

EMPLOYERS REQUIREMENTS

FOR

ELECTRICAL SERVICES

AT

JOINT ATC/ACF CANTERBURY

Project N°: 2907
Revision: C1
Date: 02/09/14
Client: SERFCA

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PART 1 - GENERAL DESCRIPTION OF INSTALLATIONS

1.1 GENERAL DESCRIPTION OF DEVELOPMENT

The site is a cadet training facility utilised by both the Air Training Corps [ATC] and the Army Cadet Force [ACF] located within Leros Barracks, Canterbury.

There is a single existing building on the site which is to be removed and replaced.

The new building will be single storey of steel frame construction with steel cladding and comprises stores, lecture/class rooms, offices and sanitary facilities.

As part of the contract, a band equipment store is also to be constructed as an extension to a separate block.

1.2 SCOPE OF WORKS

The works described in this document include, but are not limited to, the following: preparation of the site, low voltage power distribution, internal and external lighting, small power, power to mechanical services, fire alarms, voice and data and other controls, surge arrester systems, earthing and bonding and all Builders' Work in Connection.

This document must be read in conjunction with the Room Data Sheets and drawing(s), which set out the scale of provision required. It should be noted that there may be additional detail on the Room Data Sheets, within these Employer's Requirements or on the Drawing(s), all of which need to be accommodated in the Scheme.

The project is design and construct. These works will form a domestic sub-contract. The works will include the design and selection of systems and plant, liaison with the design team, liaison with the Employer's appointed consultant to ensure compliance with these requirements, systems installation and commissioning and the provision of all relevant documentation for the works.

The described systems will be maintained by the installing contractor for the duration of defects liability. Operating and Maintenance manuals and building log books will be provided. Following practical completion of the works, make quarterly visits to check for the correct operation of all equipment and carry out adjustments as necessary.

All installations will employ modern technology and controls to achieve minimum energy consumption. Sustainable principles will be used throughout the design. All installations must be reliable, durable and safe and easy to maintain.

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All installations will comply with the relevant JSP documentation published by the MoD.

1.3 BUILDING REGULATION PART L COMPLIANCE

Provide necessary information and documentation as required to allow others to undertake the SBEM and EPC calculations to show Building Regulations Part L Compliance.

1.4 SAMPLES

The Contractor is required to provide samples of all items of equipment that will be on display for approval by the Engineer/Architect/Client **prior** to ordering. All samples to be complete with the relevant finish. Where the same equipment/faceplate is specified with multiple finish types, samples of each type are required to be provided.

This is to include, but not be limited to, the following:

- Socket outlets (including 5A round pin if required)
- Fused connection units
- Fan isolators
- Data outlets
- Voice outlets
- Light switches (switch type and dimming type)
- Lighting control plates (if required)
- Luminaires (for luminaires with different references but the same appearance only one sample need be provided – check with the Engineer first)

In the case of luminaires, these samples are required to be fully working and complete with lamps.

1.5 ISOLATION

The switching off of all supplies is the responsibility of the Electrical Contractor who must ensure he complies fully with all necessary safety requirements for signage, isolation, locking off of devices, permits to work etc. relating to the electrical supplies.

Allow to attend site and make safe all electrical supplies to each building to be demolished such that the Demolition Contractor may safely undertake his works.

1.6 ENABLING WORKS

Allow to amend the existing catenary supported services running to and from the existing ACF Building to be demolished. It is known that these cables are for a variety of services and these must be kept 'live' for the duration of the works. In some instances, the cables run from adjacent buildings, are clipped

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to the external façade of the ACF Building and then run on to finally serve other buildings adjacent.

Allow to carefully remove (de-energising at an agreed time and re-energising at an agreed time all such power cables), temporarily support and then reinstate to the new building such that service is maintained.

It is essential that a site visit is undertaken to fully understand this requirement.

Where the existing underground power cable runs from the adjacent local boiler/plant room to the existing building, allow to

Disconnect, form a new trench for the new incoming cable to serve the building and in the process of which dig up and dispose of the existing redundant cable (preferred option).

Or

Cut back, label and either abandon the below ground cable as a new supply will be provided from the main site switchroom (Option if the electrical demand is too large for the local distribution board to supply).

Arrange to relocate the existing BT telegraph pole adjacent to the existing building and the accompanying telephone services. Employ Openreach/BT to make the necessary modifications with minimal downtime. From the relocated telegraph pole location, arrange to re-connect the existing incoming telephone lines (2No) run from the pole, fixed around the building at eaves level and into the new electrical cupboard..

1.7 INCOMING ELECTRICAL SERVICES

Provide a new electrical supply to serve the Main Building. It is anticipated the supply will emanate from same board currently serving the existing building in the adjacent Block's Boiler/Plant Room, but from one of the spare three phase ways available (the existing supply is only single phase).

The supply is to exit the boiler room below ground, run below ground din twin wall vehicle rated flexible smooth walled ducts. rising to serve the building in the electrical cupboard in the lobby.

Assess the loads and determine the size of the supply required. Undertake all applications as required (and arrange for payments to be made by the End User) on behalf of the End User.

Arrange for new metering to be provided for the incoming service arrange to install the metering as required to suit the programme. Undertake all applications (and arrange for payments to be made by the End User) on behalf of the End User.

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1.8 INCOMING TELEPHONE AND DATA COMMUNICATIONS

Arrange to install two new telephony services to the new building. Ducts to be to the requirements of Openreach and installed to the electrical services cupboard. The Contractor must liaise with Openreach and make preliminary applications to agree locations for the ducts. Allow for 3No ducts, which includes 1No spare, from the relocated telegraph pole. Note that the End User will order the lines for the site.

1.9 MAIN ELECTRICAL DISTRIBUTION

Provide final circuit distribution boards incorporating incoming isolators. Protect each outgoing final circuit (whether existing or new) with MCBs and RCBOs according to the circuit type.

Provide a sub-main cable to serve the new Air Source Heat Pump outside the Main Building. The armoured cable(s) is/are to run fixed to the fabric above the ceilings and penetrate through externally to serve an IP rated isolating device for the heat pump.

1.10 MAIN TELEPHONE AND DATA DISTRIBUTION

From the location of the incoming BT Distribution Point in the Electrical cupboard, provide 2No 25-pair multi-core Cat 3 cables, one to serve each of the communications cabinets in the offices. Terminate the cables in the patch panels using 8-pair connectivity.

From each of the communications cabinets, provide cables to serve the outlets in the Training Theatre run below ground between the buildings and not fixed to a catenary wire or similar.

1.11 DISTRIBUTION BOARDS

Provide new distribution boards, generally as follows:

Distribution boards to comprise of the miniature circuit breaker type complete with integral isolators and fitted with cylinder door lock. Label each board to indicate its unique reference in ink in the circuit lists provided and fit distribution board schedules of laminated paper adjacent or inside of the door. Screw fix at two positions. Provide a mains schematic and earthing distribution diagram in A4-size laminated and screw fixed adjacent to each.

Distribution boards to be:

- Manufactured and tested to BSEN60439-3
- Be suitably rated for the anticipated maximum current carrying capacity.
- IP31 degree of ingress protection
- Able to be fitted with purpose made extension boxes to house remote din-rail mounted equipment.

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Ensure that on completion there is a minimum spare capacity for future circuit breakers of 25% or a minimum of 2 spare TP ways in each part of the distribution board to allow for future additional circuits.

Provide adequate earth terminals to enable separate connection of ring circuit CPC's where supplying equipment with possible high earth leakage currents.

Ensure that on completion all unused ways are fitted with blanks.

1.12 CIRCUIT BREAKERS

Miniature Circuit Breakers – Distribution Boards

Provide miniature circuit breakers which are manufactured to be fully compatible with the distribution board.

Miniature circuit breakers to be:

- At least 15kA breaking capacity
- Manufactured to BS EN 60898
- Capable of operating at temperatures between -25°C and +40°C without the application of de-rating factors
- Capable of locking in the 'off' position.

Combined MCB/RCD (RCBO Units) – Distribution Boards

Provide RCBO units which are manufactured to be fully compatible with the distribution boards.

RCBO's to be:

- At least 15kA breaking capacity
- Manufactured to BS EN 60898 and BS EN 61009
- 30mA residual current tripping setting
- Incorporate reverse polarity protection
- Incorporate neutral protection

1.13 CONTAINMENT

The majority of the cabling will be provided above the false ceilings. Containment within stores and plantrooms are to be surface mounted within galvanised steel trunking and/or conduit. Conduit to be painted out to suit.

Major runs of containment to consist of the following:

- Galvanised steel basket (with conduit) for final circuit cables
- Galvanised steel basket (with conduit) for ELV cables

Provide concealed High Impact PVC conduit to all cables running in voids, dropping within plastered walls and studwork partitioning. Keep cabling a minimum of 100mm away from hot surfaces and thermal insulation. Note that

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within the Training Theatre, all conduit etc must be galvanised steel, even though it is protected by RCD/RCBO's.

Enclose cabling within the building fabric contained within heavy duty PVC conduits, and mount all accessories flush with the wall surfaces.

Where the circuit is not protected by means of an RCBO/RCD, the Contractor shall ensure that galvanised steel conduit is supplied in lieu of HIPVC type.

Provide 50% minimum spare capacity in all cable trunking and basket and tray to cater for future additions.

Dado trunking may be run vertically up walls to provide connectivity to the above ceiling cabling systems.

1.14 WIRING SYSTEMS

Supply and install fixed wiring and containment for each of the electrical systems as follows:

Sub-Main Cabling

Provide XLPE/SWA/LSHF sub-main cabling between the main distribution boards and all major power loads and sub-distribution boards/consumer units.

Final Circuit Wiring

Wire all final circuits using LSF Twin and Earth cables run within the containment detailed elsewhere.

AV Cabling

Wire all AV cabling for all AV outlets in the same manner as the final circuit wiring as above.

Structured Cabling

Wire all structured cabling for all data and phone outlets in the same manner as the final circuit wiring as above.

1.15 INTERNAL LIGHTING

Provide Internal lighting to meet the differing requirements of the spaces concerned, all of which are to comply with the requirements of the SLL Code for Interior Lighting.

Ensure that the requirements of SLL LG7 are fully complied with for all office spaces.

Provide samples of each type luminaire and gain approval from the Client **before** ordering as described earlier.

All luminaires are generally to be fluorescent type and must have high frequency control gear.

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Note that some luminaires may be supplied without lamps, ensure lamps (including spares) are sourced for all luminaires.

Corridors, toilets and the main entrance lobby are to be provided with PIR or microwave detectors for automatic operation (turning both on and off).

Offices and Rooms with projectors are to be provided with absence detection such that the lights have to be manually turned on, but are automatically turned off. The lighting to these rooms can also be manually turned off as required.

All other spaces will have manual switches only for the lighting.

The number of types of lamps used should be kept as low as possible as far as consistent with energy management and optical performance.

1.16 EMERGENCY LIGHTING

Provide emergency lighting systems throughout the areas of work to comply fully with all relevant British Standards and the Building Regulations.

Emergency lighting may be integral to or separate from the general lighting luminaires. It is to be supplemented by internally illuminated egress signage to all circulation spaces and/or designated fire escape routes and to each final building exit and outside each final building exit.

Provide emergency lighting systems that fully meet the requirements of BS 5266 Part 1, Type N/M3, EN 1838 and the local Building Control and Fire Officer Requirements. Provide internally illuminated maintained type M3 exit signs utilising LED's as their light source.

1.17 EXTERNAL LIGHTING

External lighting systems are to be provided as follows:

- Emergency lighting fixed to the exterior adjacent to all exits from the building to illuminate escape routes on power failure and to cover any further pathways as required by building control
- General lighting to provide security around the perimeter of the building. Provide movement activated floodlight lighting with photocell control and manual override inside each building.

The external lighting installation will be low energy, with less than 5% upward light and designed to minimise light pollution and (future) neighbour intrusion.

External lighting to be photocell and timeclock controlled generally, with settings to be agreed, but notionally set from 4pm to 10pm.

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1.18 SMALL POWER TO FIXED AND PORTABLE APPLIANCES

Power is to be provided from each final circuit distribution board to various fixed appliances and general purpose socket outlets throughout the buildings.

Provide socket outlets as identified in the room data sheets and on the drawings.

Earth leakage protection of 30mA sensitivity is to be provided on all circuits supplying 13 Amp socket outlets by incorporating RCBOs at the distribution board. Except for supplies for fridges and freezers which are to be wired on dedicated ring or radial circuits through spurs feeding a single socket outlet, both being suitably identified.

1.19 POWER TO MECHANICAL SERVICES EQUIPMENT

Power to mechanical services equipment is to include:

- Local supplies to local extract
- Local supplies to electrical heaters & controls
- Local supplies to air source heat pump
- Local supplies to water heaters.

As the mechanical services design develops, the exact requirements for these are to be ascertained. It is critical that all building services systems are co-ordinated together, both physically and electrically in order to provide a fully operational building.

Provide the power supplies to mechanical equipment generally terminating in a fused connection unit with neon indicator and flex outlet adjacent to the equipment. Final connection to the equipment generally to be in heat resisting cable to the requirement of the Mechanical Services Contractor.

1.20 FIRE ALARM SYSTEM

Employ a BAFE registered Specialist Sub-Contractor to design and provide a new Automatic Fire Alarm and Detection System.

Provide coverage to the new areas in accordance with BS:5839 Part 1 'L2/M' category and interlinked with all common area alarms. Note that integral sounders are to be used generally.

Provide new automatic detectors and manual break glass units as required. Break glass units to be complete with clear liftable flap.

The wiring loops are to be distributed and coordinated at the Contractor's discretion but care is to be taken to ensure that the number/type of devices on each loop do not exceed the maximum suggested by the manufacturer.

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Devices are to be evenly loaded on each loop and at least 20% spare capacity left on each loop.

Once triggered, the fire alarm is to alert building occupiers using electronic sounders and beacons.

The installation will be flush throughout and sounders, LED beacons and zone isolators (where required) will be integral to detection devices where practical. All devices including sounders will generally be loop powered. Break glasses will be the resettable type.

The removal of one or more detectors on the loop will not render any of the remaining devices inoperative. The control panel will be complete with battery back-up and charger unit mounted internally. The batteries will be of the nickel/cadmium type and will have the capacity to operate full audibility of the system for at least thirty minutes after a twenty four hour failure of the supply.

The Contractor will allow to provide record drawings inclusive of each device zone and address reference and cable routes and an updated framed zone chart adjacent to each fire alarm panel and repeater panel on the site. Room descriptions to appear on the LCD panel display will be in accordance with the architect's/client's requirements.

The Contractor must establish the number of cable cores required (and cable sizes when the equipment and lengths are established) with the manufacturer before installation commences.

The system is to be installed in accordance with the manufacturer's requirements. The system is to be fully tested, commissioned and demonstrated to the client with a certificate issued upon completion.

The Contractor must undertake sound pressure level testing to all areas affected by the works to ensure that minimum noise levels are met. The results of which are to be recorded and presented in the manual.

Provide a completion certificate to BS5839 to certify compliance of the installation.

The Contractor is to provide comprehensive training and demonstration of the system to the building users. Include to service and maintain the system for 12 months (i.e. including first annual service) and detail the annual charges necessary to continue this maintenance after the initial year.

1.12 VOICE AND DATA INSTALLATIONS

Employ a Structured Cabling Installer to design, supply, install and commission a new passive Structured Cabling System in compliance with the following British and European standards and all standards that are referenced within.

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- BS EN 50173-1
- BS EN 50174

Provide and install all outlets, cabling and containment and provide new CAT 5e final outlet wiring from the relevant communications cabinet to each outlet terminating in spring shuttered RJ45 sockets. Provide and install 10No patch cords (per cabinet) as required to provide connectivity in each cabinet.

Note that the ATC comms cabinet is to serve all outlets in ATC designated spaces and the ACF comms cabinet is to serve all outlets in ACF designated spaces. In communal spaces (Training Hall, etc), all twin RJ45 outlets indicated on the drawings and room data sheets are to be served from both cabinets, i.e. one outlet in each pair from the ATC cabinet and the other outlet in each pair from the ACF cabinet.

Provide containment from the incoming electrical/BT cupboard to each of the designated offices (1No ATC and 1No ACF) within which a comms cabinet is to be located to serve the outlets.

Provide the cabinets fixed to the wall at HL to the following specification:

- Minimum 6u height
- 19" standard rack
- Metal detachable sides
- Metal base and top
- Key lockable glass front panel
- Complete with 1No 4-way powerstrip within
- Wall mountable

Provide patch panels that are 1u high and complete with no more than 24 unshuttered RJ45 outlets. Provide 2No 1u cable management strips for the cabinet.

Install UTP cables with a minimum of 200mm slack at each end to allow for re-termination; the slack is to be supported in the equipment rack.

Carry out full testing as specified in the standards for all elements of the structured cabling system, and obtain appropriate passes for each element such as to ensure total structured cabling system compliance with the standards.

Rectify each failure identified during testing by replacing the faulty cable or component.

A minimum 20 year warranty is to be issued by the Contractor at the end of the works.

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1.13 AUDIOVISUAL INSTALLATION

Where noted on the Room Data Sheets, provide coaxial cabling (terminated) from outlets in the rooms, run via the ceiling void to a point to connect a future aerial. At the external location, the coaxial cable is to be left with standard terminations on the end to connect to a Freeview HD aerial. Each cable to have 30m of slack coiled up within a weatherproof and lockable external enclosure mounted on the façade at HL.

Contractor to supply and install all projectors and ceiling fixed poles/brackets at locations to suit the sizes of the screens to be installed. Ensure all secondary steelwork required to fix the pole to the soffit without damaging the structural integrity is provided.

1.14 LOOSE EQUIPMENT

The Contractor shall provide, install and set to work the loose 'white goods' for the servery, incorporating 1No microwave and 2No under counter fridges. Liaise with the kitchen supplier to ensure sufficient space is allowed for the equipment.

1.15 SURGE ARRESTORS

Provide transient voltage protection at each new distribution board and where each new cable required under these works enters/leaves each building.

1.16 EARTHING AND BONDING

Earthing and bonding is to be provided to comply with the IEE Wiring Regulations and the local DNO's requirements.

Include for the earthing and bonding of the whole electrical installation in accordance with BS 7671 Requirements for Electrical Installations, BS Codes of Practice and the local REC PME Regulations, such that the whole of the installation is effectively earthed.

Carry out bonding using green/yellow LSF insulated conductors and appropriate bonding clamps.

1.21 BUILDER'S WORK

The Contractor will make all allowances for builders work in association with the electrical installation. This includes, but is not limited to; holes through structure, supporting noggins, fixing brackets, pattresses etc.

The Contractor is to make good all fabric and finishes related to the electrical installation.

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1.22 ELECTRICAL TESTING- GENERAL

Test and commission the completed works in accordance with relevant British Standards controlling the installations being provided.

On completion, provide test and inspection reports, together with completion certificates covering the following where applicable:

- Mains wiring installations
- Emergency lighting installation included recorded lighting levels
- Recorded general lighting levels

List and describe the proposed testing equipment, which will be used on site and/or in the manufacturer's factory.

All equipment used for testing to be certified with a valid calibration certificate, a copy of which is to be provided to the Contract Administrator or their agents at their premises with reasonable notice

Ensure that at practical completion:

- Permanent labelling is marked and fixed, pencilled information is not acceptable. All power accessories should have their circuit reference numbers marked.
- Loose equipment and switchgear has screwed, glued or riveted labels, self-adhesive types are not acceptable except for the labelling of circuit numbers of socket outlets and spurs where electronic printed types are satisfactory. Test switches and three position switches are to be engraved with appropriate lettering.
- Test figures are available for electrical circuits.
- Sound levels and fire and emergency lighting certificates are submitted covering the areas of work. Fire alarm sound levels to be measured in each new/refurbished area and room and marked on an A4 plan by electronic means.
- Telephone and data systems are fully tested, commissioned and demonstrated.
- Fire alarm system should be fully soak tested for one week prior to handover.
- Draft record drawings and schedules of equipment are submitted.

1.23 CLEANING DOWN ON COMPLETION

The Contractor shall clean down and make completely safe all the installations provided. Immediately prior to handover, all electrical equipment shall be cleaned in accordance with manufacturer's instructions, including inside all diffusers and reflectors for luminaires.

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Plaster and paint on accessories and fittings will be removed in accordance with manufacturer's instructions – these shall not be scraped off which may damage the finish.

1.24 INSTRUCTION OF CLIENT PERSONNEL

The Contractor shall ensure he includes for the complete instruction of all the required onsite personnel with regard to the operational procedures and maintenance to be observed in respect of the installed electrical systems. He shall ensure the correct procedures are documented and added to the manuals as detailed elsewhere in this Specification. He shall arrange with the onsite staff for a suitable time and date for the instruction to be undertaken. This must be completed by the day for issue of the final acceptance and commissioning document or within one week of that date maximum.

Allow 1 full day training to fully train designated staff in the operation of and modification of the following systems and programming of equipment:

- General Electrical Installation.
- Fire Alarm Installation

1.25 MAINTENANCE DURING DEFECTS PERIOD

Ensure that sufficient allowance is made within the Tender Return for the maintenance during the Defects Liability Period. Note that the Tenderer is responsible for the ongoing maintenance of all installations and equipment installed under the Contract during this time, including, but not limited to, the following:

- Smoke/Heat Detectors – Clean, check and test, activate detectors and replace batteries where required. Intervals to be as the Code of Practice BS5266.
- Surge Arresting – Test operation of all surge arresting devices.
- Lighting – visual inspection, clean external luminaire diffusers and replace all faulty lamps.
- Small power – visual inspection, verify operation of RCD's and RCBO's

Note also that Service Reports for all items of maintenance are to be forwarded to the Client for their records.

1.26 HEALTH AND SAFETY MANUALS

Provide all drawings, certifications and manuals/folders at least 4 weeks prior to Practical Completion. Provide draft versions of the manuals in pdf form for electronic comment.

Record information for this project will consist of:

- 2No hardcopy sets of Operating and Maintenance manuals for the electrical installation (including all sub-contractor's information)

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- 2No copies of each of the above on CD ROM
- 2No hardcopy sets of testing and maintenance folders.

A4 pages of the following:

- Description of the extent of the work carried out
- Cat nos. of equipment and its description,
- Accessories and luminaries with catalogue nos.
- Copies of certification and operating instructions
- Copies of distribution board schedules covering new and altered circuits only,
- Sound levels, and similar schedules
- List of lamps required for replacements
- Schedule of manufacturers, wholesalers, suppliers with addresses and phone nos.
- H&S/maintenance advice
- Copies of emergency lighting log books and test sheets for end-user
- Copies of fire alarm and detection system log books and test sheets for end-user
- Paper copy on A3 or A4 folded in pocket and a copy on CD ROM in AutoCAD 2007 and pdf format.

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PART 2 – DESIGN STANDARDS & RESPONSIBILITIES

2.1 SCOPE OF CONTRACTOR’S DESIGN

This section of the Employer’s Requirements defines the performance criteria to be achieved in the completed installations and the standards to be used and the presentation format required for the Contractor’s design information. The Contractor will be responsible for producing and presenting to the Employer’s Representatives a suitable design solution for the installations compliant with these Employer’s Requirements. Design solutions will comprise drawings, calculations, equipment schedules, loadings and capacities, and locations of all plant and equipment, including specialist equipment being supplied by the Client.

The submitted design may be subject to development before final completion due to co-ordination requirements, overall budgetary restraints or value engineering. Where changes agreed by the Employer’s Representatives will result in the expressed Employer’s Requirements not being met, the Contract Administrator will issue a change order varying the Requirements.

The Contractor will also be responsible for assessing the performance of the proposed design and demonstrating to the Employer and his representatives before installation that it meets published benchmarks for energy efficiency and sustainability.

The Contractor will liaise and discuss fully with the Employer’s Representatives all aspects concerning the services design and installation.

2.2 REFERENCE GUIDES AND PUBLICATIONS

Ensure that all work conforms to current editions of the following standards:

- British Standards
- Building Regulations
- CIBSE Design Guides
- The Control of Pollution Act
- COSHH Regulations
- Construction Design Management (CDM) Regulations
- Electricity at Work Regulations 1989
- Gas Safety (Installation & Use) Regulations
- Health and Safety at Work Act 1974
- H & SE Codes of Practice including “The Control of Legionellosis”
- Loss Prevention Council Recommendations
- MoD JSP publications

If a conflict arises between these specifications, advise the Engineer accordingly and request which document is to take precedence.

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2.3 INFORMATION TO BE PROVIDED

Submit the following information for approval:

- Design Drawings indicating proposed design philosophy, and configuration of all proposed systems including system schematics. These are to be at a scale of 1:50.
- Working drawings co-ordinated with building fabric, structure and other trades and incorporating circuit references and key site dimensions to provide a neat & workmanlike installation. These are to be at a scale of 1:50 with specific details at 1:20.
- Builders' Work drawings showing all requirements associated with the services installations. These are to be at a scale of 1:100 with specific details at 1:20.
- Schedule of all proposed luminaires, plant and equipment, detailing manufacturer, reference number, duties, electrical requirements and accessories. Indicate where alternatives to the preferred manufacturers in this document are offered.
- Statements relating to the design for the Building Regulation submission

Full design calculations for the Electrical Services systems, including:

- Size of incoming supply
- Number and type of luminaries and luminance plots for working plane, floor, walls and ceilings
- Design currents for each final circuit
- Design currents for each sub-main circuit
- Phase balancing calculations
- Cable sizing
- Discrimination studies
- Cable containment sizing
- Fire alarm design certificate and noise level calculations
- Design information for BREEAM assessment
- Design information and calculations if required for the Building Regulations submission

All of these calculations are to be provided electronically in PDF format.

2.4 PROGRAMME AND DOCUMENT CHECKING

Prepare a schedule, consistent with the main Contract programme, detailing when all drawings and calculations will be issued. When issuing the drawings/calculation schedule, identify the extent and purpose of the particular issue, and the approval status of all drawings.

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Present all drawings and calculations in duplicate, in a legible, collated format, along with all data sheets and information relevant to the selection and performance of the given equipment. Allow at least seven working days for the approvals period.

The Employers representative may request the amplification of any detail considered inadequate or may challenge the results of the calculations, in order to verify the validity of the design. Approvals shall be attained on a systematic basis generally as outlined below.

The Employers representative will review the drawings, assign comments, and where necessary, depending on the content of the comments, assign a recommended comment status, i.e. as follows:

- Category 'A' - No comment, proceed with installations
- Category 'B'- Proceed with installation works subject to the incorporation of the given comments. Re-submit drawing for 'A' status approval.
- Category 'C'- Rejected, resubmit for further scrutiny, incorporating given comments. Do not proceed with the installation works.

Until such times as the drawings have attained Category 'A or 'B' status, stamp the drawings "Issued for Approval".

Stamp all drawings which have attained 'A' or 'B' status "Issued for Construction".

Submit all drawings detailing plant and equipment supplied/installed by specialists Sub-Contractors for comment.

2.5 ELECTRICAL LOADING CALCULATIONS – DESIGN PARAMETERS

The design current for each final circuit is to be estimated by direct reference to the known or likely equipment that is to be connected. Where circuits are for general purpose socket outlets, an allowance of 2A per socket outlet (i.e. 4A per twin socket outlet) is to be used.

Where applicable loads are to be balanced across phases at each distribution board and an appropriate diversity factor applied. An additional factor of 20% is to be included to cater for future growth at the final circuit distribution board position. In the absence of other information, the overall load for the building is to be estimated using a Watts/m² of no less than 40W/m².

All diversity factors must be agreed with the Engineer before being applied. Discrimination of protective devices is to take priority when selecting the ratings and tripping characteristics of devices at the main intake and sub-main positions.

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2.6 ELECTRICAL CIRCUITING – DESIGN PARAMETERS

Arrange circuits as follows:

- i) Lighting - radial
- ii) General sockets – ring
- iii) Miscellaneous power – radial.

Protect circuits using MCBs/RCBOs. Use Type B for power circuits and resistive lighting circuits, and Type C for inductive power and lighting circuits. Take special care to allow for the inrush currents associated with discharge lighting and motors.

Protect all socket outlets by RCBO units mounted within local distribution boards with 30mA tripping current characteristics.

Arrange circuits for 20 % spare ways on each individual distribution board ie so that there are 20% spare ways of the three phase capacity of each board .

Do not mix circuits on different phases in the same room unless specifically for 3-phase equipment.

Arrange general purpose power ring circuits to not serve an area larger than 100m² over one floor and more than ten in number 2 gang 13 Amp socket outlets.

Provide separate distribution boards for each major application and building.

Arrange power ring circuits supplying personal computers to supply no greater than 10 in no. PCs or laptops per circuit. Assume one PC per work station.

2.7 CABLE SIZING – DESIGN PARAMETERS

Prepare full design calculations to prove compliance with the current revision of BS 7671 (the 17th Edition of the IEE Wiring Regulations) and the local Regional Electricity Company's PME Regulations.

Submit the following calculations, prepared using a proprietary software programme:

- i) Maximum demand to the total installation
- ii) Current carrying capacity for each cable
- iii) Voltage drop for each circuit
- iv) Disconnection time for short circuit and earth faults for each circuit
- v) Prospective short circuit rating at each protective device
- vi) Maximum earth loop impedance allowable for each circuit
- vii) Protection of cables from thermal stresses associated with short circuit or earth leakage faults

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- viii) Co-ordination checks of protective devices to ensure full discrimination of the system. Discrimination 'time/current' curves and I^2t characteristics where applicable are to be provided along with the calculation results.

Allow voltage drop no greater than 3% for lighting and 5% for other uses.

Work to the following minimum cable sizes:

- i) Lighting circuits 1.5mm^2
- ii) Power circuits 2.5mm^2
- iii) Circuit protective conductor 1.5mm^2 for lighting (1.0mm^2 where twin and earth cabling is used) and 2.5mm^2 for power circuits
- iv) Supplementary bonding conductors 4mm^2
- v) Main bonding conductors to BS 7671 or supply requirements.

Ensure no cable is run within thermal insulation.

Allow for armoured cables run on trays to be installed, spaced at least one cable diameter apart.

Allow for an ambient temperature of general spaces of 30°C and 40°C in plant rooms unless specific onsite conditions take priority (i.e. heating pipework in risers to be assessed separately).

Provide every circuit with a separate circuit protective conductor (CPC) with the exception of those run in XLPE/SWA/LSF cabling, where the armouring of the cable may be utilised as a CPC. Provide supplementary copper CPCs to these circuits where required to gain the necessary disconnection times.

2.8 LIGHTING CALCULATIONS – DESIGN PARAMETERS

Prepare full design calculations to prove compliance with the appropriate CIBSE/SLL Lighting Guides where applicable.

Submit the following calculations, prepared using a proprietary software programme:

- i) Illumination levels of the horizontal working plane based on the 'Lumen Method' for each individual room
- ii) Point by point lighting level plots for walls, ceilings and horizontal working plane of each teaching and office space. Uniformity and diversity figures to be identified on each plot
- iii) Glare calculations calculated using the method described in CIBSE Technical Memorandum No. 10 'The Calculation of Glare Indices'
- iv) Emergency lighting calculations or equivalent tables to show compliance with BS 5266 and BSEN 1838.

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The external lighting design will comply with CIBSE Guide LG6 as far as practicable and with the table 1 (and its accompanying notes) of the Institution of Lighting Engineers Guidance Notes for the Reduction of Obtrusive Light 2005.

Submit designs to the local Building Control and Fire Authority for approval, and incorporate any revisions or comments generated.

2.9 LIGHTING CONTROLS – DESIGN PARAMETERS

The external luminaires will be controlled by photocell to ensure that lighting is not on during daylight hours and by movement sensors or time switches according to location. Contractors proposals are to be agreed. In any case external lighting will not normally be operational between 22:00 and 0700.

2.10 FIRE ALARM DESIGN – DESIGN PARAMETERS

Prepare designs for the fire alarm system which comply fully with BS 5839, Section B of the Building Regulations and the local Building Control Requirements.

Provide generic calculations to ascertain the number and type of sounders to be installed. These are to take into account the output levels and spectrum of the proposed sounders and the attenuation properties of typical internal partitions.

Provide LED beacons in areas subject to DDA and noise level requirements.

Submit designs to the local Building Control and Fire Authority for approval and comment, and incorporate any comments generated.

Prepare a full 'cause and effect' matrix for the system, together with a schedule of addresses for comment by the Client's representatives.

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PART 3 – PLANT & EQUIPMENT STANDARDS

3.1 MANUFACTURERS

Where manufacturer's products are referred to in this document, they are indicative of the quality of product to be provided.

Products of an equivalent quality may be offered but will be subject to approval by the Employer's Representatives.

Provide similar products from a single manufacturer, where possible, to reduce the maintenance implications.

Note that wholesaler's standard ranges may not be acceptable.

3.2 CONTACT DETAILS

Note that the persons listed below have not been contacted regarding this project.

Thorlux Lighting

3.3 ELECTRICAL DISTRIBUTION EQUIPMENT

Application: New Distribution Boards

Manufacturer: Eaton MEM Ltd
Type: Memshield 3

Application: Miniature Circuit Breakers (MCB's) for new Distribution Boards

Manufacturer: Eaton MEM Ltd
Type: Memshield 3

Application: Residual Current Breakers With Overload Protection (RCBO's) for new Distribution Boards

Manufacturer: Eaton MEM Ltd
Type: Memshield 3

Application: Contactors

Manufacturer & Type: Eaton MEM Ltd Type: silent operation (rectified coil) DIN rail type mounted in enclosures.

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3.4 CABLING & CONTAINMENT

Application: Sub-Main cabling

Manufacturer: BASEC approved
Type: XLPE/SWA/LSF
Conductor: Stranded copper
Grade: 600/1000V

Application: General Wiring

Manufacturer: BASEC approved
Type: LSF Twin and Earth
Conductor: 1.5mm² min solid copper (1.0mm² min CPC)
Grade: 600/1000V

Application: Flexible cables – general purpose

Manufacturer: BASEC approved
Type: Standard HOFR flexible cords – multi-core
Conductor: 1.5mm² min stranded copper
Grade: 600/1000V

Application: Flexible cables – high temperature applications

Manufacturer: BASEC approved
Type: Heat-resistant rubber butyl
Conductor: 1.5mm² min stranded copper
Grade: 600/1000V

Application: Fire alarm cabling

Manufacturer: Prysmian
Type: FP200

Application: Telephone/Data Installation

Manufacturer: Belden
Type: Cat 5e UTP Copper

Application: Conduit – Internal

Type: High Impact PVC
Accessories: Joints, bends, tee's, couplers, accessory boxes etc

3.5 ACCESSORIES AND ANCILLARIES

Application: General Accessories

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Manufacturer: MK
Type: Logic Plus
Finish: White plastic
Application: General Areas, offices, classrooms, lobbies and the like

Manufacturer: MK
Type: Metalclad
Finish: Standard Grey (Flush Mounted)
Application: Training Theatre.

Application: External Lighting Timeclock

Manufacturer: Sangamo
Type: Q554 Timeclock

Application: External Lighting Photocell

Description/Reference: Photocell – List No QPK new SAP Code 96010396
Manufacturer: Thorn Lighting

Application: Internal Lighting PIR

Description: 360 degree splashproof CEFL PIR Sealed
Manufacturer: Danlers

3.6 EQUIPMENT

Contractor to supply and install the following equipment:

Application: Servery

Manufacturer: Samsung
Type: Microwave
Ref: CM1069

Application: Servery

Manufacturer: AEG
Type: Fridge
Ref: S71701TSX0

Application: Classrooms/Lecture Rooms/Training Hall

Manufacturer: Sanyo
Type: Projector
Ref: PLC-XU3001

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3.7 INTERNAL LIGHTING

Include the following spares – 20 No lamps of each type (including replaceable LED) and rating. Hand to the Client and obtain a receipt.

Lamps generally to be 3000°K colour temperature

Main Building

Application: Corridors and Stores

Manufacturer: Thorlux Lighting
Type: Jubilee surface mounted linear fluorescent with reeded diffuser

Application: Toilets

Manufacturer: Thorlux Lighting
Type: Dot surface mounted circular bulkhead with opal diffuser

Application: Offices
Manufacturer: Thorlux Lighting
Type: Hi-Style Glo

3.8 EMERGENCY LIGHTING

Application: Egress Signage

Manufacturer: Thorlux Lighting
Type: Sortie

Application: General Emergency Fittings

Manufacturer: Thorlux Lighting
Type: LED downlighter with corridor and/or area optics

3.9 EXTERNAL LUMINAIRES

Application: Wall mounted near exit doors

Manufacturer: Thorlux Lighting
Type: Cobalt

Application: Security Floodlights
Manufacturer: Aurora Lighting

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Type: Polycarbonate Compact Fluorescent floodlight with PIR

3.10 FIRE ALARM

Application: Fire Alarm Panel

Manufacturer: Advanced
Type: Open Protocol

3.11 SURGE PROTECTORS

Application: Surge Protection

Manufacturer: To match distribution equipment

PART 4 – STANDARDS OF WORKMANSHIP

4.0.0 GENERAL

4.0.1 SCHEDULE OF RATES

When requested, provide a quantified schedule of rates with sub-totals and totals consistent with the electrical services price.

4.0.2 STANDARDS OF INSTALLATION

Ensure that all work conforms to current editions of the following standards:-

- BS and BS EN Standards
- National Engineering Specification Standard 'Y' Clauses for standards of workmanship
- Building Regulations
- Water & Water Supply and Fittings Regulations 1999
- Construction Design Management (CDM) Regulations
- Clean Air Act
- Gas Safety (Installation & Use) Regulations
- Electricity at Work Regulations 1989
- HVCA Codes of Practice
- Health and Safety at Work Act 1974
- H & SE Codes of Practice including "The Control of Legionellosis"
- Loss Prevention Council Recommendations
- WRc Directory

4.0.3 STANDARDS OF WORKMANSHIP

Provide a competent supervisor, on site for the duration of the contract, to oversee the works and to ensure that all work is completed in a neat, workmanlike manner. Use only appropriately skilled workmen. Ensure that electrical work is only undertaken by an NICEIC or ECA registered contractor.

4.0.4 TOOLS AND KEYS

Provide all necessary tools and keys for the operation and routine maintenance of the installations.

4.0.5 COMMISSIONING, TESTING AND DEMONSTRATING

Inspect and test the whole of the works in accordance with the IEE Regulations and relevant British Standards, and supply to the Contract Administrator 2 N^o completion certificate complete with his test results, along with the serial numbers of any instruments used together with their last calibration dates.

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On completion of the testing, offer the systems to the Engineer for witness. Allow sufficient time within the programme for both the initial testing and the witness tests thereafter.

Certificate of Practical Completion will not be issued until completion certificates are received.

4.0.6 OPERATING & MAINTENANCE INSTRUCTIONS & HEALTH & SAFETY FILE

As part of the Health and Safety File, supply working instructions for the whole of the plant covered in this Specification prior to Practical Completion, comprising the following:-

- A full description of the installation, including controls
- Schedules of all installed equipment with figure numbers, duties, electrical details and manufacturer's address and telephone number
- All appropriate Certification, etc
- Contractor's emergency call-out numbers
- Distribution Board charts
- Electrical Distribution and Alarm System schematics
- Schedule of Fire Alarm Zones and Addresses
- Fire Alarm Cause and Effect matrix
- Instructions for the safe operation of the systems
- Fault finding procedures
- A schedule of recommended daily, weekly, monthly, quarterly and annual maintenance
- Manufacturers maintenance instructions cross referenced to schedule of installed equipment
- A1 'As installed' drawings including manufacturing and control panel wiring drawings folded to A4 size in clear plastic wallets with schedule
- Disposal instructions

Submit draft copy in electronic form approval two weeks before Practical Completion. Provide a hard bound copy of the draft at practical completion for use by the building operator and a bound set of User Instructions for each unit in the building.

Within 14 days of completion of the works, supply one paper copy of the completed document and two electronic copies of the whole manual on CD-ROM in word or PDF and with the 'As Installed' drawings in AutoCAD 14 format.

4.0.7 BUILDING LOG BOOK

Provide a building log book at Practical Completion, set out in an approved format to meet the requirements of Building Regulations Approved Document L2.

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4.0.8 DEFECTS LIABILITY

The whole of the work is to be guaranteed for a period of twelve months, from the date of the Certificate of Practical Completion. The Contractor shall remedy at his own expense all defects in installation, materials and equipment due to faulty design, construction or workmanship which may develop in that period, notwithstanding the fact that the material and equipment is specified in this specification.

Defects affecting the system functionality must be repaired within two working days of them being reported.

4.0.9 MAINTENANCE

Provide all regular maintenance of the equipment as detailed in the Operating and Maintenance manual including emergency call out for the duration of the Defects Liability period.

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4.1.0 CABLES AND WIRING

4.1.1 CONDUIT & TRUNKING GENERAL WORKMANSHIP

Provide conduit and trunking in accordance with BS 7671.

Ensure entire system is electrically and/or mechanically continuous, to BS 7671. Comply with BS 7671 wherever the conduit or trunking passes through the perimeter of a fire compartment (wall, floor or ceiling) Arrange conduit and trunking to present a neat appearance, parallel with other service runs round the building line. Ensure vertical runs are plumb.

Install cable in conduit, trunking or equipment enclosures only when completely erected throughout its length. Make provision in conduit and trunking at expansion and settlement joints to allow for movement of the building structure. Provide circular through or adaptable boxes no more than 300mm either side of expansion or settlement joints for conduit crossing. Join boxes with flexible steel conduit type A or conduits arranged to form a telescopic joint and cover overall with a PVC sleeve to provide minimum degree of protection of IP44 or purpose made telescopic joint protected by a PVC sleeve to at least IP44.

4.1.2 CONDUIT

Cut conduit clean and square with axis. Remove any burs prior to erection. Site form 90° 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 bends and sets. 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.

Provide draw-in boxes in conduit at maximum intervals of 10m or after bends or sets totalling 180°.

Ensure that cast-in conduits and boxes are firmly secured so that they do not move during subsequent building operations. Ensure that there is no blockage immediately shuttering is removed. Check that 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 that conduit boxes to be cast-in will be flush with the face of concrete or plaster. Fit circular boxes with extension rings as required. Ensure fixing holes are countersunk where material thickness allows or use round head screws to prevent damage to cables and remove burs before cables are drawn in. Use two fixings for circular conduit boxes and four for adaptable boxes. 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

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round head screws. Use plug inserts and finally grout in position prior to plastering or screeding.

Support conduit in accordance with Appendix I of Guidance Note 1 - Selection and Erection, published by the IEE. Ensure conduit is not under mechanical stress. Fix boxes independently of conduit. Where protection is specified as IP44 or greater, ensure fixings of boxes are suitable to maintain degree of protection. Use saddles to fix conduit or crampets in screed or plaster.

Use flexible conduit for final connections to motors, other equipment subject to vibration or adjustment and to thermostats, motorised valves and similar duct or pipeline mounted items. Use sufficient length between equipment and circular through box at end of conduit run (min 450mm) to allow necessary full range of withdrawal, adjustment or movement. Use solid adaptors to terminate flexible conduit. Use covered flexible conduit where exposed to weather or moisture.

For steel conduit, use materials free from defects, rust, scale and oil. Repair any damage caused by threading, bending or erection by painting. Ensure length of thread on conduit matches that in 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 lock-nut. Paint exposed thread with zinc rich paint. For running couplings in Class 4 conduit, use three-piece conduit unions.

For non-metallic conduit, comply with manufacturer's instructions for bending, setting and jointing of conduit. Use only where indicated. Do not install outside manufacturer's recommended ambient temperature conditions. Use solvents recommended by the manufacturer for 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 6m on straight lengths to allow for expansion and contraction. Use semi-mastic adhesive where expansion joints are formed. Ensure special care is taken to prevent mechanical damage or warping to conduit where mechanical loads are imposed on the system e.g. lighting fittings.

4.1.3 TRUNKING

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

Arrange trunking to allow access to wiring. Arrange access so that 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.

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Ensure trunking is independently fixed and supported from the building fabric. Obtain approval for the proposed fixings/ supports. Use two fixings minimum per standard length.

Install steel trunking in accordance with the manufacturer's requirements and those of BS7671. Use trunking to avoid multiple parallel conduit runs, subject to approval. Cut trunking clean and square with axis, prepare ends and remove burs and sharp edges. Ensure inside edge 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 only factory made fittings and accessories.

Form circular holes over 6mm diameter in trunking body using correctly sized punch sets. Use twist drill for holes up to 6mm 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. Do not make connections to covers. Provide a fixed section of cover protruding 25mm either side of fabric where trunking passes through wall, floors or ceiling. Fit cable retaining straps at 500mm intervals except where cover is on top.

4.1.4 CABLE TRAY

Support from the building fabric with a minimum clearance 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. Make good finish with zinc rich paint, primer and top coat, or two pack epoxy paste, as appropriate to tray 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.

For cables on horizontal tray, use ties for each circuit. Use special tensioning tool and crop off tie ends. For cables on vertical tray use cleats bolted to tray for paper, plastic or elastomeric insulated cables, and saddles or clips for MIC. Use cleats sized to grip cable firmly without undue pressure or strain on the cable, but preventing slipping.

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 or bright MIC cables. Use one hole "P" clips for unsheathed MIC.

4.1.5 LAYOUT & SPACING

Ensure the maximum circuit lengths and groupings of cables indicated are not exceeded. Where dimensions are not indicated, select trunking and conduit

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sizes in accordance with Appendix A of Guidance Note 1- Selection and Erection, published by the IEE.

Install conduit and trunking clear of other services. Measure distance from external surface of any thermal insulation. Notify instances where minimum clearances cannot be achieved and bond items concerned. Minimum general spacings between conduits, trunking and equipment are:

Insulated steam services	300mm
Other services excluding steam	150mm
Above central heating radiators	1000mm

Appendix K of Guidance Note 1- Selection and Erection, published by the IEE.

4.1.6 CONDENSATION PREVENTION

Install conduit and trunking to ensure that 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 at different 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.

4.1.7 PROTECTION & REPAIR OF STEEL COMPONENTS

Paint joints of conduit and minor damages to finish of conduit and trunking immediately after erection or after damage occurs. Use paint compatible with finish as follows:

- Galvanised finish, use two coats of zinc rich paint.
- Black enamel finish, use two coats of good quality black enamel.

Remove grease, oil, dirt and rust before applying protective paint. Notify serious damage and repair or replace as instructed.

4.1.8 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 a conduit box located adjacent to the 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.

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4.1.9 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.

4.1.10 BUILDERS' WORK

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 chase is covered by plaster and/or rendering to a minimum depth of 12mm.

4.1.11 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 nylon tapes with fitted eyelets. For concealed conduit, ensure system is installed to enable rewiring 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 other substances to facilitate drawing-in of cables.

4.1.12 CABLING

Use new cables, delivered to site with seals intact, manufactured not more than one year prior to delivery, labelled with the manufacturer's name, size, description, BS number, classification, length, grade and date of manufacture. Ensure cable is marked with CENELEC or BASEC classification.

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 Contract Administrator for all through joints, and where overall length requirement exceeds practical drum size.

Install cables when ambient temperature is 5⁰C or greater, using cables stored at or above this temperature for not less than 24hrs. 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.

Install LSF cables in accordance with the manufacturer's instructions. Ensure oversheaths are not damaged by abrasion or scuffing.

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

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method. In vertical trunking, provide pin racks at 3m intervals. Use ties for all wires on the same circuit reference at 2m intervals. Mark ties at 10m intervals with circuit reference number. In vertical conduit, provide cable clamps in conduit boxes at 10m intervals. Allow for full range of movement at building construction movement joints. Make all joints to wiring at terminal blocks in conduit boxes.

On cable tray or rack, place cables side by side or as indicated. Fix using cleats or cable ties so that any cable may be individually removed.

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

For mineral insulated cables, straighten and dress cables using methods and tools recommended by the cable manufacturer. Use PVC or LSF sheathed cables where colour coded or indicated or where cables may come into direct contact with corrosive material. Fit temporary seals to MIC if the cable is left unterminated underground or if termination is not to be made for twelve weeks.

For flexible cords, ensure cords are gripped securely at both ends.

4.1.13 UNDERGROUND CABLING

Use XLPE/SWA/LSF type cabling for all power circuits laid directly in the ground. Cables shall be laid at a minimum depth of 600mm in general open ground and pavements and 800mm when under roadways.

All underground cables shall be segregated with other services in accordance with the following Table except where further account is necessary for grouping factors to maintain current carrying capacities of cables.

Cable	HV mm	LV mm	Telephone mm	Coaxial mm	Pipework mm
HV	50	300	300	300	300
LV	300	25	150	150	300
Telephone	300	150	50	50	200
Coaxial	300	150	50	50	200

Unless otherwise indicated all excavations within 600mm of existing services shall be by hand digging only.

Before laying, the bottom of the trenches all be cleared of loose stones and covered with a 50mm layer of sand. After laying a further layer of sand shall be applied to give 50mm total cover. A warning tape shall be placed above

each cable laid direct in the ground at a depth of 300mm below the finished ground level.

4.1.14 CABLE JOINTING

Ensure all joints and terminations are made by appropriately qualified cable jointers. Use jointing materials, components and workmanship recommended by the cable manufacturer and the jointing accessory manufacturer. Install cable glands in accordance with BS 6121 Pt5. Cut all cable ends immediately prior to jointing or terminating. Seal cables left unconnected for more than 24hrs to prevent ingress of moisture. Seal plastic sheathed cables using proprietary shrink on end caps.

Strip cables to bring out the cores and expose conductors, for the minimum length required for connection, to leave no exposed length of conductor after termination. Ensure that strands are not damaged when stripping cable cores. Twist strands together. Do not reduce numbers of strands. Secure all strands at termination.

Clean armour thoroughly prior to jointing or terminating.

At connections to equipment and switchgear without integral cable clamping terminals, use compression or solder type lugs for bolted terminal connections, of correct bore. Form all compression connections to components using tools that cannot be released until the correct degree of compression has been reached. Bolt core terminations with lugs to equipment using washers or proprietary shakeproof devices. Do not bunch more than three cores at clamping terminals or bolted connections. Mark cable conductor phasing, or other core identification, at each end of the cables, and at all joints, maintaining consistency of marking with any existing system.

Connect all cores, including multi-core cable spare cores, at all joints and terminations. Bond any unused cores of multicore cables to earth at both ends, unless otherwise indicated.

Terminate or joint MIC cables in accordance with the manufacturer's instructions.

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4.2.0 LV SWITCHGEAR AND DISTRIBUTION BOARDS

4.2.1 DISTRIBUTION BOARDS

Make internal separation Form 1 unless otherwise indicated. Make fuseboards fully shrouded. Fit each distribution board with an isolating switch.

Install busbars in the same position relative to their fuse carriers or MCBs for each pole. In TPN distribution boards, supply neutral busbars with one outgoing terminal for each outgoing circuit.

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 fuseway and MCB way by numbering indelibly. Identify each terminal on neutral busbar and earthing bar with its respective fuseway or MCB way. Provide spare ways as shown on the drawing or schedule. Provide and fix a typed copy of the distribution board schedule in a glazed frame adjacent to the board. Where specific ratings are indicated, incorporate fuses or MCBs, otherwise leave blank for future additions.

4.2.2 FIXING

Fix all equipment independently of wiring system. Use cadmium or zinc electroplated bolts, nuts washers and screws.

4.2.3 MOUNTING HEIGHT

Mount single items of equipment 1450mm affl. to centre of equipment, unless indicated otherwise. 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 affl., unless indicated otherwise.

4.2.4 ACCESS

Ensure that clearance in front of switchgear and control gear is not less than 1m or as indicated.

4.2.5 MARKING & DRAWING

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

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4.2.6 CABLE TERMINATIONS

Terminate armoured and MICS 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.

4.2.7 INSTALLATION AND COMMISSIONING

Install and commission switchgear and control gear in accordance with the appropriate standard and the manufacturer's recommendations. Include CT polarity check in commission tests.

4.3.0 LUMINAIRES, LAMPS AND ACCESSORIES

4.3.1 ORIENTATION

Ensure all luminaires, decorative diffusers, lamps, indicators, etc., are installed in the same direction within any one area e.g.:

1. Wherever possible or applicable in linear lamps to be installed parallel with long axis of the building.
2. All wall mounted 2D lamps to be installed within the 'D' sections at the top and bottom straight section level with the floor.
3. All wall-mounted luminaires mains LED indicator lamps to be in the same location i.e. bottom, or side, depending upon luminaire design. LEDs at the top will not be accepted.
4. All ceiling mounted indicator LEDs to be capable of being viewed from the same direction.
5. All decorative diffusers, floating rings, etc., to be uniformly located and in same axis etc.

4.3.2 CLEANLINESS

Ensure luminaires are clean and grease free on handover complete with new lamps. Ceiling tiles containing downlighters/compact fluorescent luminaires must be strengthened with back boards the same size as the tile.

4.3.3 INSTALLATION

Install surface fittings direct to concrete ceiling or wall, not on surface conduit boxes. Install recessed fittings flush with ceiling. Install semi-recessed fittings as manufacturer's detail. Install wall mounted fittings at the height indicated.

Ensure support is adequate for weight of luminaires. Provide two supports on luminaires longer than 600mm and up to 300mm wide. Provide four supports on luminaires longer than 600mm and over 300mm wide.

Where a luminaire is supported from conduit, provide a conduit box forming an integral part of the 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 from conduit boxes made from non-metal or heat sensitive materials, where the temperature of the material may exceed 60⁰C or the mass suspended exceeds 3kg.

Support luminaires in suspended ceilings directly from the building fabric, not from the lay-in grid ceiling.

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Use appropriate size of grommet where cables enter through hole in luminaire body. Ensure that the earthing terminal of Class1 luminaires is connected to the conduit protective conductor of the supply circuit. Clip or tie back loose wiring within the luminaire with proprietary devices at 300mm intervals.

Install lighting switches on different phases at least 2m apart. When light switches on different phases are in a common box, use phase barrier switches.

4.3.4 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.

4.3.5 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.

4.3.6 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.

4.3.7 MOUNTING HEIGHTS

Unless specified on drawings, position of electrical accessories to centre line, Socket outlets 550mm affl., Lighting Switches, Fire Alarm Call Points 1100mm affl. In Kitchen areas outlets to be 200mm centre line above work top.

4.3.8 LAMPS

Lamps are to be installed in luminaires immediately prior to practical completion and not used as means of temporary lighting. The lamps can only be used for testing of the lighting installation and during handover inspections. If any lamps are used for temporary lighting they must be replaced by new ones just prior to practical completion.

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4.4.0 FIRE ALARMS

4.4.1 GENERAL REQUIREMENT

The fire alarm system and installation shall fully comply with the recommendation of British Standards and the requirements of the local Fire Officer and the Employer's Insurers.

The fire alarm system shall operate at 24v dc open circuit line monitored, and be so wired that a full alarm is initiated by any manually operated call point or automatic detector.

Every zone and sounder circuit shall be monitored. In the case of addressable systems, each device must be uniquely addressed, and comply in all respects with the manufacturer's recommendations and particular requirements of the specification.

The fire alarm system shall be commissioned by the fire alarm equipment manufacturer.

4.4.2 POWER SUPPLIES

All primary power sources or power supplies from secondary sources shall be exclusive to the fire alarm protection system. The supply isolating switch shall be coloured red and marked "FIRE ALARM – DO NOT SWITCH OFF".

Alarm and detection systems shall operate from a secondary battery having a nominal 24 v dc system voltage. The battery charger shall be capable of maintaining the batteries in a fully charge condition on a floating trickle charge under normal no alarm conditions within +/- 10% of the system nominal voltage.

The batteries shall be of adequate capacity to ensure that in the event of a mains failure, normal operation is maintained for 24 hours then subsequent operation of all sounders under alarm conditions for ½ an hour is achieved.

When the battery charge output falls or falls 20% below the nominal output voltage then both visual and audible supervisory alarms shall be activated on the control panel.

All auxiliary isolators, fused connection units and other equipment associated with either the primary or secondary source of power shall be clearly labelled "Fire Alarm Do Not Disconnect".

4.4.3 ZONE CHART

A wall mounted zone chart in a glazed frame shall be provided adjacent to any fire alarm control panel.

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4.5.0 EARTHING & BONDING

4.5.1 MATERIALS GENERALLY

Use materials and installation methods in accordance with BS 6651, BS7671, BS 7430 and Electricity Supply Regulations as appropriate.

4.5.2 MAIN AND SUPPLEMENTARY EQUIPOTENTIAL BONDS

Material, insulated cable single core to BS6004. Use no joints in equipotential or supplementary bonds.

4.5.3 CIRCUIT PROTECTIVE CONDUCTORS

Provide protective conductors sized in accordance with BS 7671 543-01-03 and Tables 54B, 54C, 54D, 54E and 54F, or provided sized in accordance with BS 7671 543-01-04 Table 54G.

4.5.4 PROTECTIVE CABLE TERMINATIONS

For bolted connections, use crimp type lugs compressed by automatic tool to achieve correct pressure and crimp depth.

4.5.5 EARTHING CLAMPS

Use clamps complying with BS 951.

4.5.6 WARNING NOTICE/LABELS

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.

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4.6.0 IDENTIFICATION

4.6.1 LABELS AND NOTICES

Apply identification labels and notices in accordance with BS 7671 to all electrical cables plant and equipment including components of mechanical systems.

BS 7671 Labels and Notices:

Identification of Protective Devices
Diagrams, charts or tables to comply with Clause 514-09
Warning notices, voltages in excess of 250V.
Periodic inspection and test notices.
Residual current device notices.
Earth electrode safety electrical connection label.
Bonding conductor connector point to extraneous conductive parts label.
Earth free local equipotential bonding areas warning notice.
Electrical separation areas warning notice.
Outdoor equipment socket outlet notice.

4.6.2 MATERIALS

Use materials for labels with a predicted life at least equal to the equipment being identified.

4.6.3 CABLE IDENTIFICATION AT DISTRIBUTION BOARDS

Within distribution boards and consumers' units, etc, all neutral, phase and earth conductors are to be identified to indicate phase and circuit numbers by the use of cable markers.

In addition all sub-mains must be identified by the use of an identification system fitted to the outside of the sheath at the main switch panel and distribution boards. The cable identification to relate to a cable schedule to be provided on the schematic wiring diagram and in the operation and maintenance manual.

Cable markets and cable identification systems shall be manufactured by Critchley or equal and approved

4.6.4 UNDERGROUND CABLE IDENTIFICATION

Identify underground external cable routes by means of approved markers along their length at distances not greater than 30m and where a change of direction occurs on such routes. Provide cable markers with a brass plate or impress concrete to clearly indicate the reference of group of cables. Mark and protect direct buried cables with plastic tape yellow printed black "DANGER ELECTRIC CABLES" elsewhere.

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4.6.5 CABLE CONDUCTOR COLOUR CODING

Identify cable conductors in accordance with BS 7671 Para 514, note that a lighting sub-circuit switch wire is a phase conductor in a single phase circuit. Code all single-phase sub-circuit wiring red.

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4.7.0 TESTING & COMMISSIONING

4.7.1 TEST EQUIPMENT AND CONSUMABLES

Provide test equipment and consumables to complete tests satisfactorily, and to re-test any failed installations following corrective measures.

4.7.2 TESTING

Carry out in the same order as published, the tests required by BS 7671 Section 713 for New Installation or Altered or Added Installation as appropriate.

4.7.3 CONTINUITY

Confirm continuity using an AC or DC source.

4.7.4 EARTH FAULT LOOP IMPEDANCE

Use 25A test current. Measure and record source impedance. If alternative LV supply arrangements are available, measure when using supply with highest impedance. Measure impedance with main equipotential bonding conductors connected. Do not summate values of several parts of each loop. Apply temperature correction factors suitable for the installation recording values.

4.7.5 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.

4.7.6 COMPLETION CERTIFICATES

Provide completion certificates for electrical installations in accordance with BS 7671. Record details of departures from BS 7671 on certificate. Provide copies of calculations justifying departures from BS 7671 and attach to certificates.

4.7.7 CONDUCTIVE PARTS

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

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4.7.8 PHASE SEQUENCE

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

4.7.9 CABLES

Test continuity and insulation of buried cables immediately after backfilling.
Test continuity and insulation of buried cables prior to handover.

4.7.10 CONDUIT, TRUNKING AND DUCTING

Test and confirm electrical continuity before installing cables.

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