall be as recommended by the manufacture for that type of cable and shall be manufactured from either cast iron or stainless steel.

Insulated cable ties, P Clips and cleats shall be manufactured from materials with low smoke zero halogen properties.

The maximum spacing between cable cleats and fixings for cables in accessible positions is defined in the table below.

Overall diameter of cable(1)	**Type of cable and plane of cable installation**					
	Non-armoured cables		Steel Wire Armoured cables including fire resisting armoured cable		Mineral insulated copper clad or aluminium sheathed cables	
	Horizontal	Vertical	Horizontal	Vertical	Horizontal	Vertical
<9mm	300	300	-	-	600	600
9-15mm	300	300	300	300	900	1200
15-20mm	300	300	300	300	1500	1800
20-40mm	300	300	300	600		
40-50mm	600	600	900	900		
50-	600	900	900	900		

60mm						
60-70mm	900	1200	900	1200		
>70mm	900	1200	1200	1200		

Notes:

1. For flat cables taken as the dimension of the major axis.
2. Fire resistant fixings should be used for fire resistant cables.
3. The spacing's shown above apply to multi-core cables.
4. The spacing of fixings on single core cables in AC installations must take account of the magnitude of forces generated under fault conditions.
5. The spacing's stated for horizontal runs may be applied to runs at an angle of more than 30º from the vertical. For runs at an angle of 30º or less from the vertical, the vertical spacing's are applicable.
6. For cables supported on horizontal tray use ties for each circuit. Use tie manufacturer's special tensioning tool where available. Crop off tie ends.
7. For sub-circuit wiring on continuous flat surfaces of wood, plaster, brick etc. use polypropylene surface fixing clips with pre-fixed 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.
8. Space cleats, ties, saddles and clips as Appendix G of Guidance Note 1 `Selection & Erection' published by the IET.

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1011 STANDARD:

Comply with all relevant parts of BS EN 61439 for Low-voltage switchgear and controlgear assemblies.

Assemblies shall be type tested (TTA) in accordance with BS EN 61439-1 and BS EN 61439-2

1012 TYPE TEST:

Provide verification of type test in accordance with BS EN 61439 For type tested assemblies, the short circuit strength of main busbars, busbar supports, connections to incoming and outgoing units in the configuration to be used, shall be verified. Certificates issued by The Association of Short-Circuit Testing Authorities (Inc) - ASTA - are preferred, but certificates from other testing authorities will be considered.

1013 ELECTRICAL CHARACTERISTICS:

Ensure that electrical characteristics of component parts of assemblies are as indicated and apply when components are mounted in enclosures. Allow appropriate de-rating factors for effect of enclosures, other components and interconnections. Ensure that all components supplied and installed are suitable for Voltage, Current, Fault Levels and Frequency as scheduled.

1020 ELECTRICITY SUPPLY:

Ensure all electrical equipment supplied and installed is suitable for power supply indicated to BS EN 60038 and relevant parts of BS EN 61558

1014 INFORMATION ON DRAWINGS

The following electrical characteristics are shown on the system or the distribution diagram drawings:-

- Type of earthing system
- Number and type of live conductors at the origin
- Normal Voltage
- Frequency
- Maximum prospective short-circuit current at the origin (Ip(max)).
- Minimum prospective short-circuit current at the origin (Ip(min)).
- Earth-fault loop impedance at the origin (Ze)
- Electricity supplier's protective device and its tripping time at current Ip
- Protective devices
  - Current rating
  - Type
  - Category of duty

2000 PRODUCTS/MATERIALS

2011 SWITCHBOARDS / CONTROL PANELS, LV SWITCHGEAR AND CONTROLGEAR ASSEMBLY:

Standard – Relevant parts of BS EN 61439 as scheduled.

External design- Cubicle or Multi-cubicle type assembly as indicated on Schedules or drawings.

Degree of protection BS EN 60529

- Indoors boards to be rated to IP31 unless otherwise indicated.
- External boards to be rated to IP65

Electrical characteristics

- Rated operational voltage 400V +10% / -11%

Service conditions

- Ambient air temperature and altitude as relevant parts of BS EN 61439.
- EMC-Environment A - Light Industrial/Commercial

Co-ordination in accordance with BS 7671 (IET Wiring Regulations)

Ensure that the relevant fault current (short-circuit) rating of each switchgear and controlgear assembly is greater than or equal to the maximum prospective fault current at the point of connection to the system.

Ensure that the relevant design current does not exceed the rated current of the system, or rated current of a circuit of the associated assembly, taking into account applicable diversity and loading factors.

Ensure that any devices and components are integrated into the assembly in accordance with the relevant parts of BS EN 61439.

Provide facilities to allow future extension of switchboard at either end.

2012 NEUTRAL POLES

Neutral poles on 4 pole circuit breakers or switches shall be rated in accordance with the most onerous conditions specified in BS 7671 and the relevant product standard.

2021 ASSEMBLY CONSTRUCTION:

Enclosure standard BS EN 62208

Material of enclosure - steel.

Supply doors with fastenings and provision for locking in closed position. Use covers which require special tools for removal. Large removable covers to be provided with lifting handles and location brackets. Provide enclosure with fixing holes. Where enclosure is mounted externally provide fixing lugs external to enclosure.

All busbars are to be fully rated for Current carrying capacity, Frequency, Fault Level and rated Voltage as detailed on the drawings and/or schedules. Neutral bars are to be fully rated and not ½ sized bars.

Internal Separation to BS EN 61439-1 and 61439-2 and as Schedules or Drawings

Assembly to provide protection against direct and indirect contact. Protection to be maintained after removal or withdrawal of removable or withdrawable parts.

Ensure that fixed panel or cubicle of withdrawable type units are fitted with label to identify circuit with wording identical to that on the withdrawable portion.

Terminals for external conductors

Accommodate cross-sectional area of cables scheduled.

Parallel cabling to be provided with an individual terminal for each cable.

Top hat rails dimensional type to BS EN 60715. Steel rails to be manufactured and finished in accordance with BS EN 60715 Appendix A.

Mark terminals as BS 7671 (IET Wiring Regulations).

Provide earth terminal, or for multi-cubicle enclosures a copper earth bar the full length of the enclosure, so that exposed conductive parts of the assembly can be connected to the protective conductor. Ensure earth connection can be made to the assembly without damage to the finish coating. Make provision for armouring and metal sheaths of all incoming and outgoing cables, including common and individual glanding plates, to be bonded to earthing terminal or bar.

Accessibility for inspection

Arrange for following operations to be performed when assembly is in service and under voltage.

Visual inspection of switching devices and other apparatus; settings and indicators of relays and releases; conductor connections and markings.

Adjusting and re-setting of relays, releases and electronic devices.

Replacement of fuselinks.

Replacement of indicating lamps.

Fault location by voltage and current measuring.

Accessibility for maintenance.

Provide space between functional unit or group and adjacent functional units or groups.

Provide retainable fastening means for parts likely to be removed for maintenance.

Short-circuit protection and short-circuit withstand strength as Schedules or drawings. Co-ordinate short-circuit protective devices and short-circuit current arising from rotating machines as detailed in Work Section V20. For motor control centres this information as detailed in Work Section W61.

Input voltage variations for electronic equipment supply as BS EN 61439.
Supply frequency deviation as BS EN 61439
Mounting - as scheduled or detailed in scope of works.

2031 ENCLOSURES FINISH:

Apply high standard finish to enclosure and supporting metalwork. Degrease metal and remove rust prior to applying finish.

Comply with paint manufacturer's recommendations regarding preparation, stoving times, temperatures, mixing of finishes, application and coat thickness.

Finish and colour as Manufacturer's standard unless otherwise stated in the schedules. When other than manufacturer's standard finish is specified samples for each paint system and for each colour shall be provided.

2041 TYPE TESTS:

Provide certificates of verification of

- temperature rise limits.
- dielectric properties.
- short-circuit strength to relevant parts of BS EN 61439
- continuity of protective circuit.
- clearances and creepage distances.
- mechanical operation.
- degree of protection.

Temperature rise limits

Temperature rise test for test current greater than 3150 A to be agreed by the engineers.

Temperature rise when ambient temperature exceeds +40°C or is lower than +10°C to be agreed by the engineers.

Short circuit withstand strength

- Value of neutral bar current for short-circuit test 60%.

2051 ROUTINE TESTS

Carry out the following Routine Tests at the works after the panels have been finished and before shipping to site:

- Dielectric test
- Insulation resistance test
- Primary and/or secondary current injection
- Phase rotation
- Operation of protection devices, instruments and measuring devices
- Operation of control and monitoring devices

The Engineers/design team/client shall be invited to witness these tests at a time convenient to them.

2052 TESTS ON SITE

Repeat routine tests on site.

2060 SITE BUILT ASSEMBLIES:

Ensure that components of site assemblies are part of a proprietary system and type tested as defined above. Install assemblies in accordance with manufacturer's drawings and instructions.

2070 SITE MODIFICATION:

Do not make site alterations unless authorised. Where site modifications to assemblies are authorised make in accordance with manufacturer's certified drawings and instructions. Ensure that modifications made comply with type test certificate obtained for the arrangement of components.

2081 BATTERY CHARGER AND BATTERY UNIT:

Function, Input Voltage and Frequency as Schedules or drawings.

DC Output Voltage drop at full load 2%
Operating temperature range -10°C to +45°C.
Charger type Thyristor or Transistor.
Battery type Nickel Cadmium (maintenance free).
Enclosure, sheet steel,IP31
Corrosion resistant epoxy paint or Manufacturer's standard.
Colour Manufacturer's standard.

Facilities
- MCB input protection.
- Float charge.
- Battery over-discharge protection
- Fuses for battery protection.
- MCB's for outgoing circuits as indicated.
- Automatic selection of boost charge.

Meters
- Battery voltage.
- Charge/discharge current (dual scale for float and boost).

Lamp indications
- Supply on.
- Supply fail (monitor input terminals).
- Float charge.
- Boost charge.
- No charge (when supply is on).
- Battery voltage low.

Battery voltage high.

- Earth fault on output.

Common Alarm (connected to operate a relay with shrouded 230V 3A AC or 0.5A DC. N/O-N/C volt free contacts, closed on any alarm, for remote indication circuit)
- Supply failed.
- No charge (when supply is on).
- Battery voltage low.
- Battery voltage high.
- Earth fault on output.

2091 AIR-CIRCUIT BREAKERS

NA

2092 CIRCUIT-BREAKERS-MOULDED CASE

Comply with BS EN 60947-2. Provide moulded case isolating (withdrawable) or fixed type circuit-breakers, as detailed, with provision for safe maintenance. Ensure that uninterrupted current rating indicated applies when unit is enclosed and in operating environment at rated operational voltage and that Utilisation Category is B.

Withdrawable and plug-in circuit breakers shall be provided with an earthing device to permit earthing of either the busbar (main incoming devices only) or outgoing circuit, A minimum of 1No earthing device shall be provided for each frame size per switchboard.

Provide circuit-breaker with rated service short-circuit breaking capacity (Ics) and short-time withstand current (Icw) equal to or greater than that for the associated switchboard.

Provide manual closing mechanism and protection by combination of adjustable magnetic/thermal compensating devices unless otherwise indicated.

Provide 2 (unless otherwise indicated or required) N/O - N/C volt free auxiliary contacts rated a minimum of 10A 230V AC wired to external terminals within outgoing cabling section.

Where withdrawable provide interlocks to prevent movement of circuit breaker within housing when in 'closed' or 'service' position. Provide automatic shutters to cover all live contacts when circuit breaker is isolated, withdrawn or removed from housing.

Provide facility to padlock circuit- breaker in isolated/withdrawn position, and to lock automatic shutters covering live contacts when removed from housing.

2101 AIR BREAK SWITCHES DISCONNECTORS AND FUSE COMBINATION UNITS:
NA

2111 PROTECTION DEVICES AND RELAYS
Comply with BS EN 61810.
Provide protection devices and relays as specified in the Work Sections, on drawings or Schedules.
Locate such that operation may be observed and the devices reset or adjusted without access to the interior of the enclosure.

2112 AUTOMATIC TRANSFER SWITCH EQUIPMENT (ATSE)
ATSE - Electromechanical ATS'S
NA

ATSE - Interlocked Circuit Breakers
NA

2131 TRIP/CLOSE SWITCHES AND CONTROL SELECTOR SWITCHES:
Standards - BS EN 60947-3 and BS EN 60947-5-1 as relevant.
Provide a panel mounted heavy duty, spring return key operated trip/close switch on each circuit- breaker fitted with electrically operated closing mechanism.
Ensure contacts have a continuous rating or AC and DC currents of 10A minimum at between 30V to 250V and make and break duty rating for AC and DC currents of 30A at 250V for a minimum period of 3 secs.
Where remote trip/close control is required, supply a panel mounted selector switch to select circuit- breaker for local or remote operation. Ensure that selection of remote or local closing does not prevent circuit breaker tripping under fault conditions.

2132 CONTROL CIRCUITS:
Control circuit voltage shall preferably not exceed 110 Volts ac (55-0-55)
Where control circuits are taken outside the enclosure to remote equipment use 24 Volts ac.
For circuit-breaker shunt trip and protective circuits use 30 Volt dc, for integral protective devices 230 Volts ac, or as otherwise indicated.
Provide control circuit transformers to supply power at voltages to suit control components in accordance with relevant parts of BS EN 61558 complete with primary and secondary fuses.

2140 CURRENT TRANSFORMERS:
Comply with BS EN 61869-2. Provide separate current transformers for each protection device and instrumentation. Ensure current transformers provide appropriate accuracy and are compatible with protective device characteristics, performance and VA rating required for satisfactory operation of protection devices, instruments and meters indicated.

Ensure that current transformers are capable of withstanding maximum short time withstand current of value and duration indicated for assembly.
Provide test links in secondary connections of all current transformers to facilitate testing of instruments, meters and protection devices.

2151 INSTRUMENTS AND METERS:

Standards

Comply with BS 89 series, BS EN 60051-1 and BS EN 60051-5 for voltmeters, ammeters, watt meters, frequency indicators and power factor indicators.
For static electricity meters, comply with:

BS EN 62502-11 for general requirements, tests and test conditions
BS EN 62052-21 for Tariff and load control equipment
BS EN 62052-31 for product safety requirements and tests
BS EN 62053-61 for power consumption and voltage requirements
BS 7856, BS EN 50470-1, BS EN 50470-2, BS EN 62053-22 or BS EN 62053-21 for kWh meters, kVA and kW maximum demand meters and polyphase reactive kVA meters
BS EN 62053-23 or BS EN 62053-24 for kVAhr meters

For electromechanical meters for active energy, comply with BS EN 62053-11, BS EN 50470-1, BS EN 50470-3 and BS 7856

Where a meter is to be used to measure the amount of electricity supplied for billing purposes, for applications up to 100kW/100kWh the meter shall be MID Approved. For applications above 100kW/100kWh meters shall be of an approved type for electricity, by OFGEM. In addition, meters for domestic use shall be certified.

Protect wiring to voltmeters by separate fuses. Protect potential coils of watt meters, frequency indicators, power factor indicators and kWh meters, kVA and kW maximum demand meters and polyphase reactive kVA meters by separate fuses.
Supply instruments and meters suitable for flush mounting and type, size and accuracy as drawings or schedules.
Ensure that indicating scales for all instruments comply with BS 3693. Supply so that normal indication is 50% to 75% of full scale deflection.
Completely segregate all instruments in instrument compartments. Panel mount meters on front of instrument compartment.
Provide test link for energy meter testing within instrument compartment.
Provide time switches for load control to BS EN 62054-21

Standards for instruments and meters with interface for communications with controllers. (Refer to scope of works and / or schedules for project particular requirements.)

RS 232C.
BS EN 61968
BS EN 61850
Profibus BS EN 62769
Profinet BS EN 62769
Modbus.
Modbus over Ethernet.
"Wired" interfaces to BS EN 61131-2 (volt-free contacts, relay driven
Communications systems for meters, metering data, metering data exchange:

Pulsed output device to BS EN 62053-31
BS EN 62056
PD CLC/TS 50568-4 and PD CLC/TS 50568-8
BS EN 61968-9 - interfaces for meter reading and control
BS EN 50491-11 - simple external consumer display (smart metering)
Relevant parts of BS EN 13757

2160A ELECTRICAL RECORDING INSTRUMENTS:

Provide electrical recording instruments.
Standard - BS EN 61143.

2171 INDICATOR LIGHTS:

Supply lamps of same type throughout. Provide indicator lamps with lamp test facility. Supply interchangeable indicators for respective units.

For LED indicators, include a voltage suppressor on each LED.

Usage	Lamp Type
Switchboard	LED
Motor control centres	LED

Protect wiring to indicator lamp units by separate cartridge fuses.

Lens Colour in accordance with BS EN 60073.

2176 AUDIBLE ALARMS:

Provide audible alarm system as specified in the Work Section.

2177 PADLOCKS

Provide padlocks and cabinet as specified in Work Section.

Provide each padlock with two keys complete with disc and ring. Engrave disc and padlock with suitable legend.

Provide wall mounted steel cabinet with hinged door for storing padlocks and keys on hooks.

2178 SWITCHBOARD INSTRUMENT AND CONTROL WIRING:

All instrument and control wiring to be either single core insulated cable contained within plastic panel wireway or double insulated cabling installed in a harness.

Identify each end of each wire with a unique number using colour coded 'O' ring markers. Fit lugs at termination points.

All wiring is to be neatly arranged and securely fixed. Where appropriate protect by cartridge fuses complying to BS EN 60269-1, BS 88-1.

2179 MOTOR CONTROL CENTRE, STARTER AND CONTROL PANEL INTERNAL WIRING:

Segregate control wiring from power circuits.

Contain control wiring within plastic wireways or in a harness.

Identify each end of each wire with a unique number using colour coded 'O' ring markers. Fit lugs at termination points.

Take account of thermal effects of grouping when routing power wiring.

All wiring is to be neatly arranged and securely fixed. Where appropriate protect by cartridge fuses complying to BS EN 60269-1, BS 88-1.

2180 LOW VOLTAGE COILS RATING:

Ensure coils for switching relays, contactors and other applications are capable of withstanding inherent voltage drop within system without armature or switching apparatus dropping out of position.

2191 FRAMEWORK:

Construct framework for supporting electrical equipment from mild steel plate and strip, cold and hot rolled steel sections or slotted angles, in accordance with BS EN 10210 and BS 4345 respectively. Comply with BS EN 1011-2 for metal arc welding.

Finish

Frameworks mounted inside building shall have a galvanized finish in accordance with BS EN 10346 or BS EN 10143.

Frameworks mounted outside building shall be hot dip galvanized to BS EN ISO 1461 following fabrication.

Supply cadmium or zinc electroplated bolts, nuts, washers and screws.

2201 FUSES:

Supply cartridge fuse links including fuse carrier, bases and associated components that comply with BS EN 60269-1, BS 88-1, fusing factor category gG, unless otherwise indicated.

Use motor circuit fuses where indicated.

2211 DISTRIBUTION BOARDS:

Comply with BS EN 61439-1 and 61439-2 and BS EN 61439-3, as appropriate. Enclosure to be steel,with hinged lockable cover, internal separation Form 1,degree of protection IP31, unless otherwise indicated. Make fuseboards fully shrouded. Fit each distribution board with an isolating switch, size as shown on the drawings.

Install busbars in same position relative to their fuse carriers or miniature circuit- breakers (MCBs) for each pole. In TPN distribution boards supply neutral busbars with one outgoing terminal for each outgoing circuit.
Neutral to be rated as phase conductor.

Provide a multi-terminal earthing bar for circuit protective conductors for both insulated and metal-cased boards, with one terminal for each outgoing circuit. Connect directly to earthing terminal without dependence on exposed conductive parts of enclosure.
Identify each protective device by numbering. Identify each terminal on neutral busbar and earthing bar with its respective protective device.
Provide durable, printed circuit identification chart inside enclosure.

Enclosures finish
Apply high standard finish to enclosure and supporting metalwork. Degrease metal and remove rust prior to applying finish.
Comply with paint manufacturer's recommendations regarding preparation, stoving times, temperatures, mixing of finishes, application and coat thickness.

Finish and colour as Manufacturer's standard unless otherwise stated.
When other than manufacturers standard finish is specified, samples for each type of paint system and for each colour shall be provided.

Provide spare ways, 25% or as indicated. Where specific ratings are indicated incorporate fuses or MCBs, otherwise leave ways blank complete with blanking covers for future additions.

Co-ordination in accordance with BS 7671 (IET Wiring Regulations)

Ensure that the relevant fault current (short-circuit) rating of each switchgear and controlgear assembly is greater than or equal to the maximum prospective fault current at the point of connection to the system.

Ensure that the relevant design current does not exceed the rated current of the assembly, or rated current of a circuit of the associated assembly, taking into account applicable diversity and loading factors.

Ensure that any devices and components are integrated into the assembly in accordance with the relevant parts of BS EN 61439.

Ensure all devices and components are declared suitable according to the assembly manufacturer’s instructions or literature.

2221 CONSUMER UNITS:

Comply with BS EN 61439-3. Supply consumer units with minimum degree of protection in accordance with BS EN 60529, IP31.

Where a consumer unit or similar switchgear is to be installed in a dwelling, ensure that it is constructed from, or installed in an enclosure that completely surrounds it that is constructed from, non-combustible material (metal), in accordance with BS 7671 (IET Wiring Regulations).
Provide fuses or miniature circuit-breakers and means of isolation as indicated.

Enclosures finish

For steel enclosure apply high standard finish to enclosure and supporting metalwork. Degrease metal and remove rust prior to applying finish.

Comply with paint manufacturer's recommendations regarding preparation, stoving times, temperatures, mixing of finishes, application and coat thickness.
Finish and colour as Manufacturer's standard unless otherwise indicated.

When other than manufacturer's standard finish is specified samples for each type of paint system and for each colour shall be provided.

Co-ordination in accordance with BS 7671 (IET Wiring Regulations)

Ensure that the relevant fault current (short-circuit) rating of each switchgear and controlgear assembly is greater than or equal to the maximum prospective fault current at the point of connection to the system.

Ensure that the relevant design current does not exceed the rated current of the assembly, or rated current of a circuit of the associated assembly, taking into account applicable diversity and loading factors.

Ensure that any devices and components are integrated into the assembly in accordance with the relevant parts of BS EN 61439.

2231 MINIATURE CIRCUIT-BREAKERS:

Standard

BS EN 60898-1 or BS EN 60898-2 for protection of AC circuits.

BS EN 60898-2 or BS IEC 60898-3 for protection of DC circuits.

Supply miniature circuit-breakers with voltage and current ratings, type according to instantaneous tripping current, rated braking capacity and frequency as drawings, scope of works or schedules.

Arc fault detection

Miniature circuit-breakers fitted with integral arc fault detection to comply with BS EN 62606.

Ensure devices with integral arc fault detection are placed at the origin of the circuit to be protected.

2235A ARC FAULT DETECTION DEVICE

Supply arc fault detection devices in accordance with BS EN 62606.

Ensure arc fault detection devices are placed at the origin of the circuit to be protected.

2235B COMBINED ARC FAULT DETECTION DEVICE WITH OVERCURRENT PROTECTION

Supply combined arc fault detection with over current operation in accordance with BS EN 62606 and BS EN 60898-1.

Ensure arc fault detection devices are placed at the origin of the circuit to be protected.

2235C COMBINED ARC FAULT DETECTION DEVICE WITH RESIDUAL CURRENT PROTECTION:

Supply combined arc fault detection with residual current operation in accordance with BS EN 62606 and either BS EN 61008-1 or BS EN 62423 as appropriate.

Ensure arc fault detection devices are placed at the origin of the circuit to be protected.

Select the residual current detection Type (AC, A, B or F) in accordance with BS 7671 (IET Wiring Regulations).

2235D COMBINED ARC FAULT DETECTION DEVICE WITH OVERCURRENT AND RESIDUAL CURRENT PROTECTION:

Supply combined arc fault detection with residual current/overcurrent operation in accordance with BS EN 62606 and either BS EN 61009-1, or BS EN 60898-1 plus either BS EN 61008-1 or BS EN 62423.

Ensure arc fault detection devices are placed at the origin of the circuit to be protected.

Select the residual current detection Type (AC, A, B or F) in accordance with BS 7671 (IET Wiring Regulations).

2241 RESIDUAL CURRENT DEVICE:

Comply with BS EN 61008 or BS EN 62423. Supply residual current circuit breakers (RCCBs) with rated voltage, rated current, rated tripping current, rated tripping time and rated breaking capacity as indicated.

DC component

Ensure DC component does not affect operation by selecting the residual current detection Type (AC, A, B or F) in accordance with BS 7671 (IET Wiring Regulations).

Rated Tripping Current

30mA unless otherwise indicated on the drawings.

Rated Tripping Time
30ms unless otherwise indicated on the drawings.
Fit with integral over current protection as detailed on drawings or schedules.
Refrigerators and deep freezers should not be connected to RCCB Protected Circuits unless written confirmation is obtained.

Supply combined residual current/over current operated circuit-breakers (RCBOs) to BS EN 61009

Where, as indicated on the drawings or schedules, RCDs are fitted with integral arc fault detection to BS EN 62606, ensure devices are placed at the origin of the circuit to be protected.

2242 RESIDUAL CURRENT MONITORS
Standard - BS EN 62020 IEC62020

2247 AUTOMATIC RECLOSING DEVICES FOR CIRCUIT BREAKERS AND RESIDUAL CURRENT OPERATED CIRCUIT BREAKERS WITH OR WITHOUT OVERCURRENT PROTECTION:
Where detailed in the scope of works or scheduled / indicated on the drawings, supply automatic reclosing devices (ARDs) for circuit breakers, residual current devices with overcurrent protection (RCBOs) and residual current circuit breakers (RCCBs) in accordance with BS EN 63024
Ensure automatic reclosing devices are only installed on devices protecting parts of the installation where access is restricted to instructed persons or skilled persons as defined in BS 7671 (IET Wiring Regulations).
Ensure a suitable warning notice is displayed near the points of access to parts of the installation controlled by automatic closing devices

2250 CABLE TERMINATIONS:
Ensure that switchgear and distribution boards are provided with facilities to terminate size, number and type of cable indicated. Where necessary use fabricated steel extension boxes for glanding large and multiple cables.
Provide non-ferrous metal glanding plates for single core cable terminations.

2251 TERMINAL BLOCKS FOR AUXILIARY WIRING:
Provide rail mounted moulded terminal blocks with fully shrouded connectors, segregation plates, and end clamps. Ensure insulating material is suitable for maximum operating temperature of conductors.
Provide connectors to clamp conductors between metal surfaces. Ensure clamping screws do not make direct contact with conductors. Ensure conductors maintain sufficient contact pressure to ensure negligible impedance. Make metal in contact with conductors 85% copper alloy and screws of metal electrolytically compatible with copper alloy.
Provide each terminal with marking tag fitted into moulded tag slots.
Provide test probe facilities and integral disconnecting device to facilitate testing on terminals for indication, instrumentation and metering.
Manufacture rails from steel, hot dipped galvanised after manufacture.

2252 COMPONENT MOUNTING:
Mount all components on removable back plates. Ensure no fixings protrude into busbar chamber.

2261 / 2271 STATIC CAPACITOR / AUTOMATICALLY CONTROLLED CAPACITOR BANKS:
Refer to schedules for details of when / where required.
Standards
BS EN 61921 and the following to suit the application.
BS EN 60143.
BS EN 60831.
BS EN 60871.
BS EN 60931.
BS EN 60110-1

Voltage rating of capacitor - 400V, 3-phase, 50 Hz.
Mounting – as detailed in schedules or scope of works.
Capacitor unit
Provide assembly housed in sheet steel enclosure complete with main terminals, comprising individual low loss, power capacitor elements and fuses to BS EN 60143-3 or BS EN 60871-4.
Capacitor unit assembly
Incorporate thermal equalizers within assembly of elements.
Fill enclosure with inorganic, inert and non-flammable granules.
Fit discharge resistors.
Ensure all internal and external connections are adequately rated and fully insulated.
Automatic bank enclosure - Manufacturer's standard.

2281 HARMONIC FILTER:
NA

2291 MEDIUM VOLTAGE IRON CORE FILTER REACTOR:
NA

2301 SWITCHGEAR AND CONTROL GEAR ACCESSORIES
Provide switchgear and controlgear accessories as indicated. Provide insulating mats along the operating length of each switchboard of minimum width 1,000mm. Provide all switchgear operating tools required for each switchboard. Provide 10% of the number of each size of fuses used as spare.

3000 WORKMANSHIP

3010 FIXING:
Fix all equipment independently of wiring system. Use cadmium or zinc electroplated bolts, nuts, washers and screws.

3021 MOUNTING HEIGHT:
Mount single items of equipment 1450mm above finished floor level to centre of equipment, unless otherwise indicated.

Arrange groups of equipment, other than floor mounted assemblies, so that all parts of equipment requiring access for operation or maintenance are at least 500mm and no more than 2000mm above finished floor level (max height of operating handles 1800mm), unless otherwise indicated.

3030 ACCESS:
Ensure that clearance in front of switchgear and controlgear is not less than 1m, or as indicated.

3031 ACCESS TO CONTROL COMPONENTS:
Arrange control components to ensure adequate access for operation and maintenance.

3032 ANCILLARIES:
Install ancillaries in accordance with manufacturer's instructions.

3041 MARKING:
Number terminals, cables and component parts to correspond with manufacturers certified drawings.

3051 CABLE TERMINATIONS:
Terminate paper-insulated cable by means of switchboard manufacturer's standard compound filled cable boxes.
Terminate PVC,XLPE and MICC cables inside enclosure by securing cables to switchboard with glanding plates or glanding brackets; and outside enclosure with glanding plates or fabricated steel extension boxes.

Provide cable support systems within the switchboards between cable entry point and connection to respective devices. Where multicore cables are glanded at a distance from device connection points the inner cable sheath should be maintained and supported and fixed within the switchboard.

3061 INSTALLATION AND COMMISSIONING:
Install and commission switchgear and controlgear in accordance with the appropriate standard and the manufacturers' recommendations. Include CT Polarity check in commissioning tests. Commissioning of all equipment to be carried out by relevantly qualified specialist personnel.

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1011 ELECTRICAL SUPPLY:

Ensure all electrical equipment supplied and installed is suitable for power supply indicated.

1041 CONTROL DETAILS

Control details for electrical switchboards are in Work Section V20 and for mechanical controls in Work Section W60 which must be read for details on control philosophy.

2000 PRODUCTS/MATERIALS

2010A CONTROLGEAR ASSEMBLY / LV SWITCHGEAR & COMPONENTS GENERALLY:

Standards - BS EN 61439-1, BS EN 61439-2, relevant parts of BS EN 60947 and BS EN 62626-1 for enclosed switch-disconnectors outside the scope of IEC 60947-3 to provide isolation during repair and maintenance work.

Usage - Control panel, Motor Control Centre (MCC) or single starter enclosure.

Conditions of installation - Indoors.

Electrical characteristics

Rated operational voltage, 400 V. Rated short-time withstand current, 20 times rated current.

Service conditions - Ambient air temperature and altitude to relevant parts of BS EN 61439.

EMC-Environment A - Light Industrial/Commercial

Co-ordination in accordance with BS 7671 (IET Wiring Regulations)

Ensure that the relevant fault current (short-circuit) rating of each switchgear and controlgear assembly is greater than or equal to the maximum prospective fault current at the point of connection to the system.

Ensure that the relevant design current does not exceed the rated current of the assembly, or rated current of a circuit of the associated assembly, taking into account applicable diversity and loading factors.

Ensure that any devices and components are integrated into the assembly in accordance with the relevant parts of BS EN 61439.

2021 ENCLOSURES:

For control equipment remote from MCC and not a package unit.

Standards

Enclosure standard BS EN 62208

Relevant parts of BS EN 61439

Mounting rails BS EN 60715

Material

Metal clad or

Impact resistant moulded plastic.

Degree of protection - BS EN 60529,

IP 31 for units installed inside buildings.

IP 55 for units installed in wet plant rooms (boiler / heating rooms, chiller rooms, pump rooms, water services rooms, air handling rooms with water systems etc).

IP 54 for units installed in ventilation / dry plant rooms.

IP 65 for units installed externally.

Finish and colour to Manufacturers standard unless otherwise stated.

2051 LV CONTACTORS AND MOTOR STARTERS:

Application: Mechanical plant control

Standards

BS EN 60947-4-1 and -4-2.

Solid state to BS 5424-2.

BS EN 61095.

BS EN 62626-1

Type of contactor

Air break.

Classification

Electromagnetic.

Rated operational voltage,current and poles to suit application.

Uninterrupted duty.

Utilization category (ac contactors)

AC3 for Direct-on-Line, Star Delta, Auto Transformer Starters.

AC4 for Direct-on-Line, Reversing Starter.

IP rating option

Enclosure degree of protection to BS EN 60529, IP 31, or IP 65 where BS EN 62626-1 applies.

Operational Performance not less that Table 10 of BSEN 60947-4-1

Mechanical durability 3 million no-load operations

2052 COIL POWER SUPPLY:

Contactor closing coil power supply:-

To match control operating voltage.

2053 AUXILIARY CIRCUIT CONTACTS:

Application to match specific control requirements.

Utilization category

AC15 for ac circuits to BS EN 60947-5-1.

DC13 for dc circuits to BS EN 60947-5-1.

Ensure mechanical and electrical endurances compatible with contactor.

2054 CO-ORDINATION WITH SHORT CIRCUIT PROTECTION DEVICES:

Provide co-ordination to Type `2' of BS EN 60947-4-1.

Unless otherwise indicated supply cartridge fuse links including fuse carrier, bases and associated components that comply with BS 88, utilisation category 'gC'.

Provide verification of co-ordination with short circuit protection devices.

2061 CONTROL CIRCUIT DEVICES

Standard – comply with BS EN 60947-5-1 for electromechanical control circuit devices including

Manual control switches; emergency stop; control relays; pilot switches; position switches; associated equipment; auxiliary contacts and indicating lamps.

2071 IN-BUILT ISOLATING SWITCHES/DISCONNECTERS:

Standard-BS EN 60947-3 or BS EN 60947-2 (MCCB) or BS EN 62626-1.

Provide independent manual operation with rated operational current and utilization category compatible with contactor.

Ensure drive disconnector isolates all circuits including those from external sources prior to allowing access to the interior of enclosure.

2081 IN-BUILT CONTROL SELECTOR SWITCHES:

Standard-BS EN 60947-5-1, BS EN 62626-1

Provide panel mounting independent manual operation rotary type switch to

select local/off/remote control.

and to match specified plant control requirements.

Ensure switch rated thermal current, rated operational current, and utilization category are compatible with contactor control circuit characteristics and circuit protection device.

2091 IN-BUILT PUSH BUTTONS:

Standard BS EN 60947-5-1

Provide panel mounting type push buttons with actuator colours to BS EN 60073 to suit application and as specified.

Ensure rated thermal current, rated operational current and utilization category of push button contacts are compatible with contactor control circuit characteristics and circuit protection device.

Emergency Stop buttons to incorporate mushroom actuator and require positive resetting action by key unless otherwise indicated.

2101 INDICATOR LIGHTS:

Supply lamps of same type throughout. Provide indicator lamps with lamp test facility. Supply interchangeable indicators for respective units.

Standard-BS EN 842 and BS EN 60947-5-1

For LED indicators, include a voltage suppressor on each LED.

Usage	Lamp Type
Switchboard	LED
Motor control centres	LED

Protect wiring to indicator lamp units by separate cartridge fuses.

Lens Colour in accordance with BS EN 60073.

2111 CONTACTOR CONTROL RELAYS:

Standard-BS EN 60947-5-1

Install relays in contactor enclosure or install relays in separate enclosures and interconnect relays with contactor control circuits as detailed.

Relay enclosure protection to BS EN 60529 compatible with contactor enclosure.

2121 CONTROL AND INDICATOR LIGHT CIRCUIT FUSES:

Provide in contactor enclosure separate low voltage fuse bases, fuse carriers and cartridge fuses for protection of control circuits and indicator light circuits.

Fuses

Fully shrouded impact resistant moulded plastic fuse bases and carriers in accordance with BS EN 60269, BS 88. Supply category gG cartridge fuses to BS EN 60269, BS 88 unless otherwise indicated.

Fuse-holders for miniature fuse-links to BS EN 60127-6.

Cartridge fuses (miniature fuses) in accordance with BS EN 60127-2.

2131 MOTOR STARTERS / VSD's- GENERAL:

Provide VSD's as scheduled or detailed in the project specific scope of works.

Provide fuses or circuit breakers for motors below 0.37 kW.

Provide starters incorporating over current protection for motors above 0.37kW and below 37 kW

Provide isolation during repair and maintenance work in accordance with BS EN 62626-1.

Provide starter with manual reset, adjustable, inverse time delay, and ambient temperature compensated thermal over current release to BS EN 60947-4-1. Ensure over current release is compatible with starting, accelerating and running characteristics of motor, starter and driven machine combination. Use phase unbalance protection on three phase equipment.

Provide starters incorporating solid state motor protection above 37kW and below 75 kW or as otherwise indicated.

Provide starters incorporating over current protection for motors above 75 kW

Provide starter with sensitive discriminating thermal magnetic over current relay with precise time/current characteristics to BS EN 61810. Protect motor against effects of sustained and cyclic over current, out of balance phase current, stalled condition and earth faults. Use running load indication type over current relays with accuracy of setting and indication within plus or minus 3 per cent, expressed as a percentage of setting indicated.

Unless detailed otherwise in the scope of works or schedules the type of starters or VSD's shall be dependent on the size of the motor, see table below. See Work Section or Schedules for particular requirements.

MOTOR STARTING METHOD	No starters	Direct On Line	Star-delta	Soft Start	VSD (Inverter)	Assisted start (auto transformer/ assisted start)
MOTOR SIZE RANGE & TYPE	Below 0.37kW	0.37-7.5kW	7.5-30kW	7.5-400kW	All sizes where speed control is required as described in the scope of works plant / equipment schedules or schedules W60sch1 or 2	As indicated

2141 MOTOR STARTERS - CURRENT LIMITING TYPE (SOFT START):
NA

2150 MOTOR STARTERS - DIRECT-ON-LINE TYPE:
NA

2161 MOTOR STARTERS - STAR DELTA TYPE:
NA

2170 MOTOR STARTERS - AUTO-TRANSFORMER TYPE:
NA

2180 MOTOR STARTERS - STATOR ROTOR TYPE:
NA

2191 VARIABLE SPEED MOTOR DRIVES (VSD'S)
Also refer to clause Y92 2085 and plant schedules.
Standards
Comply with relevant parts of BS EN 60204 for safety of electrical equipment.
Comply with relevant parts of BS EN 61800
Comply with relevant parts of BS EN 60068 for environmental testing.
Harmonics
Comply with BS EN 61000-3-12
Incorporate facilities into the drive to minimise harmonics generated at partial loads to ENA Engineering recommendation G5/4-1 limits.

Supply VSD tailor made for HVAC application with two built in PID controllers, built in HVAC application macros and real-time clock to control speed of standard AC Squirrel cage motors.
Type - Digital PWM, unless specified otherwise, 6 pulse inverters may be used for motor ratings up to and including 35kW with 6 pulse rectifiers used for motor ratings greater than 35kW.
Where a variable speed drive is integrated with a pump or fan it shall be isolated from any vibration from the pump / motor and have a life expectancy no shorter than the motor life expectancy.

For locations and mounting – refer to Work Section W60, scope of works or plant / equipment schedules when the VSD is part of the packaged plant or supplied by the plant manufacturer.

Control range 0.5 to 120 Hz.
Power factor – 0.97 lagging or better
Starting current not to exceed 1 x FLC.
Degree of protection from drive enclosure in accordance with BS EN 60529 to be as detailed in particular specification. If this is not detailed in the particular specification provide:
IP 55 for units installed in wet plant rooms (boiler / heating rooms, chiller rooms, pump rooms, water services rooms, where water jets could occur).
IP 54 for units installed in other plant rooms eg ventilation plant rooms where only splashing water could occur
IP 21 for units incorporated with enclosures / control panels.

Characteristics
Ensure acceleration and deceleration ramps are independently adjustable.
Allow connection to a turning motor without braking to a standstill.
Allow connection to a reverse wind milling fan without causing tripping and return fan to correct speed.
Ensure inverters require no additional means for starting.
Supply inverters that do not require electrical matching to motor.
Ensure inverters are capable of running motors in parallel.

Ensure electronic maintenance and commissioning can be carried out without motor being connected.

EMC characteristics to BS EN 61800-3, class C2.

Mains interruption

Ensure inverter does not cause tripping through a mains interruption of 200 msec unless otherwise indicated.

Protection

Ensure inverter incorporates the following protection to cause electronic shut down without operating circuit protective devices.

Motor phase to phase fault.
Motor phase to earth fault.
Over voltage.
Under voltage.
Inverter overheat.
Motor overheat.
Stall protection.
Loss of control signal.
Loss of auxiliary control voltage.
Current limit.
Overcurrent protection.
Phase loss detection.
Underload supervision.
Overload supervision.

VSD controls

Local/remote facility to be provided where appropriate for operational and maintenance use.

Provide a means of running at a fixed, selectable speed on closure of a remote volt free contact. Ensure this over-rides the normal speed control reference signal.

Display

Make provision for inverter to display externally, external and internal faults following a failure.

Show 1st, 2nd and 3rd up sequential faults.

Provide digital readout to show

Output frequency Hz.
Reference 1 (Hand).

Reference 2 (Auto).
Motor current (% or Amps).
Torque (% x PN).
DC Link voltage (%).
Temperature (°C).
Fault memory.

Provide volt free remote signalling contacts to indicate:

Over current.
Frequency alarm.
Common fault.
Reference fail alarm.
Running/stopped conditions.
Healthy/tripped conditions.

Ensure parameters can be set and fault memory interrogated with door closed, and without additional instrumentation.

Cooling

Ensure the free space around the drive is in accordance with the manufacturer's recommendations for ventilation and maintenance.

When installing a VSD in a control panel cabinet or MCC, provide ventilation openings and if required cooling fans in the cabinet to ensure air cannot be recirculated such that the cooling air does not exceed the unit ambient maximum operating temperature.

Provide isolation during repair and maintenance work in accordance with BS EN 62626-1

2201 AUTOMATIC CHANGEOVER FOR RUN/STANDBY DUTY:

NA

2221 CONTROL CIRCUIT POWER SUPPLIES /TRANSFORMERS:

Provide control circuit transformers to supply power at voltages to suit control components.

Standard

Use transformers in accordance with BS EN IEC 61558-1 and either BS EN 61558-2-2 or BS EN 61558-2-6 and provide an external label of approved type and size.

Protection - primary and secondary fuses.

2231 SWITCHING AND INDICATION:

Provide switches, indicating lamps, instruments and controls of uniform appearance and physically protected.

Switches and indicators to be fitted on panel or access doors and unless otherwise indicated shall be:

Motor circuit isolating switches.
Stop/Start/Reset push buttons.
Auto/Off/Manual control selector switch.
Run and trip indicator lights.

2241 AUDIBLE ALARMS:

Provide audible alarm system as specified in Work Section.

2251 (PROGRAMMABLE LOGIC CONTROLLERS):

Provide programmable logic controllers in accordance with BS EN 61131, the manufacturer's recommendation and the specified control requirements. Provide an isolator for the Programmable Logic controller. Programming language standard - BE EN 61131. Install PLC in separate compartment with viewing window.

Control system communications to BS EN 61158-2.

2261 STARTER AND CONTROL PANEL INTERNAL WIRING:

Standards

BS 6231 for polyvinyl chloride (PVC) tri-rated switchgear cable
BS EN 50525-3-41 for Low Smoke Zero Halogen (LSZH) cable

Wiring coding, selection, installation and termination to BS EN 60445, BS EN 61439-series, BS EN 60204-1 and BS 7671, as relevant.

Ensure dedicated telecommunications functional earth conductors are identified, and labelled 'TELECOMMS FUNCTIONAL EARTH' in accordance with BS 6701.

Ensure combined protective earthing and functional earthing conductors are identified as protective conductors.

Control wiring

Segregate control and auxiliary contact wiring from power circuits. Contain control wiring in slotted plastic trunking.

Provide electrical separation for voltages of different bands in accordance with BS 7671, BS EN 60204-1 and BS EN 61439-series as relevant.

Power wiring

Take account of thermal effects of grouping when routing power wiring.

All wires

Identify each end of each wire with a unique wire number according to the control panel drawings and cable schedule.

Terminate wiring intended for screw terminals with ferrules to facilitate fault-finding and maintenance replacement.

2271 COMPONENT MOUNTING:

Mount all components of the switchgear and controlgear in accordance with the manufacturer's instructions.

Mount control components on removable back plates.

2281 CONTROL SYSTEM FUNCTION CHARTS

Prepare function charts for the control system in accordance with BS EN 60848. Obtain approval of function chart before design of system hardware or writing control software.
Function chart format - Combined function chart/circuit diagram.

3000 WORKMANSHIP

3011 INSTALLATION:

Install contactors, starters, VSD's and control panels / MCC's in accordance with relevant parts of BS EN 60947 and manufacturer's recommendations.

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Y73 – Luminaires & Lamps

Incorporates clauses from V41 – Street/area/flood lighting & some stds in NES V21

1000 GENERAL

Lamps and related equipment to comply with EU Regulation 2015/1428 with regard to ecodesign requirements.

1010 STANDARDS:

Supply luminaires and lamps as indicated to standards as appropriate.

1011 BUILDING REGULATIONS

The contractor shall ensure that all luminaires comply with the Building Regulations (Part B2 section 6) with respect to their fire retardant properties, in the configuration indicated on the drawings.

1012 PARTICULAR REQUIREMENTS

Provide luminaires as indicated in the Schedules and/or drawings.

2000 PRODUCTS/MATERIALS

2011 LUMINAIRES:

Standards

Supply luminaires with photometric data in accordance with relevant parts of BS EN 13032.
Ensure luminaires of similar type have same photometric performance as published data within the tolerances defined by the standard.

Supply luminaires with performance in accordance with:

BS EN 62722-1 in general.
BS EN 62722-2-1 for LED luminaires.
BS EN 62922 for organic LED (OLED) panels.

Supply luminaires in accordance with relevant parts of BS EN 60598 and BS 4533 where still current as below: (Luminaires with type “n” protection to comply with BS EN 60079-15 and BS EN IEC 60079-7)

- Fixed general purpose luminaires to BS 4533 Section 102.1 (BS EN 60598-2-1).
- Recessed luminaires to BS EN 60598-2-2.
- Luminaires for road and street lighting to BS 5489-1 and BS EN 60598-2-3. Photoelectric controller to BS 5972
- Floodlights to BS EN 60598-2-5, N Protection to BS 4533 Section 102.51. Floodlight towers steel structures to BS EN 1993-3-1
- Luminaires for hospitals and health care buildings to BS EN 60598-2-25.
- Luminaires with limited surface temperature to BS EN 60598-2-24
- LED modules for general lighting to BS EN 62031 and BS EN 62717
- Transilluminated traffic bollards to BS EN 12899-2
- Rope lights to BS EN 60598-2-21.
- Luminaires for stage lighting, television and film studios to BS EN IEC 60598-2-17
- Presentation of data for luminaires used for road lighting to be in accordance with BS EN 13032-5

General requirements and tests / classification BS EN 60598-1 as indicated.

Safety

Fit luminaire with cover glass to protect against ultra-violet emission and risk from explosion of lamps where scheduled.
Ensure ground recessed luminaires are selected and installed in accordance with the guidance provided in Table A.1 of BS EN 60598-2-1, with respect to their location and intended application.

Safety support for Components - Provide secondary support for translucent covers, diffusers and gear trays so they are prevented from falling when their primary fixing is released.

Electromagnetic Compatibility- Ensure luminaires comply with BS EN 61547 for EMC immunity.

Comply with relevant parts of BS EN 61995 for devices for the connection of luminaires.

2021 EMERGENCY LIGHTING LUMINAIRES:
Comply with BS EN 60598-2-22.
Comply with ICEL:1001. Ensure emergency lighting luminaires are marked with ICEL certification label.

2030 EXIT SIGNS:
Comply with 5499-4.

2041 HAZARDOUS AREA LUMINAIRES:
NA

2050 SIGNS & HIGH VOLTAGE INSTALLATIONS:
NA

2055 OPTICAL FIBRE LUMINAIRES
NA

2057 LED LUMINAIRES:
Standards
Supply luminaires with photometric data in accordance with relevant parts of BS EN 13032
Supply luminaires in accordance with BS EN 60598
Supply luminaires with performance in accordance with BS EN 62722-1 and BS EN 62722-2-1
Classification to BS EN 60598-1
Safety support for components
Provide secondary support for translucent covers, diffusers and gear trays so they are prevented from falling when their primary fixing is released.
Photometric performance
Ensure luminaires of similar type have same photometric performance as published data within the tolerances defined by BS EN 13032-1
Electromagnetic compatibility
Ensure luminaires comply with BS EN 61547 for EMC immunity.

2061 LAMPHOLDERS - GENERALLY:
Standards
Ensure lampholders are suitable for use with corresponding lamp caps to - BS EN 60061-1.
Lamp holders - BS EN 60061-2. Enhanced safety type BS 7895.
Bayonet lampholders - BS EN 61184.
Lampholders for tubular fluorescent lamps and starter holders - BS EN 60400.
Edison screw lampholders - BS EN IEC 60238.
Lampholders of miscellaneous types for building-in (e.g. projection lamps, floodlighting lamps etc) - relevant parts of BS EN 60838

Interchangeability - Ensure lampholders in luminaires of similar type and rating are identical.
Earthing - Ensure metal lampholders incorporate an earthing terminal.
Material - When plastic is used in the lampholder it shall be heat resistant moulded plastic.

2080 LAMPHOLDERS - MOUNTING:
Securely mount lampholder in luminaire when it is sole support for lamp.
Cord grip - provide integral cord grip type when lampholders are suspended by cord.
Conduit Mounted - when mounted directly to conduit system use backplate lampholder for conduit box.

2090 CONTROL GEAR AND COMPONENTS
Comply with all parts of BS EN 61347 / BS EN IEC 61347
Compatibility

Ensure control gear and components are suitable for lamp type, wattage, starting characteristics, and luminaire environment.
Obtain from manufacturers written confirmation of compatibility.

Efficiency tested in accordance with the relevant parts of BS EN IEC 62442 to suit lamp type selected.

Lighting control interface for dimming (Analogue voltage dimming interface for electronic current sourcing control gear) to BS EN IEC 63128

2101 FLUORESCENT LAMP BALLASTS AND STARTERS:
NA

2110 DISCHARGE LAMP BALLASTS AND STARTERS:
NA

2115 LED MODULE CONTROL GEAR:
Provide LED module control gear to BS EN 61347-2-13 and BS EN 62384.

2120 CAPACITORS:
Use capacitors in accordance with BS EN 61048 and BS EN 61049 in tubular fluorescent, high pressure mercury and low pressure sodium vapour discharge lamp circuits.

2130 SUPPLY TERMINALS:
Use screw terminals for supply cables and circuit protective conductors, sized to terminate up to three 2.5mm2 conductors. Provide separate terminal blocks for each incoming circuit, with marking to identify each circuit.

2141 FUSE:
Include a fuse holder and BS 1362 fuse in each incoming circuit phase connection for fluorescent and discharge luminaires.

2150 INTERFERENCE:
Comply with BS EN 55015 .

2160 REMOTE GEAR:
Locate control gear in separate lockable cabinet of sheet steel with same degree of protection and finish specified for luminaire. Comply with manufacturer's recommendations for cable type and maximum length between gear and lamp.

2180 FLUORESCENT LAMPS:
NA

2182 FLUORESCENT INDUCTION LAMPS:
NA

2185 TUNGSTEN HALOGEN LAMPS
NA

2190 HIGH PRESSURE MERCURY VAPOUR LAMPS:
NA

2192 METAL HALIDE LAMPS:
NA

2200 HIGH PRESSURE SODIUM VAPOUR LAMPS:
NA

2210 LOW PRESSURE SODIUM VAPOUR LAMPS:
NA

2215 LED LAMPS / MODULES:

Standards

BS EN 50564 for measurement of low power consumption.

BS EN 62031 for measurement of low power consumption.

BS EN 62612 for performance requirements and BS EN 62560 for safety specifications - self-ballasted LED lamps, for supply voltages > 50 V.

BS EN 62838 for LEDsi lamps with supply voltage not exceeding AC 50 V or ripple-free DC 120 V.

BS EN 62868 and BS EN 62922 for Organic LED (OLED) panels.

LED modules control gear

BS EN 62717 for performance requirements

BS EN 62031 for safety requirements

BS EN IEC 62386-207 for digital addressable lighting interface (DALI) control gear.

BS EN 61347-2-13 and BS EN 62384 for control gear.

2221 TRANSFORMERS FOR LV LUMINAIRES

NA

2230 LAMP MANUFACTURER:

Ensure that lamps of each type are from same manufacturer.

2241 SUPPORT SYSTEM - CONDUIT/TRUNKING:

Use not less than 20mm conduit of same type as main conduit system. Trunking type and size as indicated on drawings.

2251 SUPPORT SYSTEM - ROD:

Use continuously threaded rods with matching washers and nuts, minimum 6mm diameter and a carrying capacity of not less than twice the weight of the complete luminaire. Material, Cadmium plated steel unless otherwise indicated.

2260 SUPPORT SYSTEM - CHAIN:

Use cadmium plated steel chain with load carrying capacity of not less than twice weight of complete luminaire.

2271 SUPPORT SYSTEM -FLEXIBLE CORD:

Use size and type as appropriate. Confirm temperature rating is suitable for operating temperature of luminaire or lampholder. Confirm that cord is adequate for mass to be supported.

2280 SUPPORT SYSTEM - WALL BRACKETS:

Provide wall brackets. Confirm wall brackets are suitable for supporting luminaire.

2290 SUPPORT SYSTEM - BALL AND SOCKET:

Provide ball and socket as top support, complete with cover fixed to circular conduit box.

2295 SUPPORT SYSTEM – WIRE ROPE

Standards BS EN 12385-1, BS EN 13411-3, BS EN 13411-4, and BSRIA COP 22/2002

Use proprietary Wire Rope Suspensions Systems comprising of stainless steel components.

2301 COLUMNS AND BOLLARDS:

Standards

BS EN 40-2, BS EN 40-5, BS EN 40-6, BS EN 40-7 and BS EN 12767

Material, finish, height and lamp as specified in Work Section or on drawings.

Applied loads-Supply columns designed for additional externally applied loads 3 times luminaire mass.

Cutout and fuses to BS 7654 -Provide cut-out fuses and cable termination within accessible, lockable services enclosure.

Earthing-Include earthing terminal fixed within service enclosure.

Column base plate-Manufacturers standard.

2305 LIGHTING COLUMN/BOLLARD SWITCHGEAR:

Comply with the following unless detailed otherwise in the schedules or scope of works.

Service compartment

Standards

BS EN 40-2 for general requirements of lighting columns

BS 7671

Accessible only by use of a key or tool

Rating to BS EN 60529 - IP44.

Switchgear and circuit protection

Enclosure

Standard BS EN 61439

IP Rating to BS EN 60529 - Drip-proof to a minimum of IP31.

Circuit protective devices/Isolators

Standard

BS EN 60898

BS EN 61008

BS EN 61009

BS EN 60269, BS 88

BS EN 60947

Means of isolation

Double-pole isolator switch with key-lockable lock off facility or Double-pole mcb or RCBO with key-lockable lock off facility.

3000 ACCESSORIES

3011 TRACK LIGHTING:

NA

3021 INTEGRAL PHOTO-CELLS:

Incorporate integral photo-cell on luminaire where indicated, or provide photo cell control as indicated.

3031 AIR HANDLING LUMINAIRES:

NA

4000 WORKMANSHIP

4011 ORIENTATION:

Install luminaires in accordance with the drawings, and in horizontal plane unless otherwise indicated. Orientation of lamps to be consistent throughout installation.

4021 CLEANLINESS:

Ensure luminaires are clean and grease free on handover.

Use gloves to prevent contamination of optical components as recommended by the manufacturer.

4031 INSTALLATION OF RECESSED FITTINGS:

Install luminaires flush with finished ceiling level.

Install ground recessed luminaires taking into account the guidance given in Table A.1 of BS EN 60598-2-13.

4040 INSTALLATION OF SEMI-RECESSED FITTINGS:

Install luminaires as manufacturer's detail.

4050 INSTALLATION OF WALL MOUNTED FITTINGS:

Install luminaires at height indicated.

4061 MATERIAL OF SUPPORTING SURFACE:
Ensure classification of luminaires is appropriate. Do not mount luminaires on or adjacent to readily flammable surfaces.

4070 INSTALLATION IN POTENTIALLY EXPLOSIVE ATMOSPHERES:
NA

4080 LUMINAIRES IN AREAS WITH INFRA-RED CONTROL SYSTEM:
Install luminaires in areas with infra-red control systems or data bearers so as to cause minimum disturbance to the infra-red transmission system in accordance with BS 7693.

4101 INSTALLATION OF EXTRA LOW VOLTAGE TUNGSTEN HALOGEN LAMPS:
NA

4110 SUPPORT
Ensure support is adequate for weight of luminaires.
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

4120 SUPPORT FROM CONDUIT:
Where luminaire is supported from conduit provide a conduit box forming an integral part of conduit system at each point of suspension. Ensure suspensions are vertical.
Where conduit enters luminaire use back-nuts and washers to secure luminaire body to conduit support. Provide tube with corrosion resistance equal to conduit system.
Do not support luminaires directly from conduit boxes made from non-metal or heat sensitive materials, where the temperature of the material may exceed 60°C or the mass suspended exceeds 3kg.

4130 SUPPORT FROM TRUNKING:
Where luminaire is supported from trunking use proprietary clamps or brackets appropriate to the luminaire and trunking.
Do not support luminaires directly from trunking made from non-metal or heat sensitive materials, where the temperature of the material may exceed 60oC or the mass suspended exceeds 3kg.

4141 SUPPORT BY DIRECT FIXING:
Refer to fixing methods as manufacturer's recommendations.

4151 SUPPORT IN SUSPENDED CEILING:
Support luminaires directly from building fabric and independent of ceiling unless otherwise indicated.

4160 SUSPENSION:
Suspend luminaires at height indicated. Ensure suspensions hang vertically unless otherwise indicated.

4170 SUSPENSION BY ROD:
Use washers, nut and lock-nut at top and bottom of rod. Paint cut ends with calcium plumbate primer or zinc rich paint.

4180 SUSPENSION BY CHAIN:
Use hook cover for suspension from circular conduit box. For connection to luminaires use luminaire manufacturer's own chain hook, but if not available use hook with standard screw threaded body to be secured to luminaire body with nuts and washers. Where indicated use captive hooks.

4190 SUSPENSION BY FLEXIBLE CORD:

Suspend cord from ceiling rose.

4200 SUSPENSION BY BALL AND SOCKET:
Install cable through ball and socket connected to conduit box.

4205 WIRE ROPE SUSPENSION SYSTEM:
Only use where specified within the Scope of Works or Schedules.
Proprietary Wire Rope Suspensions Systems which comply with BS EN 12385-1, BS EN 13411-3, BS EN 13411-4, and BSRIA COP 22/2002. Wire Rope Suspensions to be suitable for the safe working load and comprise Stainless Steel grade 316 wire rope, Stainless steel grade 302 Spring fasters with fixings by loops, stud (permanently fixed to wire rope length) or toggle as appropriate. The installation shall comply with BSRIA COP 22/2002

4211 COLUMNS AND BOLLARDS
Location-Confirm location before excavation.
Bases- Install bases or supervise work by others.
Mounting-Mount column or bollard on base as recommended by manufacturer.
Ensure columns and bollards are vertical.
Earthing-Install circuit protective conductor to connect luminaire to earthing terminal in service compartment; size circuit protective conductor same as live conductors. Bond accessible metal parts of column or bollard to earthing terminal.

4220 CONNECTIONS TO LUMINAIRES
Cable Protection -Use appropriate size of grommet where cables enter through hole in luminaire body.
Earthing-Ensure that the earthing terminal of luminaire is connected to the conduit protective conductor of the supply circuit.
Loose Wiring-Clip or tie back with suitable proprietary devices loose wiring within luminaire, at 300mm intervals.

4231 CONNECTIONS TO LUMINAIRES - DIRECT TO CONDUIT:
Terminate circuit wiring in luminaire terminal block using loop-in system taking all conductors through same cable entry of luminaire , unless stated otherwise in work section V21.

4241 CONNECTIONS TO LUMINAIRES - DIRECT TO TRUNKING:
For lighting trunking terminate wiring in luminaire terminal block using loop-in system taking all conductors through the same cable entry of luminaire, unless stated otherwise in work section V21.

4250 CONNECTIONS TO LUMINAIRES - SUSPENDED FROM TRUNKING:
Where luminaires are suspended from trunking, secure plug and socket type ceiling rose to BS 546, adjacent to, or on side of, trunking. Terminate circuit wiring at socket. Take flexible cord from plug of ceiling rose to supply terminals of luminaire.

4261 CONNECTIONS TO LUMINAIRES - RECESSED FITTINGS:
Where luminaires are recessed in a suspended ceiling, terminate circuit wiring at plug and socket type ceiling rose to BS 546, located not more than 500mm from the access through the ceiling. Use flexible cord from plug of ceiling rose to supply terminals of luminaire.

4270 CONNECTIONS TO LUMINAIRES - CONDUIT SUSPENSION:
Terminate circuit wiring in terminal block within supporting conduit box. Use flexible cable from terminal block to luminaire, installed within tube.

4280 CONNECTIONS TO LUMINAIRES - ROD OR CHAIN SUSPENSION:
Terminate circuit wiring in terminal block within supporting conduit box. Use flexible cord from terminal block to luminaire and clip cable to one of the rods or chains, do not weave cable through links of the chain.

4290 CONNECTIONS TO LUMINAIRES - MICS CABLE:
Fix cable gland to luminaire and continue conductors to supply terminals of luminaire.

4301 LIGHTING SWITCHES ON DIFFERENT PHASES:
When lighting switches on different phases are in a common box, use phase barriers in accordance with BS 7671. Provide warning label.

10000 NES Y73 TEXT Dec 19 and V41 June 17

Y74 – Accessories for Electrical Services

1000 GENERAL

Install all switches, controls, outlets and meters in accordance with BS 8300 Parts 1 and 2 and legislation appropriate to the building location.

1010 APPLICATION:

Supply fixed electrical wiring accessories for use with fixed and portable peripheral equipment using either power or signalling cables.

1020 SAMPLES:

Where indicated submit samples of proposed materials and equipment for approval before work is started. Label each sample with name, catalogue number and services in connection with item.

1021 ACCESSORIES SUPPLIER:

Unless otherwise indicated source all accessories from the same manufacturer.

2000 PRODUCTS/MATERIALS

2011 ACCESSORIES - COMMON REQUIREMENTS

Provide accessories as detailed in the Work Sections / schedules and shown on drawings.
General requirements for electrical accessories to BS 5733.
Boxes and enclosures for electrical accessories to BS EN 60670 series.
Area of installation – as detailed in particular specification.
Enclosure box to BS 4662 for recessed (flush) mounting, with performance and safety standards in accordance with BS EN 60670-1.
Enclosure box to BS 5733 for surface mounting
Unless scheduled otherwise, degree of protection to BSEN 60529

IP30 Interior
IP54 Exterior

Hazardous area classification to BS EN 60079-14 as scheduled.
Enclosure degree of mechanical protection IK code to BS EN 62262 as scheduled.
Switches for Home and Building Electronic Systems (HBES) to comply with BS EN 50428 or BS EN 60669-2-5.
Coverplates to be overlapping unless otherwise specified
Enclosure material and finish to match conduit system. Enclosures to be recessed unless otherwise specified.

2021 INTERIOR LIGHTING SWITCHES:

Standard
BS EN 60669-1
Enclosure box to BS 4662, BS 5733 or BS EN 60670-1 as appropriate
Switchtype

Switches shall incorporate rocker bars unless otherwise specified. For emergency lighting a secret key switch shall be used with rocker bars as other switches in that area. If dimmers and/or press switches are shown on drawings then they shall be of the same rocker bar pattern as the switches in that area.

Rating of all the switches to be 15A. Mounting to be on an adjustable steel grid. All switches shall have a snap action microgap mechanism. Pole configurations as indicated on the drawings.
Electronic control switches e.g. dimmer switches and time switches are to comply with relevant part of BS 60669,
Ancillaries

Earthing terminal integral within switch box.
Blank inserts in all spare ways.
Neon's, shrouds, red rocker bars and operating keys as specified.

2022 PULL CORD SWITCHES

Standard

BS EN 60669-1 and BS EN 61058-2-1.

Rating of all the switches to be 16A for lighting circuits and 40-45A for showers, fans etc as specified. Mounting shall be surface. All switches shall have a snap action microgap mechanism. Pole configurations for 40-45A switches shall be DP and for 16A as specified (ie 1 way, 2 way, SP or DP).

Ancillaries

Earthing terminal integral within switch box.

Neon indicator lamp.

Integral patress for surface mounting.

2031 EXTERIOR LIGHTING SWITCHES:

Standard

BS EN 60669-1.

Enclosure box to BS 4662, BS 5733 or BS EN 60670-1 as appropriate.

Switch type shall be either rocker bar with sealed-in plastic membrane or rotary disc or lever operating through sealing gland. Rating of all switches shall be 15A. Action shall be two position, unless otherwise stated. Enclosure pattern shall be weatherproof and shall be surface, unless otherwise stated. Enclosure material shall be galvanized cast iron or impact resistant moulded plastic.

Ancillaries

Earthing terminal integral within switch box.

For neon etc shall be as indicated on the drawings.

2041 TIME SWITCHES:

Wire timer and switch circuits to separate terminals. Information regarding control and additional specification for time switches used for lighting is in work section V21, for all other uses see work section V20.

Standard BS EN 60730-2-7.

Time switch type shall be quartz stabilized motor with 30 hour spring reserve or quartz stabilized solid state with a minimum of 50 hour nickel cadmium battery backup unless otherwise specified.

Enclosure shall be dustproof sheet steel or impact resistant moulded plastic with viewing panel and arranged for conduit entry, unless otherwise indicated.

2051 LUMINAIRE CONNECTORS:

Rating shall be 5A.

Connector type

Load carrying captive cord grip type plug/socket and clip-on cover to BS 5733, BS 546 or BS 5733 Load Supporting BS 7001 (3 or 4 pin as appropriate).

Load carrying capacity to match connected luminaire.

Cover plate finish white moulded plastic.

2071 ISOLATING SWITCHES:

Provide isolating switches for fixed appliances, with utilization category and making capacity as indicated.

Standard - BS EN 60669-1

Enclosure box to BS 4662, BS 5733 or BS EN 60670-1 as appropriate.

Standard – BS EN 60947-3

Enclosure box - BS 4662, BS 5733 or BS EN 60670-1, BS EN 60947-3.

Isolation during repair and maintenance - BS EN 62626-1

Standards - BS EN 60669-1 and BS EN 60669-2 or relevant parts of BS EN 61058 or BS EN 60947-1 / BS EN 60947-3 and BS EN ISO 62626-1 to suit the application.

Mounting to be on an adjustable steel grid. Engrave front plate to indicate equipment served.

Switch type toggle.

Ancillaries

Earthing terminal integral within switch box.

Neon indicator with red lens.
Cord outlet with cord grip.

2081 FUSED CONNECTION UNITS SWITCHED AND UNSWITCHED:
Standard - BS 1363-4.
Enclosure box to BS 4662, BS 5733 or BS EN 60670-1 as appropriate.
Engrave front plate to indicate equipment served.
Pole configuration to be DP switched or unswitched as shown on the drawings.
Ancillaries
Fuses to BS 1362 sized as indicated.
Cord outlet and cord grip, where scheduled.
Neon indicator where scheduled.

2091 SOCKET-OUTLETS:
Standards
13A socket-outlet to BS 1363-2 (2016 or later)
13 A plug tops to BS 1363-1.
Enclosure box to 4662, BS 5733 or BS EN 60670-1 as appropriate.
Home and Building Electronic systems to BS EN 60669-2-5.
Where RCD is incorporated the RCD to be in accordance with BS 7288.
Gangs - 2.

Socket outlets shall be single or twin and DP switched or unswitched as shown on drawings. The rating shall be 13A. Provide separate earth terminals for termination of cpc's suitable for high protective conductor currents, where scheduled or where circuits are identified.
Ancillaries
Plug tops, provide for 25% of outlets.
Where protected outlets specified extend outlets to have either a spring flap covering whole of outlet, or screw type weathering cap and chain.
Neon indicator where specified.

2091F SOCKET-OUTLETS - DOUBLE WITH INTEGRAL USB CHARGING, SWITCHED:
Standard
Socket-outlet to BS 1363-2 (2016 or later).
Enclosure box to BS 4662, BS 5733 or BS EN 60670-1 as appropriate.
HBES systems to BS EN 50428 or BS EN 60669-2-5.
USB charging in accordance with BS EN 62680-1-1
Switching - Switched.
Rating - 13 A.
Ancillaries - two USB charging socket-outlets
Gangs - 2.

2091H SOCKET-OUTLETS - INDUSTRIAL, UNSWITCHED:
Standard
Socket-outlet to BS EN 60309-2.
Enclosure box to BS 5733 or BS EN 60670-1 as appropriate
Voltage, poles, interlocking and BS EN 60529 ingress protection rating
Ensure socket-outlets have an ingress protection rating not less than IP44.
Ensure socket-outlets for use outdoors or in areas with sprays, water jets or excessive splashing have an ingress protection rating of not less than IP66

2091I SOCKET-OUTLETS - INDUSTRIAL, SWITCHED:
Standard
Socket-outlet to BS EN 60309-2, switched socket-outlet assembly BS EN 60309-4.
Enclosure box to BS EN 60309-4, BS 5733 or BS EN 60670-1 as appropriate.
Isolation provided for use during repair and maintenance in accordance with BS EN 62626-1
Voltage, poles and BS EN 60529 ingress protection rating
Ensure socket-outlets have an ingress protection rating not less than IP44.

Ensure socket-outlets for use outdoors or in areas with sprays, water jets or excessive splashing have an ingress protection rating of not less than IP66

Ancillaries and interlocking - as scheduled.

2095 DUAL USB CHARGING OUTLETS:

Standard

Electrical safety to BS EN 62368-1 or BS EN 60950-1.

Enclosure box to BS 4662, BS 5733 or BS EN 60670-1 as appropriate.

HBES systems to BS EN 50428 or BS EN 60669-2-5.

USB battery charging in accordance with BS EN 62680-1-1

Supply voltage: AC 230 V 50 Hz.

USB charging socket-outlets

Quantity - 2.

Output voltage and current to BS EN 62680-1

Ensure that the BS EN 60664-1 installation overvoltage category is suitable for the intended installation conditions at the point of connection to the fixed installation in accordance with BS 7671 (IET Wiring Regulations).

2101 COOKER CONTROL UNIT:

Standard - BS 4177. Enclosure box to BS 4662, BS 5733 or BS EN 60670-1 as appropriate.

With integral 13 A switched socket-outlet and pilot light.

Pole configuration to be DP switched. The rating shall be 45A.

2111 CORD OUTLETS:

Standard - BS 5733 and BS EN 61058-2-1.

Engrave front plate to indicate equipment served. Rating shall be 20A for all outlets except cooker and for cooker outlets 45A. Pole configuration to be DP & E.

Ancillaries

Cord grid. Cord Set to BS EN 60799.

Terminal block sized for cables.

For cooker 2x10mm^2, for all others 2x2.5mm^2

2121 CABLE AND APPLIANCE COUPLERS:

Standards

Industrial couplers, BS EN 60309-1, BS EN 60309-2.

Appliance couplers for household and similar general purposes BS EN 60320-2-2.

Material polycarbonate male and female type connectors.

Colour

25V, Violet.

50V, White.

110 - 130V, Yellow.

220 - 240V, Blue.

380 - 415V, Red.

500 - 750V, Black.

Degree of protection to BS EN 60529

Internal- IP 44.

External - IP 67

Ancillaries as indicated on drawings. RCD's in accordance with BS 7288.

2125 REMOTE CONTROL STATIONS

Standard - BS EN 60947-5-1

Actuator colours and marking to BS EN 60073.

Ensure rated thermal current, rated operational current and utilisation category of contacts are compatible with control circuit characteristics and circuit protection device.

Provide local isolation of equipment for safe maintenance, where necessary, to:

Relevant parts of BS EN 60947, BS EN 62626-1 as appropriate.

2131 TELEPHONE AND DATA OUTLET SOCKETS:

Standard - For jack socket to BS 6312-2.1 and BS 6312-2.2 or RJ 45,LJU.

Size shall be standard unless otherwise indicated. Circuit configurations as indicated on drawings. Connections shall be insulation displacement type unless otherwise indicated.
Enclosure box to BS 4662.

2151 D TYPE MULTIPIN CONNECTORS:

Circuit configurations as indicated on drawings. Connections shall be solder terminals. Size and circuit configuration (single or twin) shall be as indicated on drawings.

2161 BNC SOCKETS:

Circuit configurations as indicated on drawings. Connections shall be crimp terminals. The impedance of the outlet shall be 75 ohm. The mounting shall be insulated unless otherwise indicated. Connections shall be insulation displacement type unless otherwise indicated.
Ancillaries shall be dust caps for sockets unless otherwise indicated.

2171 AERIAL SOCKETS:

Standards BS EN 50083 and BS EN 60728-11
Circuit configurations (single or twin UHF, VHF, TV, FM or DAB or satellite Intermediate frequency as indicated on drawings. Connections shall be insulation displacement type unless otherwise indicated
Ancillaries safety isolation to CAI recommendations for communal aerial systems.

2181 LOW VOLTAGE ISOLATING TRANSFORMER UNITS:

Standards

BS EN IEC 61558-1 for general safety requirements for transformers
BS EN 61558-2-4 for isolating transformers
BS EN 61558-2-6 for safety isolating transformers
BS EN 61558-2-15 (in medical locations).

The configuration shall be single phase, double wound. Rating - Input 230V/ Output power 1500VA, unless otherwise indicated on the drawings.

Type	Output Voltage	Description
V1	110V	For power tools in plantrooms with plug and socket to BS EN 60309-1
V2	24V	For portable lights in plantrooms
V3	110/24V dual	For power tools and portable lights in plantrooms

Ancillaries – Unless scheduled otherwise

Plug and socket for 110V, Plug and socket for 25V, DP switch primary supply, Centre tapped secondaries, secondary side fusing.

2191 SHAVER POINTS:

Provide shaver points, internally switched by plug insertion.
Standard – BS EN 61558-2-5.
Enclosure box to BS 4662, BS 5733 or BS EN 60670-1 as appropriate.
Components - Double wound single phase transformer 230/230V and 110V, with internal overload protection.
Outlet compatibility for:
UK shaver plugs to BS 4573
2-pin Europlug to BS EN 50075
US 2-pin plug to NEMA 1-15

2201 INDICATOR LAMPS:

Standard BS EN 62094-1.

Lamp – LED unless detailed otherwise in the scope of works or schedules.

Coding principles for indicators (lens colour) to BS EN 60073.

Lens retaining rings - Moulded plastic unless detailed otherwise elsewhere.

3000 WORKMANSHIP

3010 EARTHING:

Ensure metal framework of equipment is bonded to main earth point. Ensure that cable CPC's are connected to earth bar.

Provide earth CPC between earth lug on metal box and accessory casing except where accessory is encased in plastic.

3020 PROTECTION:

Ensure there is no physical or electrical damage to accessories when they are removed from their packaging and during installation.

Provide masking covers for surface mounted accessories to protect surface from paint.

Where accessories are flush mounted install front plate after painting is finished.

3030 FIXING:

Align accessories horizontally and vertically, as indicated. Where accessories are grouped, mount horizontally in line and parallel to each other and equidistant.

Fix cover plates to boxes with brass fixing screws.

3041 MEASURING MOUNTING HEIGHTS:

Take measurement for position of electrical accessories to the centre line of equipment from either finished floor or worktop. Where specified height coincides with top of tiling, leave a clear gap of 50mm above tiling.

3051 STANDARD WALL-MOUNTED ACCESSORIES MOUNTING HEIGHTS:

Mounting heights shall be in accordance with Schedule Y74sch2, unless indicated otherwise.

For locations not listed provide common mounting heights for accessories of a similar type and function, considering the function of the accessory, its use in the workplace, facility or infrastructure, and any risks to health, safety and welfare.

Ensure mounting heights for sockets and accessories comply with the following standards as relevant to the use of the building:

Approved Document M Volume 1
Approved Document M Volume 2
BS 8300 Parts 1 and 2
IET Guidance Note 1: Selection and Erection

10000 NES Y74 TEXT Dec 19

1010 INSPECTION AND TEST PROCEDURE:

Comply with:

BS 7671 (IET Wiring Regulations) for requirements for initial and/or periodic verification of low voltage electrical installations in general.

Relevant parts of BS EN 61557 and IET Guidance Note 3: Inspection and Testing for methods and measuring equipment, monitoring and methods.

BS EN 60079-17 for appropriate safety precautions when undertaking inspection and testing in potentially explosive atmospheres.

Adopt progressive testing where necessary.

1020 SUPPLY CHARACTERISTICS:

Obtain information called for in BS 7671 about supply characteristics from Supplier, other than where to be measured as part of testing procedure.

1030 DESIGN INFORMATION:

Obtain all design assumptions, calculations and any other information to enable compliance with BS 7671 to be verified.

2010 INCORPORATED EQUIPMENT CHARACTERISTICS:

Obtain and use information from manufacturers of equipment provided.

Use information provided, for equipment supplied by others and incorporated into installation.

2021 PROSPECTIVE FAULT CURRENT:

Determine values of prospective fault current (I_{pf}) by measurement, unless other means are indicated as described in Appendix 14 of BS 7671. Determine I_{pf} at all necessary points within installation to confirm correct equipment selections.

Where necessary obtain from supply undertaker values of I_{pf} at the origin of the installation. Adjust subsequent measured values of I_{pf} accordingly. Where alternative supply arrangements are available select the arrangement giving rise to the highest I_{pf} value.

2030 INITIAL VERIFICATION:

Carry out detailed inspection to verify the requirements of BS 7671 Section 643 in the order given in Section 643.

2041 TEST EQUIPMENT AND CONSUMABLES:

Provide test equipment and consumables in accordance with relevant standards and manufacturers' instructions to complete tests satisfactorily, and to retest any failed installations following corrective measures.

Standards

Test equipment and accessories to relevant parts of BS EN 61557, relevant parts of BS EN 61010, and Health and Safety Executive Guidance Note GS38 Electrical test equipment for use of low voltage electrical systems.

Test equipment quality assurance requirements to BS EN ISO 10012.

2051 TESTING

Carry out in the same order as published the tests required by BS 7671 Section 643.

2061 CONTINUITY OF PROTECTIVE CONDUCTORS:

Confirm continuity. Use AC or DC source

2071 PROTECTION BY AUTOMATIC DISCONNECTION OF SUPPLY:

Using a test current of at between 20 A and 25 A, measure and record external earth fault loop impedance Z_e.

If alternative supply arrangements are available, determine the lowest and highest values of Z_e.
Verify the highest value of earth fault loop impedance Z_{db} for each distribution board.
If alternative supply arrangements are available, verify the earth fault loop impedance Z_{db} for each distribution board when using the supply arrangement with the highest impedance.
Measure the highest value of earth fault loop impedance Z_s for each circuit, and verify that each circuit meets the requirements of Chapter 41 of BS 7671, including the effectiveness of any

supplementary protective equipotential bonding where necessary.
If alternative supply arrangements are available, verify each circuit's earth fault loop impedance Z_s when using supply arrangement with highest impedance.

Where residual current devices are used for automatic disconnection of supply, verify their operation using test equipment meeting BS EN 61557-6, taking into account the operating characteristic of the device in accordance with Table 3A in Appendix 3 to BS 7671.
For IT systems, verify compliance with Regulation 411.6 of BS 7671 using methods identified in Regulation 643.7.1 c).

2080 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.

2091 STANDBY GENERATORS:

Perform works tests on standby generators and provide test certificates.
Comply with BS 5000-3 and BS 5000-11 or BS EN 60034-3 as appropriate.
Carry out load test where specified within Work Sections.
Allow for attendance by the Engineer to witness works tests.
Carry out special tests where indicated in the Works Sections.

2101 HV AND LV SWITCHGEAR:

Perform works tests on HV and LV switchgear in accordance with BS EN 62271-200 and relevant parts of BS EN 61439 as appropriate, and provide test certificates.
Allow for attendance by the Engineer to witness works tests.
Carry out special tests where indicated in the Work Sections.

2111 HV POWER TRANSFORMERS:

Perform works tests on HV power transformers in accordance with BS EN 60076-3, BS EN 60076-4 and BS EN 60076-5 and provide test certificates.
Allow for attendance by the Engineer to witness works tests.
Carry out special tests where indicated in the Works Sections

2121 SPECIALIST INSTALLATIONS:

Carry out site testing and inspection and provide test certificates for specialist installations in accordance with:-

fire detection and alarm systems – relevant parts of BS 5839.
evacuation alert systems – BS 8629
lightning protection - BS EN 62305
fire protection for electronic equipment installations - BS 6266.
fire extinguishing installations and equipment on premises – relevant parts of BS 5306.
emergency lighting installations and equipment on premises - BS 5266-1, BS EN 50171, BS EN 50172 and BS EN 13032-1 as appropriate.

The Fire Alarm Trade Contractor shall carry out audibility measurements in all areas of the building to ensure that minimum audibility levels have been achieved in accordance with BS 5839 for fire alarm installations and BS EN 50849 and BS 5839- 8 for Voice Alarm Installations.

The Evacuation Alert System Trade Contractor shall carry out audibility measurements in all flats to ensure that the minimum audibility levels have been achieved in accordance with BS 8629 Clause 10.2.

Audibility measurements shall be performed once areas are complete (including all finishes and furnishings where provided within the Contract) and plant operational under normal conditions. The Fire Alarm Trade Contractor shall allow to adjust loudspeaker tap settings to achieve a sound level

within the 'preferred' range. Following adjustments to loudspeaker tapings, audibility measurements shall be repeated.

Results of final audibility measurements and 'as-installed' loudspeaker tap settings shall be recorded on Record Drawings.

Standby power supplies shall be subjected to a discharge test to demonstrate that they have sufficient capacity to maintain power to the system in its quiescent and alarm states, for the rated durations. Dummy loads shall be added to the system to simulate loads allowed for future capacity.

2131 CALIBRATION:

Provide current certificates of calibration for all instruments used during test procedures. Record particular instrument identity on record sheets.
Ensure that the method of calibration meets the quality assurance requirements of BS EN ISO 10012 and that all reference sources are traceable to United Kingdom Accreditation Services (UKAS) accredited standards.

2141 CERTIFICATION AND REPORTING:

Complete and hand over to the Client a Completion or Periodic Inspection Certificate to BS 7671 Section 644 and Appendix 6 or New Installation or Additions or Alterations to an Existing Installation as appropriate.
Append any risk assessments and other documentation required by BS 7671 to the certification.
Append inspection and test results to the certificates.

2151 INSTALLATION CERTIFICATES:

Provide installation certificates for electrical installations in accordance with BS 7671 (IET Regulations) Section 644 and Appendix 6.
Certificates shall be accompanied by a complete schedule of test result:
Record details of departures from BS 7671 (IET Wiring Regulations) on certificate.
Where appropriate provide copies of calculations justifying departure from BS 7671 (IET Wiring Regulations) and attach to certificates.
Append any risk assessments and other documentation required by BS 7671 to the certification.
Append inspection and test results to the certificates.

2161 RECORDS:

Record all results and instrument readings on approved Record Sheets and hand over to the client two copies for each inspection and test, as soon as possible after such inspection and test.
Append results of testing to BS 7671 (IET Wiring Regulations) to the certification provided in accordance with Section 644.

3000 WORKMANSHIP

3011 EXTRANEOUS-CONDUCTIVE PARTS AND PROTECTIVE BONDING:

Test for protection against direct and indirect contact in accordance with BS 7671 (IET Wiring Regulations) dependant on the method of protection.
Verify that all extraneous-conductive-parts of the installation are adequately connected to the main earth terminal in accordance with BS 7671 (IET Wiring Regulations).
Verify that all extraneous-conductive-parts of a location are effectively connected by protective bonding. Unless protection against electric shock requires a lower value, verify that the impedance of main protective bonding does not exceed 0.1Ω
Where additional protection is provided by supplementary protective bonding, verify that the resistance is sufficiently low to provide the required additional protection requirements of Chapter 41 of BS 7671, between simultaneously-accessible extraneous-conductive-parts and/or exposed-conductive-parts.

Confirm the classification of conductive parts which are not verified as either exposed-conductive-parts or extraneous-conductive-parts of the location, as defined in BS 7671 (IET Wiring Regulations). Demonstrate that their impedance to the earthing terminal of the location is sufficiently high, in accordance with Section 13.5 of IET Guidance Note 5: Protection Against Electrical Shock, using appropriate values of human body resistance R_b and maximum current through the human body I_b for the installation conditions and external influence

3020 PHASE SEQUENCE:
Check and confirm correct polarity of all conductors in all circuits.

3031 HIGH VOLTAGE TESTS:
Carry out high voltage tests as indicated:
Comply with relevant parts of BS 923, BS EN 61180, BS EN 60060 and BS EN 61180 as appropriate.

3041 CABLES:
Test continuity and insulation of all cables and carry out HV tests on HV cables prior to handover.
Test continuity and insulation of buried cables immediately after back-filling.

3051 CONDUIT, TRUNKING AND DUCTING:
Test and confirm electrical continuity of metal containment systems before installing cables.

10000 NES TEXT Y81 Dec 18

2000 PRODUCTS/MATERIALS

2011 LABELS AND NOTICES:

Apply identification labels and notices in accordance with BS 7671 (IET Wiring Regulations), Section 514 to all electrical cables plant and equipment including components of mechanical systems. Fit labels and notices as shown on drawings or specified in the Work Sections.

BS 7671 Labels and Notices

Identification of protective devices.
Diagrams, charts or tables to comply with Clause 514.9, 560.7.9, 560.7.10 and 560.7.11 and as indicated.
Warning notices, voltages in excess of 230 volts to earth.
Isolation notices
Periodic inspection and test notices.
Residual current device quarterly 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.
Outdoor equipment socket outlet notice.
Circuits with high protective conductor current (Regulation 543.7.1.205).
Wiring complying with previous versions of Section 514 (Regulation 514-14-1)
Operating instructions to comply with clause 560.7.12.
Warning notice, non-standard wiring colours.
Warning notices, alternative sources of supply

2021 MATERIALS:

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.

Ensure durability of identification is to BS ISO 17398.

External- Engraved thermosetting plastic laminate.

Internal - Engraved thermosetting plastic laminate.

Labels shall be coloured in accordance with The Health and Safety (Safety Signs and Signals) Regulations 1996, and associated HSE guidance L64 generally as follows:

Application	Background Colour	Colour of Lettering / Symbols
Prohibition, danger alarm notices	RED	WHITE
Warning notices	YELLOW AMBER	BLACK
Identification or descriptive notices	WHITE	BLACK
Mandatory notices	BLUE	WHITE
Emergency escape / First Aid notices	GREEN	WHITE

2031 FIXING:

Fix labels and notices using materials compatible with label or notice and surface to which it is fixed using fixing screwed into tapped hole. Use adhesives only with written consent from the Engineer.

2041 ARRANGEMENT:

Obtain approval prior to manufacture, with regard to style, colour, lettering, size and position of all labels and notices. Provide sample showing style, colour, lettering and size, for approval.

2051 LETTERING AND SIZE OF LABELS AND NOTICES:

Ensure that all lettering and symbols comply with the requirements laid out in BS 7671 (IET Wiring Regulations), Section 514 and BS ISO 3864-1 for height of lettering where not otherwise indicated. Ensure labels and notices 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.

Font - Helvetica Medium unless otherwise indicated.

2060 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 flat horizontal arrays have leading phase to the left and neutral to the right from left to right when viewed from supply point. Arrange 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 conductor arrangements defined are when viewed from front face of all equipment and terminating facilities. Apply identification markers in accordance with BS 7671 (IET Wiring Regulations), section 514 to all conductor termination points.

2070 SAFETY SIGNS:

Label all electrical plant and equipment in accordance with relevant parts of BS ISO 3864 and provide safety signs complying with BS EN ISO 7010. Provide sign W012 where voltages above ELV exist.

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

For any fire extinguishing system provide signs in accordance with BS EN ISO 7010

Give details of,

- Name of the Substation or switchroom.
- The presence of High and Low Voltages.
- Administrative instructions for access.
- Location and method of contacting controlling authority.
- Actions to be taken in an emergency.

Position safety signs in accordance with BS 5499-10.

2080 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.

2085 GRAPHICAL SYMBOLS FOR USE ON EQUIPMENT IN ACCORDANCE WITH BS EN 80416:

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

2090 MAINTENANCE NOTICES:

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

2091 MOULDED CASE CIRCUIT-BREAKER - WARNING LABEL

Where moulded case circuit breakers are used in the construction of a switchboard or panel board the contractor shall provide a warning notice in minimum print. size of 5mm letters fixed in a prominent position clearly visible from the operating side of the switchboard or panel board to warn of possible danger as follows:-

WARNING LABEL

ALL MOULDED CASE CIRCUIT- BREAKERS WHICH TRIP FOR ANY REASON DURING OPERATIONAL USE MUST BE VISUALLY INSPECTED FOR ANY FORM OF DAMAGE PRIOR TO ANY ATTEMPT BEING MADE TO RESET THE DEVICE TO SERVICE CONDITION.

Reference to manufacturers recommendations and instructions for use and operation of MCCB devices must be identified in all operations and maintenance documentation.

2092 SUPPLIES TO FIRE FIGHTING AND LIFE SAFETY SYSTEMS

Every switched disconnector and protective device that can isolate the supply to fire fighting or life safety system plant, equipment or controls shall be labelled (using white characters on a red background) as follows:

Device	Label Text (XXX = system refer below)
Protective device that only serves fire fighting or life safety plant or controls, but incorporates no switch.	"XXX"
Protective device or switched disconnector that only serves fire fighting or life safety plant or controls.	"XXX : DO NOT SWITCH OFF"

Additionally the following labels shall be provided depending on whether the device(s) is supplied from the live or dead side on the main isolating device:

Supply Arrangement	Label Text (XXX = system refer below)
Device supplied from the dead side of the main isolating device.	"WARNING: THIS SUPPLY REMAINS LIVE WHEN THE MAIN SWITCH IS TURNED OFF"
Main isolating device – Devices served from the live side	"WARNING: THE XXX SUPPLY(IES) REMAIN(S) LIVE WHEN THIS SWITCH IS TURNED OFF"
Main isolating device – Devices served from the dead side	"WARNING: THIS SWITCH ALSO CONTROLS THE SUPPLY(IES) TO THE XXX CIRCUIT(S)"

System	Label Text Replacing XXX
Generally or a combination of the below sytems	"FIRE FIGHTING / LIFT SAFETY SYSTEMS"
Emergency voice communication system (EVC)	"EMERGENCY VOICE COMMUNICATION SYSTEM"
Evacuation alert system	"EVACUATION ALERT SYSTEM"
Fire alarms or Fire and Voice Alarms	"FIRE ALARM SYSTEM"
Voice alarms	"VOICE ALARM SYSTEM"

2100 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.

2101 ELV LIGHTING TRACKS

Where ELV lighting tracks are intended to serve extra-low voltage luminaires without integral transformers a warning label shall be affixed either to the track or adjacent to the track. The label shall be engraved;
'WARNING: Transformer fed track. No more than n x 50 watt 12 volt fittings (or equivalent) to be connected to this track'. Where 'n' is the maximum quantity appropriate to the transformer rating.

2110 MOTORS AND STARTERS LABELS:

Fit identification labels to all motors, starters and starter panels. Ensure positive identification of respective motors and starters. Provide motors with non-corrodible labels attached adjacent to each bearing giving details of the lubricant to be used. Mark direction of normal rotation on motor casing. Provide labels to identify motor equipment fitted with surge suppressors and thermistors stating that insulation test voltages must not be applied to thermistors and thermistor control units. Ensure labelling is compatible with schematic and wiring diagrams, and complies with BS EN 60034-8. Labels fitted at manufacturers Works or, if indicated otherwise, labels fitted at site.

2121 ENGRAVED ACCESSORY PLATES:

Engrave switchplates, spur units, pushes and special plates for bedhead units, call systems, fire alarms, etc. as indicated. Use 6mm high letters with engraving coloured red, except where otherwise indicated.

2131 SWITCHGEAR:

Fit labels on switchgear as required by BS 7671 and relevant parts of BS 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, as required.

Any identification of a switchboard busbar or conductor shall comply with the requirements of BS 7671 Table 51, so far as these are applicable.

2141 DISTRIBUTION BOARDS:

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

Where final circuits are intended to serve circuits with high protective circuit currents, provide labels in accordance with BS 7671, Regulation 543.7.1.5.

Where alterations or additions are made to an installation that includes conductors identified using colours complying with versions of BS 7671 prior to Amendment No2:2004, a warning notice complying with Regulation 514.14.1 shall be affixed to each switchboard or distribution board which serves circuits wired using both the current and previous versions of BS 7671.

2161 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.

Earthing and bonding networks for buildings with telecommunications, information technology and control system installations in accordance with BS EN 50310 and BS 7671.

Telecommunications functional earths as BS 6701.

2171 INDICATOR LAMPS AND PUSH BUTTONS FOR POWER SYSTEMS:

Use indicator lamp and push button colours in accordance with BS EN 60073.

Indicator lamp	Red	-	danger or alarm.
	Yellow	-	caution.
	Green	-	safety.

Where not defined submit details of proposed colours for other lamps.

Push buttons	Red	-	emergency action.
	Red	-	stop or off.
	Yellow	-	intervention.
	Green	-	start or on.

Where not defined submit details of proposed colours for other lamps.

2180A 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.

Provide colour coding where specified in Work Sections for special applications

2191 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 on route or at convenient inspection points by means of non-releasable plastic straps unless otherwise stated.
Ensure labels show the following information:-

Reference number of cable.
Size and number of conductors.

2192 SCHEMATIC DIAGRAMS:

Provide a purpose made schematic diagram permanently fixed showing the connections of the equipment and plant.

Locations - At main switchgear, (fixed to structure).
Materials - Printed paper, transparent cover and framing, or printed paper, encapsulated.

2201 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 BS EN 60445 based on the element reference and the appropriate element terminal reference and BS 7671, where applicable.

On 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 BS 7671 (IET Wiring Regulations) Section 514. Ensure that all identification of terminals and conductors is recorded and included on record drawings and in operation and maintenance documentation.

At each interface between conductors identified using colours or markings complying with versions of BS 7671 prior to Amendment No2:2004, identification ferrules shall be fitted to the existing conductors marked in accordance with BS 7671 Appendix 7 Table 7A or Table 7E, as appropriate.

2211 UNDERGROUND CABLE IDENTIFICATION:

Identify external underground cable routes by means of approved concrete markers along their length at distances not exceeding 35m 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 number of the cable and operating voltage of cable.

Provide key to any reference system used at switchgear.
Mark direct buried cables with plastic tape yellow printed black as detailed below:-.

WIDTH	up to 600mm	600-1000mm	1000-1400mm	1400-1800mm
DEPTH up to 500mm	1 tape at 200mm below ground level in the centre of the trench	2 tapes at 200mm below ground level horizontally spaced 400mm apart	3 tapes at 200mm below ground level each tape horizontally spaced 400mm apart	4 tapes at 200mm below ground level each tape horizontally spaced 400mm apart
DEPTH 500-800mm	1 tape at 200mm and 1 tape at 500mm below ground level in the centre of the trench	2 tapes at 200mm and 2 tapes at 500mm below ground level each tape on each level horizontally spaced 400mm apart	3 tapes at 200mm and 3 tapes at 500mm below ground level each tape on each level horizontally spaced 400mm apart	4 tapes at 200mm and 4 tapes at 500mm below ground level each tape on each level horizontally spaced 400mm apart

2221 CABLE CONDUCTOR COLOUR CODING:

Identify cable conductors in accordance with BS 7671 (IET Wiring Regulations) Regulation 514 and Appendix 7, note that a lighting sub-circuit switch wire is a phase conductor in a single phase circuit.
In alterations or additions to existing installations identify conductors and terminals as BS 7671 Appendix 7.

All single phase final sub-circuit phase wiring carried out-using single core cables shall be coloured brown. Where multi-core cables are used for switch wires, blue, black or grey conductors shall be coded Brown at terminations.

2231 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 high voltage conductors as they lie, ensuring their complete length is phased out on completion. Ensure connections at terminations of HV 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, 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 conducted cables, identify each core at the joint and make the joint core to core.

2241 CABLE SHEATH IDENTIFICATION - INTERNAL:

Use the following coloured cables sheaths and cable codes for various services as follows:

Service	Sheath Colour	Cable Code
Fire alarm / Evacuation Alert Systems	Red	FA
Clock circuits	Brown	CL
Telecommunications	Grey	T
Data	As system suppliers requirements or as indicated	D
Control	Black	C
Radio frequency	Black	RF
Low voltage	Black	LV
Low voltage mineral insulated	Orange, unless otherwise indicated on the drawings	
Low voltage essential circuits	Blue	
Extra low voltage control	Brown	ELV
High voltage	Red	HV

2251 CABLE SHEATH IDENTIFICATION - EXTERNAL:

Identify cable sheaths for various services in accordance with NJU Guidelines on the Positioning and Colour Coding of Utilities' Apparatus, as follows,

HV - Red.
LV - Black.
Telecommunications and data - Grey.

2261 ADDITIONAL SAFETY SIGNS:

Comply with BS ISO 3864-1 for design principles for safety signs and safety markings.

Application

For main switch and electrical plant room access doors - BS EN ISO 7010 - P011 & P004 with supplementary sign "Authorised persons only".

For use with permit to work systems - BS EN ISO 7010 - P031. Printed on rigid plastic, with hanging loop, with supplementary wording "Do not operate. Work in progress".

For use at each emergency stop - BS EN ISO 7010 with supplementary sign "Emergency stop push-button".

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Y90 – Fixing to Building Fabric

1010 PREPARATION:
Mark-out, set out and firmly fix all equipment, components and necessary brackets and supports.

1020 MANUFACTURER'S DRAWINGS:
Use manufacturer's drawings and templates for purposes of marking and setting out.

1030 FIXINGS:
Ensure structure and fixings are suitable for items to be fixed.

1040 LOADING DETAILS:
Provide loading details for all fixing types.

1050 BUILDING-IN BY OTHERS:
Provide all necessary assistance to enable any item of building-in type to be built in by others.

1060 SIZE OF FIXING:
Use largest size of bolt, screw or other fixing permitted by diameter of hole in item to be fixed.

1070 GREASING OF FIXINGS:
Ensure all bolts, screws or other fixings used are greased or lubricated in accordance with manufacturer's instructions.

2000 PRODUCTS/MATERIALS

2010 STANDARDS:
Ensure that fixings such as expanding anchors are tested for tensile loading and where appropriate resistance to loading in shear.

2020 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.

2030 SCREWS:
Generally use sheradized steel wood screws for fixing to concrete, brickwork or blockwork.
In damp or exposed situations use greased brass wood screws.

2040 CAST-IN FIXINGS:
Where cast-in fixings are permitted, mark out and set fixings in accordance with manufacturer's instructions.

2050 SHOT FIRED FIXINGS:
Obtain approval prior to using shot fired type fixings.

2060 SELF ADHESIVE FIXINGS:
Obtain approval prior to using self-adhesive type fixings.

2070 PROPRIETARY CHANNEL INSERTS:
Provide proprietary channel inserts for casting in where indicated.

2081 NON-PENETRATIVE SUPPORT SYSTEMS FOR ROOF MOUNTED EQUIPMENT:
Obtain approval prior to using non-penetrative support systems for roof mounted equipment.
Ensure that the roof build-up is suitable for non-penetrative supports.
Install in accordance with the manufacturer’s recommendations.

3000 WORKMANSHIP

3010 DRILLING:
Drill holes squarely. Use drills of requisite size and depth, and appropriate to fabric. Do not flame-cut holes in metal work.

3020 PROPRIETARY FIXINGS:
Comply with manufacturer's instructions for all fixings.

3031 FIXING TO REINFORCED CONCRETE:
Take precautions to avoid fixing through reinforcement. Unless otherwise indicated do not fix to the bottom, or within 100mm of the bottom, on the sides of concrete beams.

3040 FIXING TO BRICKWORK:
Do not fix to unsound material or mortar between brickwork courses.

3050 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.

3061 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 or spring type toggle fixing.

3071 FIXING TO CONCRETE, BRICKWORK OR BLOCKWORK
Fix equipment, brackets and supports using wood screws in plugs or drill holes and fix using steel bolts of grouted bolt type or expanding bolt type fixing, as required.

3081 FIXING TO METALWORK:
Fix equipment, brackets and supports by drilling holes and fixing using either self-tapping screws or gravity type toggle fixing or spring type toggle fixing or set screws or bolts complete with washers, shakeproof washers and loose nuts as recommended by the manufacturer

3091 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.

3101 NON-PENETRATIVE SUPPORT SYSTEM FOR ROOF MOUNTED EQUIPMENT / SERVICES
Where detailed in the scope of works or on the drawings or offered as an alternative to traditional mounting methods, a proprietary system shall be provided. Systems to comprise a free standing, galvanized steel frame, assembly and support bases to spread the load.
Support frames must not penetrate the roof waterproofing membrane or insulation, but shall facilitate easy access to the roof waterproofing for the purpose of future repair and renewal by others.
The system manufacturer shall submit loading calculations for approval by the structural engineer based on the limiting UDL deck loading, maximum point loads and maximum base pressures.
Ensure that future roof maintenance access to roof finish is provided under each support system

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End of Specification

This is the final page of the specification.