**Facilities, Residential and Commercial Services**

Project Electrical Briefing Document

| | |
|---|---|
| **PP&T Ref** | FM00098 |
| **Title** | Project Electrical Briefing Document |
| **Version** | 5.4 |
| **Last updated** | 7th$^{th}$ January 2021 |
| **Review Date** | 31$^{st}$ January 2022 |
| **Owner** | Senior Electrical Engineer |
| **Unit** | Engineering Services Group |
| **Approved by** | Head of Engineering Services |

# REVISIONS

Any revisions to the Project Electrical Briefing Document will be numbered and the appropriate page(s) will be identified by the number of the revision and the year. A new revisions page will be produced to cover further revisions as indicated below.

| Revision Number | Rule Number | Page Number | Date Received |
|---|---|---|---|
| | | | |
| | | | |
| | | | |
| | | | |

**Definitions**

*Project Manager* **-** University appointed lead for the design and construction process.

*Lead Consultant* – On multi-disciplinary projects, usually the Architect.

*Engineering Consultant* – Building Services Consultant will often be engaged in several or all of the following services: procurement, management of the works, and the design of electrical & data installations for the University of Liverpool.

*Electrical Design Engineers* – Engineering Consultant or the Design & Build Contractor undertaking the design of electrical & data services.

*Senior Electrical Engineer* – Owner of electrical technical standards for the University of Liverpool Contact details michael.grogan@liverpool.ac.uk.

# Contents

## 1. Introduction

1.1. The Directorate of Facilities, Residential and Commercial Services (FRCS) of the University of Liverpool (UoL) is responsible for *most* of the Estate & associated Electrical System & Equipment.

1.2. The University of Liverpool manage a list of approved consultants and contractors with the accrued benefits of collective knowledge retention when teams are regularly working with each other, most commonly within the structure provided within the NEC4 form of contract which reflects procurement and project management developments and emerging best practice.

1.3. To manage the design and construction processes, the University and its partners work under the operational leadership of a Project Manager. All the team will utilise a change control system to standardise the management of the design and construction process.

1.4. This (FRCS) document sets out the high-level requirements for Electrical Design Engineers undertaking design for the refurbishment, alteration and new build construction works on behalf of the University of Liverpool.

1.5. This Project Electrical Briefing Document has been produced for the Electrical Design Engineer with Guidance on the following topics:

- Preferences for electrical equipment and systems.
- Background on the engineering systems in place at the University, which may require adaptation.
- Selection and installation of wiring systems and equipment.
- Incorporate RIBA 2020 plan of work stages 1 to 7 as appropriate
    - Stage 0 -Strategic definition
    - Stage 1 -Preparation and briefing
    - Stage 2-Concept Design
    - Stage 3-Spatial coordination
    - Stage 4-Technical design
    - Stage 5-Manufacturing and Construction
    - Stage 6-Handover
    - Stage 7-Building Use
- Design and construction process.
- Documentation.
- Operation of the systems.
- Maintainability[i].
- Efficiency & sustainability.

1.6. This Project Electrical Briefing Document applies to all electrical services designed and installed to new facilities or the modifications to existing buildings at the University of Liverpool.

1.7. This Project Electrical Briefing Document is not intended to be exhaustive in its content. This briefing document should be read in conjunction with the University's Standard Specification for Electrical Installation Work **FM00153**.

1.8. The appointed Electrical Design Engineer will always be expected to meet legislative

requirement and current best practice.

1.9. It is not the intention of University guidance to interfere with, or absolve, the Designer from their professional responsibility & indemnity for the electrical design.
However, if such concern exists, it shall be immediately raised by the Electrical Design Engineer with the Project Manager and the Senior Electrical Engineer.

1.10. If there are any deviations proposed on a project from this guidance, the Electrical Design Engineer will clarify the principles with the University's Senior Electrical Engineer.

## 2 Contractor and Sub-Contractor Procurement.

2.1. Consultants and Project Managers shall ensure that the Main Contractor comply with the following procurement and management processes for electrical works.

2.2. National Inspection Council for Electrical Installation Contracting

All Electrical Contractors undertaking work at the University of Liverpool must be an APPROVED and Registered with The National Inspection Council for Electrical Installation Contracting (NICEIC) for the category of work being undertaken.
The Main Contractor shall verify that his proposed Electrical Sub-Contractor provides an evidence pack including the following :

- NICEIC roll number http://www.niceic.com/
- Provide a copy of the last annual technical audit undertaken by the NICEIC.
- Confirm the names and CV's of the appointed NICEIC 'Qualified Supervisors' for the proposed Electrical Contractor.
- The Electrical Contractor is covered NICEIC Platinum Guarantee.

2.3. Electrical Contracting Association

All Electrical Contractors undertaking work at the University of Liverpool must be Approved Contactors with the Electrical Contractors Association (ECA).

- The Main Contractor shall verify that his proposed Electrical Sub-Contractor provides an evidence pack including the following:
- ECA roll number https://www.eca.co.uk/
- Approved for the categories of work being undertaken in the project.
- Guarantee Scheme.
- Carry a Warranty for the particular project.
- Insolvency Bond.

2.4. Sub-Contactor Staff Working at the University of Liverpool.

The Main Contractor shall ensure that the Electrical Contractors staff working at the University of Liverpool carry at all times an up to date identity data cards. The following two

1. University of Liverpool Health & Safety Inducted Contractor identity card.
2. Electro technical Certification Scheme Construction Skill Certification Scheme identity card. (ECS/CSCS) confirming most to date, indicating their role, electrical qualifications and training. https://www.ecscard.org.uk/

The Contractor shall keep a record at his site office the NICEIC and ECS staff information who are working on his project for inspection by the University of Liverpool project management team,

Including detail confirmation regarding all levels of competency and the qualifications of all the staff.

2.5. Design and Professional Indemnity

On most projects undertaken at the University there will be a need either for the Sub Contractor to undertake full design or elements sub-contractor design under transfer from the Consultant Engineer. The Main Contractor shall ensure the Electrical Contractor carries a minimum of £5 million professional indemnity insurance for Design of Electrical Engineering Systems.

2.6. It shall be noted occasionally that Electrical Contractors working at the University of Liverpool will be required to carry higher design insurance values, which will be stipulated in the Particular Tender Documentation for the Project.

## 3. Clients brief

3.1. (RIBA Stage 1) It is the responsibility of the Engineering Consultant to obtain a detailed brief for the work and prepare detailed room data sheets. The brief and room data sheets must be recorded in writing by the Engineering Consultant and 'signed off' by the client department.
3.2. In a broader based design project with a full design team, the engagement process with the client group will usually be co-ordinated by the Lead Consultant and the Project Manager.
3.3. The 'electrical elements of the brief and room data sheets 'will be reviewed by the Project Manager and the Senior Electrical Engineer and approved prior to tender.
3.4. With reference to the latest edition of the IET Wiring Regulations. The Electrical Design Engineer shall consider the use of Arc Fault Detection Devices (AFFD) for circuits feeding higher fire risk locations.

3.5. During the development of the brief, if an aspect of the proposed work falls under 'The Dangerous Substances and Explosive Atmospheres Regulations 2002' this shall be immediately be raised with the Project Manager and the Construction Health & Safety advisor.
UoL will engage specialist advice, if requested by the design team.

## 4. Space Planning

4.1. (RIBA Stage 2 & Stage 3) For new or major redevelopment of a building, High Voltage (HV) switch rooms and substations (with minimum 2 Hour fire compartment), are to be located on the ground floor for buildings with direct access to the outside, with appropriate vehicle access for off loading and loading of transformer and switchgear equipment.

4.2. The Engineering Consultant in conjunction with the Building Designer shall carefully consider the building construction, materials and options for risk mitigation. The Engineering Consultant is to be mindful of the risks of explosion and electrical fire and the operational issues & risk associated with the management of HV Systems. Building Fire compartmentation must be maintained at all times and all associated builders work should be included for sealing of cable penetrations through walls
Whilst events of this type occur less than a dozen times a year in the UK, the impact of such events can be severe on the building and its operation.

4.3. The University of Liverpool HV substations and HV switchgear shall NOT be located in the same space as Low Voltage (LV) switchgear and other key electrical equipment such as generators, voltage optimisers and UPS or equally within an energy centre or mechanical plant space.

4.4. The engineering consultant shall ensure the following layouts are compliant with the factories act with regards to safe working space The Health and Safety at Work etc Act 1974 (the HSW Act), the Management of Health and Safety at Work Regulations 1999 (the Management regulations) and the Electricity at Work Regulations 1989 (EAWR) are applicable to the selection, use, operation and maintenance of high-voltage switchgear. The HSW Act also places duties on the manufacturers of switchgear.

4.5. Equipment Dimensions, Weights and Operation Space

Due to the variety and continuous improvement of equipment in feature and safety, the type of the equipment and hence its dimensions and weight may vary from time to time. The substation layout is subjected to the equipment being used.

In general, the minimum clearances and safe operating areas required around the electrical equipment shall be :

11kV switchgear - 1000mm at the back of the panels.
- 1500mm in front of 11kV circuit breakers.

Where metering circuit breaker panels are installed,

2000mm for the operation of the VT lifting trolley may be required.
- 750mm on the other two sides of the switchboard.

Power transformer - 900mm around the LV terminals.
- 750mm on the other sides.

The operation of the RMU requires the panel door of the RMU to be in the open position with an operating handle in place hence a space of 735mm is required in the front of the RMU with an additional space for the operator to stand.

LV board - 1000mm in front of the board.
- 750mm on the sides where cables turn in and out.
- The cable trench edge shall be 120mm from wall.

LV capacitor bank - 750mm in front and 200mm on two or rear sides.

4.6. Foundations

The transformer foundation/plinth shall be capable of supporting a minimum load of 9000kg. The minimum loading of the passage for delivery of the transformer from the unloading point to the
transformer plinth shall be sufficient to support the transformer weight. Normally, the transformer is supported by two inverted U channels or four steel wheels which stand on the transformer foundation/plinth. The plinth strength shall be adequate to stand for the pressure imposed by transformer base channels or wheels.

The minimum dimensions of the transformer plinth should be 1.8m long x 1.3m wide and level with finished floor level. Actual plinth size is subjected to the transformer rating and type.

The 11kV switchgear foundation shall be capable of supporting a maximum static plus dynamic load of 17kN per panel. The minimum cover between the finished floor level and the reinforcement bar of
the foundation shall be 80mm. The floor surface shall be flat and within a tolerance of 1mm in 1000mm.

4.7. The substation minimum clear head room shall be:

- 3.3m above ground for substation without transformer.
- 3.6m above ground for substation with transformer and 630mm diameter exhaust fan.
- 3.8m above ground for substation with transformer and 800mm diameter exhaust fan.

The recommended maximum ceiling height is 4m but subjected to the required clearance of lifting hoist on the ceiling if provided.

4.8. The switch room floor shall be finished with a monolithic (granolithic) screed, steel trowelled to finish and levelled to an accuracy of 2mm over any 2m dimension. The floor shall be
finished with a light grey dust sealed flooring treatment. The walls shall be sealed with a suitable paint
finish.

4.9. Any trenches shall be of a waterproof construction and shall be finished to prevent dust.

4.10. There are a small number of buildings across the University where Essential Systems will require a dedicated electrical switchboard. These locations shall be in separate lockable rooms with a minimum of 2 Hour fire compartment. The Engineering Consultant in conjunction with the Building Designer shall locate with immediate access to the cores with view to immediate access by the Fire Service.
For substation location exposing to the risk of flooding such as near an inclined road, slope and sea front, anti-flooding provisions shall be built to prevent flooding of the substation.

4.11. Engineering service risers shall be designed with full height doors and electrical services switchgear and equipment shall be careful co-ordinated to be visible, accessible and operable. Larger risers may require internal lighting & emergency lighting.

4.12. Separate electrical and comm's cabling risers are preferred, as opposed to combining with mechanical services. General details and sections for electrical containment routes and all necessary separations from other services, including the various electrical services shall be detailed at an early stage.

4.13. In most situations sub-switch rooms/risers etc. shall be accessible from circulation spaces. With the clear space planning strategy to avoid locating key electrical equipment in teaching and other operational space.

4.14. For new and refurbished server and communications rooms these will be in a separate functional space and locked by Salto Access Control System (provide a distribution board in each comm's room) as per the University of Liverpool CSD Network Design Guide 7.3.)

4.15. Under no circumstances shall any Contractors or Designers route gases and wet services through or above HV / LV switch rooms, or within electrical risers etc.

4.16. The acoustic performance of the engineering functional spaces and plant shall be carefully considered, particularly when located near to student accommodation.

## 5. Planon /References

5.1. The University operates a maintenance reporting system based on a software package called Planon. In the event of fault or defect, staff and students report via telephone or email to the Facilities Management Helpdesk.
When reporting faults, the user is requested to report an allocated space reference number and/or room number depending on the Campus.
Reference labels are fitted on doors and on the University of Liverpool architectural drawing layouts. See also FM00113 Code of practice for the production of electronically drawn information

5.2. The Planon system is also used to allocate work to technicians and contractors under planned preventative maintenance.

5.3. At the briefing and the concept stage, the Engineering Consultant shall agree with the Project Manager, CSD and FM stakeholders what references & labelling should be applied to the building services. e.g. socket and data outlets, fire detection, MAC & IP addresses, switchgear, door access, cctv etc.

5.4. The asset naming convention should be implemented from a design perspective, this following through to the installation then maintenance.

Example the typical numbering sequence utilised on the University of Liverpool campus would be:

The HV system incorporates unique designated numbers for all the substations,
Cables are identified as HV/ring number/ cable number
HV/R5/2 - is the hv cable from substation 43 to substation 44 forming part of the HV ring 5

For the main LV switchboard
Building number/space reference/transformer number- SB/DB reference number

The reason for having the transformer number on it is so it identifies the source of the supply. Some buildings are fed from transformers in other buildings.

Consider Arts and Humanities
the building number is 811 and Transformer number is 44 , Lv switchboard MSB01

The labelling will consist of - 811/space reference/44/MSB01

## 6. Location of Existing Underground Services

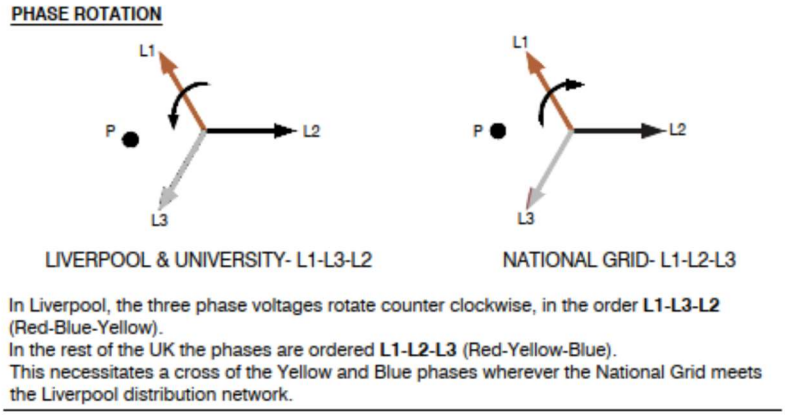
6.1. For the three major campus (Brownlow Hill, Greenbank and Leahurst) the University maintains

a set of existing underground drawings. These can be requested from the Project Manager.

6.2. It is a standard project process; that the relevant existing underground layouts are verified by on site survey. The Project Manager will arrange such surveys based on the scope provided by the Engineering Consultant.

## 7. Phase Rotation

7.1. The Electrical Designer attention is drawn to the Phase Rotation employed on the Scottish Power (MANWEB) network. The rotation is termed the Liverpool Cross and is delivered in that configuration to many University Buildings at the main LV switch board.
The rotation will need to be verified on a project by project basis, if the scope of work relates to high voltage system, LV interconnectors, UPS and generator selection and the main switchgear connections.
Detailed below is a diagram indicating the Liverpool Phase Rotation against the National Grid sequence.




## 8. Cables

8.1. Cables shall meet the British Standard applicable to the cable type and all cables used at the University must be BASEC and BS7671 approved.
All cables used inside buildings shall be Low smoke 0(zero) Halogen to British Standard BS EN 5025-3-11.
Where particular risks for fire exists, the designers/installer shall comply with the Section 422 of the IET regulations BS7671

Most cables designed for permanent installation within domestic, residential and commercial buildings are subject to the Construction Products Regulation (CPR), covered by BS EN 50575. BS EN 50575 is a regulation which brings together common classification, criteria and monitoring requirements to form seven Euroclasses.
These classes have fire performance assessment processes based on BS EN 60332-1-2, BS EN 50399 and BS EN ISO 1716. There are additional tests for Smoke Production, Flaming Droplets and Acidity
It is up to the designer, specifier or installer to satisfy themselves that the products chosen are appropriate for the application and meet any contractual requirements. It is important to note that at the moment, CPR-classified products can be used, whatever their Euroclass, providing

they are contractually acceptable. When specifying cable, take care to assess the risk of fire within a building and the potential ease of evacuation. Airports, hospitals, prisons, tunnels and high-rise buildings all offer their own unique challenges and should be assessed individually. SY cables shall not be used

8.2. The High voltage 11kv cabling between the transformer and the RMU shall be installed utilising suitable sized multicore cross linked polyethylene insulated, steel wire armoured cables with low smoke and fume, zero halogen outer sheath, constructed in accordance with BS 6622:2007 and insulated to accept voltages equal to or greater than 11,000 volts. The cable shall be finished with a red sheath colour and fixed with appropriately sized Raychem heat shrunk termination kits complete with stress relief terminations to suit the cable.

8.3. Cabling to the main switch room shall be supported on heavy duty cable ladder systems and secured along the full length of the cable by the use of cable cleats consisting of two identical half racks, die-cast in magnesium free silicone aluminium alloy conforming to BS 1490.

8.4. The Contractor shall ensure that all bends and sweeps on the support systems are installed with radius to suit the bending radius of the cable installed on them.
11000v Voltage cabling shall include a reference tag at each point of termination securely fixed to the cable sheath identifying the cable by cross reference to the main HV distribution schematic.

8.5. Any cable ducts to be installed shall be coloured and installed in accordance with the National Joint Utilities Group - "Guidelines on the Positioning and Colour of Utilities Apparatus" document NJUG-07.

8.6. For large and complex buildings, Approved Document B (5.38) refers to BS 7346-6 for guidance on the selection of cables that need to operate for an extended period during a fire. This guidance is found in BS 8519.

For life safety systems it is recommended that the system should be capable of remaining operational for minimum of 60 minutes in large and/or complex buildings and 30 minutes in others.
For fire fighting systems it is recommended that the system should be capable of servicing active systems for 60 minutes or 120 minutes depending on the specific application.
The fire survival times are allocated categories for ease of reference:
> Category 1 - 30 minute fire survival time
> Category 2 - 60 minute fire survival time
> Category 3 - 120 minute fire survival time.

8.7. Diverse cable routes for fire fighting supplies should be considered for the installation of the cable by suitable protection using either within a concrete trench with concrete cover, routing within a dedicated shaft or void of the appropriate fire rating, or enclosure throughout their length by passive fire protection material giving 120 minute fire resistance together with the capability of withstanding the effects of a water jet after such exposure.

## 9. High Voltage System

9.1. The University has three major campus sites located in the Liverpool and the immediate area.

- Brownlow Hill Campus, Liverpool City Centre.
- Greenbank Residential Campus, near Sefton Park, Liverpool.
- Leahurst Campus, Institute of Veterinary Science, South Wirral.

9.2. The Brownlow Hill Campus has a University owned and operated 11,000-volt network comprising four number 'open' rings and one radial circuit supplying circa fifty substations with CHP plant(11Kv) servicing most buildings on campus with heat and power. There are a small number of buildings that are supplied directly from the local Scottish Power (MANWEB) network. There are several buildings which are supported by low voltage standby generators.

9.3. Similarly, the Greenbank Residential Campus has a University owned and operated 11,000-volt network comprising a small number of substations with combined heat and power generators servicing most buildings on campus with heat and power.

9.4. The Leahurst Campus is supplied directly from the local Scottish Power (MANWEB) network at High Voltage and the University distributes at Low Voltage. Most buildings on campus are backed up by central standby generation.

9.5. There are several smaller campus locations in the Northwest of England, however these are all supplied at LV by the local Electrical Network Operator.

9.6. If relevant to the project, the latest issue of the HV/LV distribution schematic for each campus will be available upon request to the Senior Electrical Engineer.

9.7. All newly installed substation equipment shall have a minimum of 50% spare capacity.

9.8. Transformers are to be Wilson or Schneider
11000/415V e2 Ec Amorphous Midel 7131.
Naturally cooled KNAN to IEC 6007:2011 and
to Tier 2 of EU Regulation No 548/2014.
The transformer shall be mounted on anti-vibration mountings to minimise noise transfer to the structure.

9.9. Ring Main Units will be Schneider Ringmaster SF6 Units fitted with self-powered Bowden Earth Fault Indicators for one HV cable leg.

9.10. In normal circumstances, remote tripping shall NOT be provided to Ring Main Units.

9.11. Provision of Earth Fault Relays or Restricted Earth Fault Relays shall be discussed in every instance with University's Senior Electrical Engineer.

9.12. High Voltage cables shall be manufactured by Prysmian Group. The cable will be copper conductors XLPE/CTS/PVC/SWA/PVC 11kV medium voltage power cable will be used for UoL power networks, in fixed installation outdoors in cable ducts. The cable consists of a Class 2 stranded copper conductor, semi conductive conductor screen, XLPE insulation, semi conductive insulation screen, plain copper tape screen for each core, PVC bedding, galvanized Steel Wire Armour and red PVC outer sheath. 6350/11000 volts to BS6622 and IEC 60502-2, flame retardant to IEC 60332-1. An earth tape or bare cable shall be run alongside the HV cables interconnecting substation HV earth bars.

9.13. The University's High Voltage Installation Contractor (Authorised Persons) is:
D & A Systems Ltd
Tel No: (+44) (0)1244 530796

## 10. Substation / Switch room Requirements

10.1. When undertaking project works within or constructing substation & switch rooms the following lists will be checked and any missing items to be installed or rectified by the Electrical Design Engineer:

- *Floor and walls are painted and sealed*
- *Substation and LV switch room access doors are fitted with University suited lock (Salto)*
- *Adequate maintenance access and working space shall be allowed around all switchgear.*
- *Water tight*
- *All relevant signs, labels, and safety notices are installed.*
- *All HV switchgear and transformers to be fully labelled and clean.*
- *All earthing and earth bars suitably fixed and identified*
- *All LV switchgear to be fully labelled and clean.*
- *Smoke Detection to be fitted.*
- *Rubber matting installed as required.*
- *Heating if required, shall be -thermostatic controlled, tubular oil filled radiators.*
- *Updated distribution schematic drawings of size A0 or A1 installed in a frame on the wall including earthing arrangements and cable sizes.*
- *All protective devices set and commissioned.*
- *A minimum of 2 twin 30mA passive RCD protected sockets shall be installed within each substation and switch room.*
- *Lighting shall be IP65 LED fittings, which are wall mounted and with separate emergency luminaires*
- *All cable penetrations into the substation/switch room and pipe ducts sealed.*
- *Telephone hands free white handset is fitted and in working order (HV substations only).*
- *Test certification completed to the satisfaction of the Senior Electrical Engineer.*
- *Appropriate ventilation /extract fan fitted and working as required*
- *HSE safety resusitation poster installed and emergency contact number displayed*

10.2. The LV switch room or HV substation itself shall be left as follows:

- *Clear of all debris, waste materials irrespective of whether they are a result of the current project works.*
- *Adequately ventilated – grilles, filters and vents checked and cleared.*

10.3. Electrical switch rooms and sub stations shall be formally handed over to the University Authorised Person on completion.

10.4. No new substation shall be made 'live' without the written approval of the Authorised Person.

## 11. Low Voltage Interconnectors

11.1. The University of Liverpool, Brownlow Hill & Greenbank Campus benefit from low voltage interconnectors, these are used in certain maintenance situations.
For example, after manual load shedding on the LV side there are options for local shut down for maintenance of HV equipment without interruption to supplies. As with the HV system the interconnectors are controlled and operated only by the University Authorised Person.

11.2. The University does not utilise castell key systems with respect to the safety management of

the low voltage interconnector circuits. Operational matters are controlled under the Low Voltage Safety Rules (Standard Operating Procedure) FM00221 involving the requirement for method statements and risk assessment and ultimately the issue of documentation and the formal release of keys / access cards for switch room access. This process is controlled only by the University Authorised Person.

11.3. Where installations have two transformers supplying a low voltage panel with an open bus coupler. Switching and operational matters are controlled only by the University Authorised Person.

11.4. In terms of new and replacement switchgear, safety interlocking shall be reviewed on a case by case basis in conjunction with the Senior Electrical Engineer.

Use of Castell interlocks and Auto change over switches **shall be** considered for additional safety subject to appropriate risk assessments being carried.

Consideration should be given when switching the local supply over to the LV interconnecting supply the Supply impedance will change effecting the tripping times of the breakers in place. The new Zs values must be recorded and tripping times identified and recorded whilst the system is operating in this designated mode.

## 12. Voltage Optimisers

12.1. The University has invested in several Voltage Optimisers (VO) at both the Brownlow Hill and Leahurst Campus.
Where VOs have been installed, the nominal single-phase voltage has been set between 220 and 225 volts.

## 13. Low Voltage Distribution

13.1. As part of the University Business Continuity Plan (BCP). When main switchgear is upgraded or part new construction a plug-in generator connection shall be provided.
The changeover is to be manual with a connection point to a suitable location outside the building. The phase rotation of the hire standby generators complies with the National Standard for Phase Rotation (L1/L2/L3).
The phase rotation of many University of Liverpool Buildings follows a non-standard configuration known as the Liverpool Cross. (L1/L3/L2).
So, if the project and FM team deems the need for the facility of a standby generator connection the external termination box will need special consideration with respect to phase rotation.
The Electrical Design Engineer shall review the BCP with the Senior Electrical Engineer on a project by project basis.

13.2. Generous maintenance access and working space shall be allowed around all switchgear.

13.3. The design load of the building has a certain amount of diversity applied to the actual connected load of the building which the Main LV panel is designed to
In addition to the Diversified load for the building a further 50% spare load capacity is applied to the Main LV Panel .
The additional 50% load is derived from.
The current HV/LV infrastructure for a local transformer Failing, allows for Interconnecting an LV cable between buildings as a 'temporary essential supply' from the healthy building to serve one of the main LV panels with loss of supply.

This is generally treated as a supporting reduced load were the building transformer fails and the load is reduced for a short period of time to keep the failed building running. This reduced load is added to the healthy building load as part of the 50% spare load available from the healthy building load.
This interconnector is normally derived via a 400amp switch (identified by colour yellow)with 350amp protection fitted, hence maximum additional load available would only be 350amps).

Example A 1000amp available load with 50% spare capacity applied would allow for connecting the 350amps to make an anticipated load of 850 amps this would still leave a further 15% to cater for the variation in the building load.

13.4. Discrimination is also required between protective devices.
It is the designers responsibility to size the transformer and main lv panel to cater for the overall load
of the building plus incorporating the support load to another building.
(Diversified Building load+ 50% spare load capacity) = (Diversified Building load+( secondary source to stand by building + remaining % spare load capacity))

13.5. Spare connections/ ways are required to all newly installed Main LV panels as 25% spare ways available subject to overall length of panel

13.6. Cables are sized as per the IET Regulation and the expected design load applying the various de-rating factors accordingly, the cable current carrying capacity must be greater than the protective device.

13.7. Protective devices shall be selected to suit the load and discrimination with other devices up and down stream.

13.8. The final circuit loads are fixed and cables shall be selected and designed to this fixed load.

13.9. Main Containment routes should be sized for future additional cables hence 40% spare space

13.10. All newly installed final distribution equipment and cabling shall have a minimum of 25% spare capacity for future expansion.

13.11. The University's Standard Specification for Electrical Installation Work FM00153 provides more detail in respect of electrical sub-stations, main switch rooms, main switchgear, cabling methods, and distribution equipment.

13.12. Adjacent to each distribution board and switchboard a single socket shall be installed, the socket shall be on a 20A radial circuit without RCD protection, and marked 'test socket'.

13.13. The main LV switchboards for a building shall be Form 4 Type 6 compartmentalised not grouped. The preferred manufacturer for electrical main switchboards includes ABB or equal approved.

13.14. In each case, the choice of main switchboard's boards must be approved by the University's Senior Electrical Engineer.

- The preferred method of 'distribution' is to use Moulded Case Circuit Breakers. Where MCCB's are used to achieve discrimination the use of adjustable MCCB's is permitted
- MCCBS and HRC fuse gear where used and installed shall achieve discrimination
- Fuse switch devices shall designate both its capacity rating and the actual fuse size which has been fitted.

- Air Circuit Breakers will be ABB or Schneider.
- All out going ways must have 'padlocking' kits provided.
- Outgoing ways for LV interconnectors cover compartment doors shall be Yellow in colour.
- Outgoing ways for Essential Supplies cover compartment doors shall be Red in colour.
- A remote enclosure for power factor correction must be used.
- The switchgear is to be adapted to allow for thermal imaging of all connections.
- Transient over-voltage protection (surge protection).
- Incorporate anti-condensation heaters.
- Data connectivity to BMS must be provided for remote monitoring and central collection (meters).

13.15. Cables are clearly identified from the main switch board by means of cable number markers. The Electrical Design Engineer shall review this with the Senior Electrical Engineer on a project by project basis.

## 14 Generator connections

14.1. Where Main Stand by generators have been installed ensure a facility exists to ensure the normal supply is not run in parallel with the generator supply. Special attention should be given to the changeover arrangements so that operation in parallel with the incoming supply is not possible. Line and neutral isolation from the incoming supply should be provided.

14.2. Generating sets should be protectively earthed by connecting the frame and the neutral point of the generating set, associated exposed-conductive-parts and extraneous-conductive-parts to a main earthing terminal. The earthing terminal or bar should be connected to an independent earth electrode. The earth loop impedance at any point of the installation should be low enough to ensure operation of the fault protection, and this should be taken into account if the earth electrode forms part of the earth fault loop,

14.3. A separate earth electrode network should be provided solely for the generator when running and the incoming normal supply earth is not available.

14.4. A plug-in generator connection shall be provided. The changeover is to be manual with a connection point to a suitable location outside the building configured and labelled with the designated supply descriptions and current rating.

14.5. For single phase generators

The electrical contractor shall allow for supply and installation of an external single phase generator connection using a bulkhead BSEN60309-2 blue 3 pin plug, secured to the outside of the building.
Generator to be supplied complete with a flexible cable, length to suit location with a mating cable mounted BSEN60309-2 blue 3 pin socket. Plugs & sockets to be minimum IP67.
The connection is to be of the type that incorporates a switching / latching mechanism such that the connectors cannot be engaged or disengaged with the power on.

The generator outlet shall be connected to the internally mounted 63amp manual change over switch adjacent to the distribution boards using a 3c 16mm2 XLPE/LSF cable.
From the change over switch the electrical contractor shall install a 3c 16mm2 XLPE/LSF cable to the auxiliary distribution board and from the change over switch to the essential distribution board.
The switch and outlet shall be labelled with the designated supply descriptions.

## 15 Distribution Boards

15.1. Distribution boards shall generally be single phase type A or three phase type B distribution boards complete with incoming 125amp main isolator, and a full complement of MCBs and RCBOs for all outgoing ways.

15.2. MCB's or RCBO's are to be employed within the final Distribution Board (DB's) for final sub-circuit protection and selected to allow for discrimination.

15.3. The low voltage servicing strategy is to have separate boards for lighting, small power and mechanical supplies.

15.4. The preferred manufactures include:
MEM, Crabtree, ABB, Schneider or equal approved.

15.5. Cables are clearly identified within each distribution board by means of cable markers. Provide new boards in any building to match the existing.

15.6. All Distribution Boards must have 'padlocking' kits provided. Barrel locks are not acceptable.

15.7. RCDs / RCBOs shall be fault rated to a minimum of 10kA or higher to achieve cascade discrimination; small power circuits will generally be installed protected by RCBOs whether supplying fixed equipment or socket outlets.
Where RCBO type devices are used for final distribution they shall be of the 'passive' type. (i.e. They do not trip with a loss of power.)

15.8. Exceptions to this are circuits supplying medical / chemical refrigerators, fire alarms, security supplies, data racks, and similar high priority equipment.

15.9. Circuit breakers supplying computer network cabinets shall be Type D BSEN 60898.
A minimum of two radial 32A circuits in rating for each cabinet will be terminated via a BS4343 socket connector.

15.10. PC's will normally be protected with RCBOs.

15.11. Lighting circuits will be protected by MCBs in accordance with BS7671.

15.12. For student accommodation – the current architectural model preferred by the University is to group all ensuite bedsit rooms with a kitchen /common room. A local distribution panel to serve the load cluster.

## 16 Metering

16.1. The University currently monitors electrical consumption on the HV ring mains and at the main low voltage switchboards.

The following meter shall be provided by the Electrical Design Engineers for main and sub distribution switchgear: Cube 400 Multi-Function Electricity meter with RS485/422 Modbus serial communications as supplied by Northern Design (Electronics) Ltd, 228 Bolton Road, Bradford, West Yorkshire, BD3 0QW, telephone 01274 729533. Further information can also be obtained from the University Energy Team.

16.2. Metering is to be centralised whenever possible and located within the main LV switchgear and distribution boards.

The metering unit on the main incomers to the switch boards shall display Volts, Amps, kWh, and KVA, frequency, power factor, total harmonic distortion and maximum demand as a minimum.

16.3. The University monitors consumption by utilising an eSight Software system. Meters are linked back via a JACE usually adjacent the switchboard to the University Computer Network.

16.4. For additional metering a detailed discussion will be required with CSD and University Energy Team to extend their networks to facilitate the new metering.

16.5. Metering shall comply with Building Regulations Part L 'Conservation of Fuel and Power.

16.6. Metering shall be configured in a typical building under the following headings in accordance with CIBSE TM39 - this ensures that the metering ties in with the TM54 Design Energy use study. Data collected commonly under the following headings for energy benchmarking:

- Lighting
- Small Power
- Mechanical Plant
- Sundry large loads (kitchen, significant research plant, NMR) etc
- Further metering may be required where the load is part of a generator & UPS essential supply & changeover.

## 17 Earthing, Lightning Protection and Surge Protection

17.1. The Electrical Design Engineers shall engage a lightning protection specialist who shall carry out a risk assessment in accordance with BS EN 62305, in order to ascertain the required level of lightning and surge protection.

17.2. General Lightning Protection shall consist of lightning air termination network as required to be provided.

17.3. The Electrical Design Engineers shall provide resistivity tests of the ground.

17.4. It is the responsibility of the installer of new transformer and new primary electrical board to ensure that the site earthing arrangements and the new equipment is connected using suitable sized earthing conductors, to maintain satisfactory earthing and equipotential bonding.

17.5. In general

Two number main earth reference terminal (MERT) bars shall be provided within each of the substations under the HV Infrastructure project.

Earth cable connections will be required to all existing earth bars, transformers, main LV panels and all electrical equipment fed from the main LV panels.

17.6. The Medium voltage cabling between the transformer and the RMU the armoured cable gland earth stud shall be positively earthed to the MV panel earth bar at the rear of the switchboard by the use of removable flexible braid earth tags with suitably sized cable lugs crimped at each end.

17.7. The electrical contractor shall be responsible for the earthing within the HV substation forming part of the HV network installation from the main earth bar to the Distribution boards, tray works, electrical outlets, mechanical services all bonded according to the IET regulations and as described above and in **FM00153**.

17.8. The electrical contractor shall allow for installing all other earthing requirements from the

main LV earth bar

17.9. Earth bars shall be installed to sub stations, switch rooms and external areas

17.10. Earth bars provided are to be manufactured from hard drawn copper and come complete with M10 brass connection bolts, glass reinforced polyester insulators and a black powder coated steel base.

17.11. Earth bars within sub stations are to be made from 10mm x 50mm copper bar, have a minimum size of 24 Ways or the maximum number of ways based on the number of earth cables present plus 25% spare capacity, whichever is the greater.

17.12. Earth bars within switch rooms are to be made from 6mm x 50mm copper bar, have a minimum size of 12 Ways or the maximum number of ways based on the number of earth cables present plus 25% spare capacity, whichever is the greater.

17.13. Earth bars are to come with either single or twin disconnecting links

17.14. Earth bar locations are to be agreed on site before installation.

17.15. The earth bars within these substation switch rooms are to be cross bonded to ensure that the correct and shortest fault current path is taken back to source.

17.16. The Electrical Design engineer - Contractor shall be responsible for ensuring that the earthing and bonding system installed complies with the 18th Edition of the IET Regulations for Electrical Installations, particularly with regard to exposed and extraneous conductive parts and exposed metallic parts of the building structure etc.

17.17. All earth bonding conductors shall be not less than the minimum sizes given in the BS 7671 18th Edition of the IET Regulations.

17.18. Regulation 411.3 (protective earthing), chapter 542 (earthing) and chapter 543 (protective conductors) sets out the requirements for the minimum permitted CSA of an equipotential bonding conductor. The regulation stipulates that the CSA of the main equipotential bonding conductor should be directly related to the main earthing conductor. Where the CSA of the earthing conductor is selected using Table 54.8 of BS7671, as is normally the case, then Table below provides the required data in order to correctly select the required equipotential bonding conductors in each area.

17.19. Every area on site is unique and the electrical contractor is to allow to assess the local requirements in each switch room or external area where earth bars are identified as a requirement and complete the required equipotential bonding utilising table detailed below

| Phase Conductor CSA ($mm^2$) | Earth Conductor CSA ($mm^2$) | Main Equipotential Bonding Conductor CSA ($mm^2$) | Comment | |
|---|---|---|---|---|
| 4 | 4 | 6 | | Main Equipotential Bonding Conductor CSA must have a minimum value of $6mm^2$ |
| 6 | 6 | 6 | | |
| 10 | 10 | 6 | | |

| | | | | |
|---|---|---|---|---|
| 16 | 16 | 10 | | |
| 25 | 16 | 10 | | |
| 35 | 16 | 10 | | |
| 50 | 25 | 16 | | |
| 70 | 35 | 25 | | Main Equipotential Bonding Conductor CSA need not be more than 25mm$^2$ |
| 95 | 50 | 25 | | |
| 120 | 70 | 25 | | |
| 150 | 95 | 25 | | |
| 185 | 95 | 25 | | |
| 240 | 120 | 25 | | |
| 300 | 150 | 25 | | |
| 400 | 240 | 25 | | |

17.20. The Electrical Design Engineer proposed earthing installation must comply with BSEN 50310+A1:2016. [ii]
The design shall be fully co-ordinated with:
- General equipotential bonding requirements for buildings as detailed within BS 7671. The IET Wiring Regulations.
- Lightning protection BS EN 62305.

17.21. The electrical contractor is to make the following allowance, at every earth bar location:

- 10mts of 25mm$^2$ 6491B earth cable to local building structural steelwork
- 10mts of 25mm$^2$ 6491B earth cable to local metal pipework or ducting
- 2 x 10mts of 25mm$^2$ 6491B earth cable to local metal containment systems
- Main bonding conductors are required to ensure that all metalwork at each level remains at the same potential.
- Supplementary bonding is required between all simultaneously accessible conductive parts as required at each level.
- The Contractor shall Test all earths on completion.

17.22. All cables shall be identified with a unique cable reference in a visible position that indicates the cable number at each end by means of a proprietary manufactured indelible cable marking system.

17.23. An earthing single line diagram is to be produced to identify the extent of the earthing and bonding system throughout.

17.24. The earth fault loop impedance should be sufficiently low for the protective device (fuse, circuit breaker, RCD) to operate in the required time in the event of a fault to earth.

17.25. Emphasis will be placed on surge protection and its design to meet BSEN 62305 Part 4. All surge devices will be manufactured by Furse (ABB).

17.26. Over voltage protection devices shall be designed and installed based on the concept of Lightning Protection Zones (LPZ) and in accordance with BS7671 Section 443, Section 534 and Appendix 16 and with BS EN 62305 part 4.

17.27. All SPDs are to comply with BS EN 61643

17.28. Consideration is to be given to the risk of both direct and indirect lightning strikes. Consideration is to be given to both power cabling and data/ELV cabling

17.29. All boards serving equipment at risk of either a direct or indirect lightning strike are to have Type 1 surge protection. Equally all cabling (including data, ELV cabling etc.) at risk of a direct or indirect strike are to have SPDs installed at the point of entry/exit into/from the building.

17.30. All boards with final circuits supplying sensitive equipment (such as IT equipment A/V equipment etc.) are to have Type 2+3 SPD installed.

17.31. SPD is to have an indicator light (in a visible location) to show when the device is close to or has failed.

17.32. Connecting cables are to have a maximum length of 500mm, be bound and have a minimum CSA of:

16mm² for Type 1 SPDs

4mm² or equivalent size to line conductors if smaller than 4mm²for Type 2, 3 SPDs

## 18 Selection of Containment

18.1. Detailed reference shall be made to the University's Standard Specification for Electrical Installation Work FM00153.

18.2. The electrical contractor is to allow for a dedicated tray system to support all new lv (power/lighting) and ELV (data security, fire) cabling throughout. These containment systems generally consist of heavy duty hot dipped galvanised systems including brackets, supports, manufactured bends, tees, elbows, joints, risers etc. for a complete installation.

18.3. The electrical contractor is to allow for all primary support and bracket systems to support the new cable tray systems as required.

18.4. The electrical contractor shall allow for site run secondary containment from the primary containment to the final outlet position required The containment system is to be continuously bonded to earth throughout with the use of earth bonding straps and a main bond local to each main earth bar within the LV switch room.

18.5. To provide segregation, cables must be installed on separate trays, or steel dividers are to be added between LV and ELV cables. Penetrations through fire walls must be fire stopped after the installation of the service using appropriate approved material.

18.6. Tray or ladder shall not be mounted upside down to support any cabling systems.

18.7. New cable management systems shall be designed to provide a minimum of 25% spare capacity.

18.8. In summary:

Galvanised steel trunking preferred for grouping final circuits inside buildings.
Heavy gauge galvanised cable tray or ladder for power cables in substations and switch rooms.
Cable basket shall only be used for fire alarm and emergency lighting, data and telephone cables.
Galvanised steel conduit for 'flush' fitted lighting switch drops and data outlets in accordance with BS7671.

18.9. General building systems cabling including security, fire alarm, BMS and emergency lighting etc are not to be installed on or within data & voice containment.

18.10. Labels shall be fitted at regular intervals along the route of the containment confirming its use in voids and risers.

18.11. 3 compartment Dado trunking shall be utilised, very careful consideration should be given to bending radii when Cat. 6A cables are installed. In all data installations all cable types all containment shall be sized and installed in such a way as the cable manufacturer requirements for being radius in relation to the pulling in of cables and final install cable lay are fully complied

with.

18.12. Compliance with DDA with respect to colour differential will be carefully considered for the visually impaired.

18.13. Preferred PVC trunking manufacturers are to be MK or Marshall Tufflex.

18.14. With reference to the 18th Edition of the IET Wiring Regulations regulation 521.10.202 – regarding the support of wiring systems.
These requirements outline the need for cabling to be supported by fire-resistant fastenings and fixings which are not liable to premature collapse in extreme heat. This means that plastic cable clips, non-metallic cable ties and plastic trunking to support wiring systems would be unlikely to comply with BS7671 for new installations.

18.15. The requirements of BS7671 apply to all wiring systems in a building, including those of distribution and final circuits, safety services, and data and communications services. The University of Liverpool require that all new wiring systems are designed and installed to ensure that they are supported in such a way that they will not be subject to premature collapse when affected by fire, especially around escape routes.

18.16. Wiring systems should always be supported in the event of a fire and structural performance should not be affected by increased temperature. The requirements made by BS7671 would be unlikely to be met by the sole use of plastic cables clips, non-metallic cable ties and plastic trunking to support wiring systems.

18.17. All containment fixings shall be all metal construction. All expanding plugs shall not be plastic. Expanding metallic anchors, concrete screws and other mechanical fixings shall be used.

18.18. Stainless steel cable ties that can provide essential support and are capable of withstanding temperatures of 300°C or greater, when used with suitable fire resistant mounts and fixings as described above, together with a suitable metal containment system, stainless steel cable ties will offer compliance with the new regulations and can significantly reduce the risk of loose wiring and melting trunking.

18.19. Cables shall not in normal circumstances be laid freely in any way. Cables shall be laid in or on the containment system. If no system exists and it is inappropriate to provide one, cable must be clipped or carefully tied.

18.20. General Builders Works & Making Good

As part of the general electrical contract works, the electrical contractor is to allow to complete all associated general builders works and making good, as required to allow the installation of the new LV and ELV infrastructure. This work shall include the following:

- Forming penetrations of all sizes and making good
- Fire Stopping after the installation of the service using appropriate approved material.
- General sealing of penetrations to external areas to make watertight
- Diamond Drilling through floors and ceilings as necessary

Painting and decoration will not form part of the general builders works requirements

## 19 Low Voltage Cabling & Off-Site Prefabricated Wiring Systems

19.1. When building user requirements, drawings and room data sheets have been fully defined before tender, the option of prefabricated distribution & wiring systems may offer opportunities for new build projects. A high proportion of standard engineering services elements which can easily can be manufactured off site, offer project teams the most cost effective implementation.

19.2. The Electrical Design Engineer proposed solution will need to address the following:

- Metal / armour outer sheath is required.
- LSOH for both cabling and plug in devices.
- The proposed system and their plug-in components are only installed in areas of the building, where the voids are fully accessible for ease of maintenance, adaptation, fault finding and allow full test and inspection of the elements post construction.
- Minimum service life of forty years.

19.3. The prefabricated distribution and wiring system must comply with the latest revision of BS 8488 and the IET Wiring Regulations (BS7671).

19.4. The Electrical Design Engineer shall note carefully the impact of the ambient temperature, where the system is to be located and run and the potential ageing effects on the systems component (reference to HVAC plenums, combined services risers and mechanical plant rooms).

19.5. Careful consideration shall be made with respect to the compatibility and suitability of all associated components, particularly when different manufacturer's products are involved in the proposed design & installation.

19.6. The metallised wiring system shall be fixed throughout it length and laid flat in a single layer to galvanised steel tray using metal banding tape.

19.7. The University offices, laboratories and workshop's etc may offer opportunities to exploit bus bar systems economically to serve lighting and power. However, for main distribution supplying switchgear and main distribution equipment, the use of armoured cabling is preferred.

19.8. Most final circuit installations undertaken at the University shall be carried out using single core 6491B (LS0H) cables enclosed in galvanised steel trunking and conduit.

19.9. Main and sub distribution will be carried out using armoured cables will be XLPE SWA LS0H and XLPE SWA PVC when buried in trenches.

19.10. The Electrical Design Engineers shall provide 'Engineering Services' fire stopping HILTI or equal approved.

19.11. Twin and earth cabling shall only be used in exceptional circumstances with the approval on a project basis by the Senior Electrical Engineer.

## 20 Accessories

20.1. Accessories will be MK or Crabtree.

20.2. All switched socket outlets will be double pole.

## 21 Labelling and Notices

21.1. All building services cabling ,accessories and equipment should be referenced and labelled clearly with labels and notices in accordance with BS 7671 (IET Wiring Regulations), section

514 including components of mechanical systems.

The following list is not exhaustive but includes :
Mechanical and electrical plant, control panels , switch boards , sub distribution ,accessories, switches, sockets, isolators , fire alarm devices. MAC, & IP addresses for all computer network devices & equipment , door access devices , cctv camera's, external light fittings etc
Note fuse switch devices shall designate both its capacity rating and the actual fuse size which has been fitted.

21.2. Apply identification

- Identification of protective devices.
- Diagrams, charts or tables to comply with Clauses 514.9 and 560.7.9.
- Warning notices, voltages in excess of 250 volts.
- 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.

21.3. Identify each substation and main switch room with or as appropriate safety signs to BS ISO 3864-1.

- Application
  - For main switch and electrical plant room access doors, BS EN ISO 7010 complete with supplementary signs as shown with "Authorised persons only".
  - For use with permit to work systems, BS EN ISO 7010 complete with supplementary signs as shown "Do not operate. Work in progress".
  - For use at each emergency stop, BS EN ISO 7010 complete with supplementary signs as shown "Emergency stop push-button".

- safety sign 8.A.0044 to BS 5499-5 for any fire extinguishing system and notice giving details of,
  - Name of the Substation or switch room
  - The presence of Medium and Low Voltages.
  - Administrative instructions for access.
  - Location and method of contacting controlling authority.
  - Actions to be taken in an emergency.

- Switchgear:
  - Fit labels on switchgear to relevant parts of BS EN 61439 and BS EN 60439 to indicate duty of unit, its voltage, phase and current rating, actual protective device rating fitted, size of conductor involved, and all other necessary details.
  - Use an agreed serial coding system for the University Of Liverpool, provide at the switch a key to the coding system.

- 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 supplied and area supplied by circuit.

- Schematic Diagrams:
  • Provide a purpose made schematic diagram permanently fixed showing the connections of the equipment and plant.
  • Locations and materials as indicated in contract preliminaries.

## 22 Hand Dryers

22.1. Hand dryers will be high performance models and shall be Lovair Air Fury or equal approved. Exceptions when applied to child and disabled facilities.

## 23 Lighting

23.1. At the concept stage the lighting designer shall undertake a formal presentation including visualisations to the design team and the University user group.

23.2. The lighting manufacturer shall have BS EN ISO 9001:2008 and BS EN ISO 14001:2004 accreditation for quality and environmental management systems.

23.3. Luminaires shall be UK CE marked and conform to the following standards:-

| | |
|---|---|
| EN 55015 | Limits and measurement of radio disturbance |
| EN61547 | Electromagnetic compatibility immunity requirements |
| EN 61000-3-2 | Limits for harmonic current emissions |
| EN 60598-1 | Luminaires: general requirements and tests |
| EN 60598-2-1 | Fixed general purpose luminaires |
| EN 60598-2-22 | Luminaires for emergency lighting |

23.4. All luminaires shall be accompanied with photometric information where tests have been carried out on independently assessed equipment and in accordance with BS EN 13032-1. Acceptable file formats are Eulumdat, IES and TM14.

23.5. Luminaires will predominantly be LED.

23.6. All LED modules shall be tested in accordance with IEC 62717.Where practical, LED luminaires shall be fully serviceable where LED PCB's and electronic control gear are fully replaceable.

23.7. Employ protected PCB circuits so if one LED fails all others remain in operation.

23.8. All LED's to be tested to LM80-08:2008 with certificates to be provided:
L80 at 50,000 operating hours - 80% lumen maintenance.
B10 - up to 10% of LED's will exceed 10% lumen depreciation at 50,000 operating hours.
3 Step Macadam's Ellipse for internal lighting and 5 step for external.
A variable output driver is used for future flexibility.

23.9. Fittings in office/classroom applications to be compliant to BSEN 12464 and <UGR19.
Sports areas are to be compliant with a UGR21.
Efficacy of luminaires to be no less than 100 lm/W (luminaire lumens per watt).
The luminaires are to have the LED's mounted on a replacement gear tray for future maintenance.
The LED luminaires wattage is to be based on the actual running wattage, on a like for like basis.

23.10. WARRANTY: -
The luminaires are to have an onsite repair warranty of no less than 3 years, where the manufacturer carries out the repair of a faulty luminaire on site, at their expense, at a mutual

convenient time with the client, plus a further 2 years replacement parts only.

23.11. Consideration shall be given to energy savings and pay-back periods and this should be discussed with the Project Manager and as detailed below:
Luminaires should be selected from 'popular' manufactures with replacements and spares being readily available. Luminaires with a system wattage of >15W shall be provided with a power factor correction of at least 0.9.

23.12. Tridonic and Phillips control gear only to be used.

23.13. The use of tungsten dichroic lamps are not permitted.

## 24 External Lighting

24.1. Leahurst (2018) and Brownlow Hill Campus (2016) have recently had all the external lighting replaced with LED lamp technology.
Due to the quantities involved a reference system has been develop for ease of maintenance reporting purposes. This involves the building number and sequential luminaire number which is then cross referenced to a LABELS which are mounted at low level on a column or the wall for ease of viewing and repeated on the campus as fitted drawings.
Future work and any modifications or additional building and luminaires will follow the above principles of adding a local LABEL and updating the 'AS fitted ' external lighting CAD drawings.

24.2. In general the external building perimeter lighting shall achieve the requirements of CIBSE Lighting Guide LG6, ILE Guidelines, BSEN 12464-2:2007, BS5489 and provide a safe environment for people and the building, minimising any potential light pollution and glare.

24.3. The external building perimeter lighting shall be vandal resistant and fitted with efficient light output, long life lamps. The external building perimeter lighting installation shall give colour rendering of 65Ra or above for the security cameras.
The external perimeter lighting shall be provided by luminaires with a minimum efficacy of 70lm/w.

24.4. The exterior lighting shall be controlled via dedicated contactors /circuits on a zoned basis to allow a lower level of illumination for essential areas or non-essential illumination to be switched off, with each zone controlled via a time-clock. Designated as security and amenity lighting.
The contactors are switched via relay outputs from the University BMS and controlled by a combination of time programmes and a lux sensor in the BMS software.

For security lighting the programme will enable the lux sensor between 3.00pm and 9.00am, 7 days per week 365 days per year.
For amenity lighting the programme will enable the lux sensor between 3.00pm and 11,00pm and between 5.30am and 9,00am, 7 days per week 365 days per year.
The lux sensor will be set to operate both security & amenity lighting when the light level falls below 200 lux & switch off when lighting levels rise above 300 lux. The software will incorporate a time delay of 5 minutes for both on and off operations.

24.5. All lighting columns shall be fitted with the following BICC DP cut outs for 230v. The column tops shall be wired using 3 core 2.5mm flexible cable from the outgoing fused ways.

24.6. Columns shall be hinged incorporating counter balance subject to location suitable root mount or base plate to be incorporated

## 25 Lighting Controls

25.1. At the project briefing stage (for larger building's) consideration shall be given to a monitoring system as a maintenance test and diagnosis tool.

25.2. The provision of energy saving control to the lighting installation is a requirement on all scales of project. Although Standalone control is utilised on small projects against larger 'networked' systems. The contractor shall submit detailed proposals to satisfy the requirements of the lighting control systems meets with the University requirement across the campus.

25.3. It is the intention of the University to standardise across the campus with a wireless lighting management system that allows the university to monitor their energy performance data and complete operational information for all standard internal, external and Self-testing emergency luminaires with integral battery for 3 hour emergency operation.

25.4. Intelligent luminaires to be fitted with integral Smart sensor providing daylight harvesting, maintained illuminance, presence/absence detection and scene setting.

25.5. The system shall be capable of group presence communication ensuring luminaires can illuminate in groups and with individual scene setting control using 868/922 MHz wireless mesh connectivity with building wide link address capability. System to include seamless integration of wireless emergency lighting luminaires. All aspects are to be programmable from floor level using an infra-red remote control programmer. The system to provide daily maintenance status reports, energy performance data, occupancy profiling information and air quality data for viewing on remote website with the capability to store drawings and documentation.

25.6. The manufacturer supporting product offers

- a professional on-site commissioning service to ensure that the products are configured to provide the desired performance and return on investment.
- monitor and maintain new installations for 12 months from the commissioning date. After this period products are still covered by a standard 5 year warranty.
- Extended service warranty

25.7. Luminaires operate on a stand-alone basis:
luminaires link wirelessly in groups for presence detection and scene setting. Energy performance data and operational status information can be retrieved using the system Programmer.
Emergency luminaires are self-test with the addition that operational status and most recent emergency test information can be retrieved using the System Programmer.
The same luminaires are wirelessly linked into a Gateway which collects and transmits their energy performance data and complete operational information, for all standard and emergency luminaires, to the World Wide Web for viewing using tablets, smart-phones, laptops and computers.

25.8. The control system utilises a wireless mesh network. Each device acts as a repeater, ensuring that data signals always find a suitable communication path. Groups are easily created and changed providing future flexibility and reliability without altering wiring with an operational frequency of 868MHz Efficient communication . Intelligent algorithm with low transmission of data – transmits less than 1% of total time (99% of time wireless is off) -reduces wireless traffic increasing reliability.

25.9. Software uses simple wait before transmit logic to ensure error free transmissions.
Using a single robust hand held infra-red programmer luminaires can be very quickly and easily commissioned, and all operational settings can be fine tuned in the future if desired.

25.10. The System Gateway uses the mesh network to communicate with individual luminaires, controlling emergency light test timing and obtaining information on energy usage, luminaire status, occupancy profile and air quality. The system uses 868MHz secure radio communication chosen for its excellent transmission distance and object penetration, especially useful within buildings.

25.11. Each luminaire shall act as a wireless node, repeating each command received on to the next luminaire, providing a robust system that will always find a communication path

25.12. Building Address
Identifies devices that are within the same system and forms the boundary for the wireless mesh
network to prevent adjacent buildings communicating.

25.13. Group Address
All luminaires with the same building address and the same group address will work together for presence detection and scene control.

25.14. Device Address
Individual luminaires within each group can be given a unique address to provide identification.

This information shall be transmitted to the world wide web for viewing using tablets, smart phones.

The system shall Deliver:
full energy performance reports.
Provide emergency lighting status information.
Provide luminaire status information.
Management of emergency lighting testing dates/times.
Management of external lighting switching times.
Provide occupancy profiling information.
Provide air quality information.
Management of Colour Active regime.

25.15. Records shall be accessed remotely with a username and password.

25.16. Off-site Storage shall include
Energy performance data, emergency lighting testing records, occupancy profiles, air quality data,
"as fitted " drawings, Interactive drawings and commissioning certificates are stored remotely on the web server.

25.17. The above system shall be as manufactured by Thorlux Lighting their Smartscan system or equal and approved

Thorlux Lighting
Merse Road
North Moons Moat
Redditch, Worcestershire
B98 9HH England

25.18. Where energy saving systems are installed, consideration should be given to providing switches that will provide local control to the user, i.e. the switch can override the system to off.

This will also provide a facility to switch the fitting(s) off for maintenance.

25.19. Presence detectors shall have a power consumption of 150mA and be complete with a relay even when controlling digital ballasts. This will ensure the quiescent power is kept to a minimum and help reduce the base load of a building overall.

25.20. Where switch override is provided then the preferred type of detection would be absence with a recovery facility. Absence recovery provides the safety feature of enabling the luminaries to switch ON automatically if the lights have timed out, negating the user having to walk to the switches to bring them back on.

25.21. Large open plan or laboratory areas shall be provided with auto absence by day with presence by night, overcoming the challenge to locate or use switches under dark conditions.

25.22. PIR's shall be completed with a high definition lens for increased sensitivity and range with an adjustable clip on lens mask that allows infra-red programming to pass through. The lens mask should be used to avoid triggering and refreshing of timers from unwanted traffic outside a designated working zone.

25.23. Microwave detector may be required in certain instances.

25.24. The PIR shall be provided with a minimum of a 5-year warranty

25.25. If Digital Addressable Lighting Interface systems (DALI) are to be installed, surge protection in accordance with BS EN 62305:2011 must be provided. If in doubt, discuss with the University's Senior Electrical Engineer.

25.26. The University stand-alone technical solutions for small works:
Exor (Honeywell) or equal approved.

Principles of control systems
Generally lighting controls using DALI shall be controlled utilising
- a switch to activate
- modulation by a combination of daylight sensors and DALI to present levels
- occupancy sensors to de-activate.
-Stores shall be PIR controlled only.
-Risers and plant rooms lighting shall be controlled by manual switches.
-DALI control shall be used to optimise energy efficiency.
-In toilet areas dual channel controls shall activate shut-off valves to Public Health systems as well as lighting.

25.27. The DALI system shall be used to regulate the light output to the set level.
Lighting within toilets shall be controlled using PIR presence detection. The lighting shall automatically be switched on when the space is occupied, and switch off after a predetermined time if no presence is detected. The PIR's shall be provided with an adjustable run on timer capable of being adjusted between 0 and 20 minutes. The PIR shall also be used to switch local water shut off solenoid valves to reduce the effects of leaks and flooding. The position of the control unit must be carefully considered to avoid vandalism.

25.28. For adult education classrooms, levels shall be set to 500 Lux in the evening and 300Lux in the day. Daylight sensors shall be used for daytime and modulation shall be used for increasing to 500 Lux with the DALI system.

25.29. In classrooms, the DALI system shall control the lighting levels and local override switches shall

be provided at the teachers position and in certain rooms dimmable according to the local user requirements.
These rooms shall be provided with daylight linked absence detection sensors, and manual override switches.

25.30. When the room is unoccupied for a predetermined time period the absence detection shall hold (or switch) the lighting off.

25.31. The lighting shall be brought on when the light switch is manually operated.

25.32. Each individual row of luminaires shall be day light linked such that when sufficient natural daylight is present, the individual row of luminaires shall be held off automatically.

25.33. In class room areas the lighting provided immediately adjacent to whiteboards shall be provided with dedicated switching control, which shall ensure luminaires adjacent whiteboards, can be manually turned-off to reduce glare and increase contrast on the screen if required.

25.34. Areas such as corridors shall be provided with timer and PIR controls. Half of the lighting shall be controlled by time switch alone, the remainder by PIR.

25.35. Manual override switches shall be provided for building management use to override the time clock controlled lighting.

25.36. Stair lighting shall be controlled via the BMS generally and also fed for the emergency lighting via DALI control.

## 26 Emergency Lighting

26.1. At the project briefing stage (for larger building's) a monitoring system shall be incorporated as a maintenance test and diagnosis tool (not central battery type).

26.2. It is the intention of the University to standardise across the campus with a wireless lighting management system that allows the university to monitor their energy performance data and complete operational information for all standard internal, external and Self-testing emergency luminaires with integral battery for 3 hour emergency operation.(see general lighting above)

26.3. Emergency lighting shall be designed to the current British Standard.
Emergency lighting levels particularly circulation and escape routes shall be illuminated to 1 lux average along the centre line of the escape route and 0.5lux in open plan areas other than escape routes. High risk areas shall be illuminated in accordance with BS5266 pt. 10.

26.4. Use of Standalone alone for smaller refurbishment schemes shall be :
Emergi-lite 3 Hr non-maintained LED SELF TEST bulkhead fittings wired from the local lighting circuit or equal approved. The fittings should be semi-recessed whenever possible.

26.5. The use of combined "lighting/emergency lighting" fittings shall NOT generally be used unless the Project Architect can offer compelling reasons based on the project ceiling plan aesthetics.

26.6. Technical submittals shall be provided where required by the accompanying Materials and Workmanship clauses.

26.7. The following areas shall be provided with emergency lighting:

- All escape routes - principally corridors, staircases and points of egress.
- Areas over 60m2.
- Rooms that receive no natural daylight.
- Toilets that are more than 8m2 or are accessible toilets.
- Areas containing potentially hazardous equipment, e.g. plant room, kitchen, resistant materials, etc.
- Community use areas.

- Classrooms and other teaching spaces of an area less than 60m² that are not used as public escape routes or community use shall not be provided with emergency lighting.

## 27 Fire Alarm Systems

27.1. The Engineering Consultant shall develop a 'cause and effect' schedule this shall demonstrate the interdependences and system operation at tender stage in conjunction with the fire compartment and fire strategy for the building.

The schedule may include:

- *Single and/or double knock items confirmed.*
- *Zonal operation of sounders.*
- *HVAC operations and Building Management System.*
- *Smoke dampers.*
- *Smoke extract.*
- *Automatic Opening Vent*
- *Fire curtain.*
- *Automated fire extinguishers.*
- *Lifts.*
- *Security.*
- *Access Control.*
- *Audio Visual.*

27.2. Advice on the level of protection for any scheme should be sought from the University Safety Advisor responsible for fire risk assessment under the 'The Regulatory Reform (Fire Safety) Order 2005' via the Project Manager.
Most new build projects will be supported by a Fire Engineer & Building Control appointment.

The system should be designed and installed to suit the Fire compartments and zoning of areas within the building. Details of the fire compartments must be confirmed during the early stages of the design.

27.3. However, in principle the following is the Universities approach:

*a) Non-Residential Property*

For the level of protection provided will be Minimum L4-L5 in accordance with BS 5839 Part 1: 2017.

L4 to BS5839 is the use of Automatic Fire Detection (AFD) to protect escape routes. L5 to BS 5839 Part 1: 2017 provides for additional detection to cover higher risk areas such as electrical switch-rooms, mechanical plant rooms, comm's rooms, laboratories etc.

Automatic Fire Detection will be installed in voids in accordance with BS 5839, unless a specific project risk assessment undertaken by the University Safety Advisor deems that it is <u>not</u> required.

*b) Residential Property.*

L1 must be provided. Particular care will be taken on the choice of the automatic devices and the sensitivity adjustment of the system.

27.4. Manufacturers of Fire Alarm Equipment across University Campus vary, however, the most common on the Brownlow Hill Campus is as follows:

Open architecture for example Morley analogue addressable panels with
Apollo detectors,
KAC manual call points (fitted with anti tamper protective covers)
and,
6" red Vimpex electronic bells or equal approved.

27.5. In most of the University's student residences Gent (Honeywell) systems are commonly used with sounders instead of bells and multi criteria sensors in the student spaces.

27.6. Please note that all new 'break glass call points' should be of the resettable element type. fitted with anti tamper protective covers

27.7. Cable will be 'Enhanced' soft skinned cables (RED) in accordance with BS 5839 Part 1: 2013. Note will also be used to interface door access systems to fire alarm panels as appropriate.

27.8. Electrical Design Engineers shall consider the outset of the project the approach to referencing, identification and location of detection devices so that in the event of fire alarm, the physical location of the fire within a building can be made as quickly as possible.

For new building & major refurbishment projects all devices shall form part of an addressable fire alarm system and labelled.
This generally follows the format **Panel/Loop/Zone/Device.**

27.9. Fire alarm mimic drawings of the building layout should be produced and installed adjacent to the main fire alarm panel showing the locations of the system installed complete with fire log book

27.10. Fire alarm 'as fitted drawing plans shall be produced showing:
Location of all fire alarm devices, sounders detectors, interfaces etc
Associated address for each device
Route of loop taken by cable between devices for all floors
Allocated zones
Main and mimic panels
Disabled Refuge alarm points

27.11. Each system signals back to Security Control room in Bedford House, Oxford Street via a Emizon TCD dual-path device.

27.12. Grainger Systems Ltd are the term Fire Systems maintenance contractor at the time of writing.
Wavertree Technology Park,
1A Newton Court,
Liverpool L13 1EJ,
Telephone: 0151 220 4068.

27.13. Provide fire alarm log books indicating commissioning of all devices

## 28 Security Systems

28.1. Intruder Alarm systems linked to Bedford House, Oxford Street
Each system signals back to Security Control room in Bedford House, Oxford Street via a Emizon TCD dual-path device.

28.2. In general a grade 3 Intruder Detection System (IDS) shall be provided to protect the building

from unauthorised entry.

The IDS will enable designated/remote Security Staff to be notified of:

- Unauthorized entry to, or egress from building,
- Unauthorized entry to, egress to, or movement within specific rooms or areas, or
- Staff in need of immediate assistance.

This is to be achieved via a combination of:

- Monitored, magnetic door contacts on doors,
- Local PIR detectors, and
- Staff panic alarms at specific sensitive locations.

The system will follow the University standards.

28.3. A significant proportion of the older internal building CCTV are a standalone local system, and most are linked back to Bedford House, Oxford Street via fibre optic cables. Increasingly new cameras are IP type which have been added to the University's data network over the last few years.

28.4. The Computing Services Department (CSD) operate and maintain the IP CCTV and Access Control connected systems on the University network.

28.5. CSD are the University of Liverpool owner of a set of minimum standards for CCTV and Access Control.
These documents will be obtained from the Project Manager.
The required 'WARRANTY PERIODS' are indicated within the CSD Guidance Documents.

28.6. The CCTV and camera located and building security strategy shall be developed in close consultation with Project Manager, Campus Security and Building Users.

28.7. In general the building shall be protected by a building wide CCTV System.

The CCTV coverage shall be provided to the following areas of the building;

- The external perimeter of the building,
- All entrances/exits to the building. Including public & staff entrances, & escape exits etc.
- At main thoroughfare zones and corridors for tracking purposes paying particular attention to lifts and stairs.
- At locations where cash may be handled, including at reception desks, cafes, and reprographic rooms,
- In all lift cars and associated floor lobbies to assist in recording movement through the building, Mirrors are to be fitted to the internals of the lift car.
- Plant areas.

28.8. The CCTV system will be based on an Internet Protocol (IP) system, in line with the University standards; and monitored from Bedford House via connection to University of Liverpool's IT network.

28.9. The primary non-residential card access system across the Leahurst and Brownlow Hill Campus is the Grosvenor Sateon System that are interfaced to the fire alarm system to 'fail-safe' and are linked to Bedford House, Oxford Street for programming etc.

28.10. The University Computing Services Department (CSD) maintains the specification for the Access Control System and is available upon request from the Project Manager.

28.11. Other access systems used by the University are as follows:

All Residential Blocks – Aperio X Plan.
Gallagher – MIF building No 807, Brownlow Hill.
Sentinel Skuba – Sports Centre, Brownlow Hill.
Centaur Millennium – Libraries.

Salto - Some switch room and server rooms. Most locks will be the European cylinder – G9X2 which is fully integrated with the Salto XS4 platform, please note offline line configuration currently employed.

28.12. In general Access Control System shall be provided within the building, with access control provided on all strategic doors, including on the following;

- All staff entry routes into the building
- On all doors to staff rooms/areas
- Doors leading into staff/'back of house' areas from general public access area
- All bookable rooms
- All sensitive or secure areas
- All workshops, print media and reprographics rooms.
- Main plantrooms
- IT/Comms Rooms
- Within all lifts

28.13. Doors will generally be provided with proximity card readers or fobs according to the University requirements.

28.14. Intercoms shall be provided for video entry/intercom panel to be provided at the main entrances. Located for suitable use under DDA requirements

28.15. The Access Control System is to be primarily a POE (Power Over Ethernet) based system, with power provided from AC controllers located in risers remote from the doors.
The system shall follow the University standards.

28.16. Car park traffic barriers pay machines with intercom are linked to Bedford House, Oxford Street for control and programming. The traffic barrier intercoms are part of the University telephone system.

28.17. The current supplier is

CameParkare Limited,
Unit 108 Longmead Road,
Emerald Park East, Emersons Green,
Bristol, BS16 7FG,
Telephone 0844 371 70 72.

28.18. Gemini Security Systems Ltd are the term Security maintenance contractor at the time of writing.

49 Whiteside Road, Haydock,
St Helens,
WA11 0XN,
Telephone: 01744 600 483.

## 29 Data and Telephones (General)

29.1. The Universities Computing Services Department (CSD) operate and maintain these systems. CSD are the University of Liverpool's owner of a set of minimum standards for the design and installation for telephones and networks. These documents will be obtained from the Project Manager. See CSD -Network Design Guide
The required 'WARRANTY PERIODS' are indicated within the Guidance Documents.

29.2. It is the Electrical Design Engineers responsibility to consult with Computer Services Department (CSD) and shall have the University of Liverpool sign off the drawings and specification before any DESIGN can be used for tender purposes.

29.3. At the concept stage of the project the demarcation between equipment to be purchased direct by the University and that supplied by the potential works contractor will be discussed and agreed between CSD Network Manager and the Project Manager. CSD will place charges on new data activations and these charges need to be assessed in conjunction with the Project Manager.

29.4. Many of the buildings on campus employ a 'structured-wiring' system and this should be considered for any projects of significant size.

29.5. Under no circumstances shall new data cabinets be installed within electrical switch rooms. Space within a dedicated server room shall be provided to accommodate the new data cabinets within the project

29.6. Data cabling shall NOT be routed through substations and main electrical switch rooms.

29.7. New data & telephone installation works shall be undertaken using CCA rated minimum. Cat 6A U/FTP to meet POE ++ to deal with increasing power demands of up to Type 4 (100W) Power over Ethernet.

29.8. Construction Product Regulations (CPR) now apply to data wiring, especially in the areas of fire safety.

29.9. University of Liverpool will only accept products from Connectix and Excel.

29.10. Selection of the Data Cabling Contractor must be formally approved by CSD and the Project Manager on all projects

## 30 Work Sequence

30.1. On most new build or major refurbishment projects, it is common to install the cabling and complete the fit out to the areas, prior to completion of the comm's room.

30.2. The University based on recent project experience , would prefer to 'fast track' the comm's room installations, so these are water tight and live with rack equipment active at a very early stage of the project. Please note activation of the ports is usually undertaken remotely by CSD.

## 31 Telephones

31.1. In general telephone wiring and sockets may be installed locally by the electrical contractor.
31.2. All new systems are planned to be VOIP.

31.3. CSD retain strict control of termination at the distribution points.

31.4. The University has a mixture of CW1308 cabling to local floor distribution points and structured category 5/6/6A wiring back to data cabinets. CW1308 cabling shall be terminated in wall mounted 1308 DP boxes located within the server room with a cable installed from the DP to a single patch panel on the server rack (allowing patching). However, all lines associated with life safety and lift emergency phones shall terminate directly at the wall DP to ensure these cannot be de patched in error.

31.5. The Electrical Design Engineers are to note the differences between external and internal telephone cabling and specify accordingly.

31.6. For new and refurbishment building projects multi core copper cables to link to existing server rooms with available lines. A standard schematic can be provided by the Project Manager.

31.7. The Electrical Designer Engineers in consultation with CSD will establish whether the appropriate number of multi core cables are available /required to connect lift emergency handsets and HV substations and any other project driven telecom's requirement.
31.8. The Electrical Design Engineers will provide enough information for the Telephone Services Manager (CSD) to estimate new connections/lines and/or transferring of connections/lines. These charges need to be assessed in conjunction with the Project Manager and will be part of the works costs.

## 32 Data

32.1. When determining the number of outlets as part of a refurbishment project. The Electrical Design Engineer shall rigorously review the number of unused ports available in existing local cabinets. This investigation shall again be undertaken in conjunction with CSD Network Managers.
32.2. The Electrical Designer Engineer as part of the project scope shall ensure that all equipment on third party systems e.g. CCTV and access control are compatible for connection to the UoL networks (FM and CSD). The designers attention is drawn to the sizing of cabinets were servers are employed for CCTV.
Comments shall be sought from CSD i.e. Access Control and CCTV.

32.3. The data drawings will include the location(s) of the appropriate data cabinet(s) Cat 6A cable and fibre links.
The Electrical Design Engineer shall plan and fully co-ordinate all containment routes for data and voice.
32.4. A separate set of data and voice co-ordination drawings (shall include all other equipment to be connected to the UoL network e.g. CCTV cameras) shall be produced showing what cables are enclosed or laid upon what tray and trunking. Emphasis is placed on the co-ordination and selection of containment below a ceiling line.

32.5. The Electrical Designer Engineer shall consider with University of Liverpool whether the CCTV elements of the project can be incorporated into the CSD network rather than dedicated FM fibre and coaxial to Bedford House, Oxford St.

32.6. University of Liverpool prefers the use of enclosed containment systems in areas of a building which are visible to students and staff.

32.7. The Electrical Design Engineer drawings must show all outlets and the position of the data cabinets and patch panels. This containment drawing set must be approved by CSD representative and the Lead Consultant.

32.8. Wiring may be undertaken by the Electrical Contractor subject to approval termination at both the patch panel and the sockets, and testing must be by a specialist contractor approved by the University's Computer Services Department (CSD).

32.9. Up until recently RJ45 data sockets have been wired as dual sockets, with 2 No Low Smoke 0H (LS0H) Cat 6A cables. CSD are updating their data switches in local cabinets and newer installation will only require one cable. Please consult on a project by project basis with CSD.

32.10. Any active data socket that needs to be transferred, even from building to building will normally be re-activated by CSD free of charge. Clearly wiring will not be included in this free service.

32.11. All new installations Ethernet switches to be power over internet (POE) and WiFi.
Certain WIFI access points require two cables.

32.12. CSD will undertake a signal strength WIFI (HEAT) map for each project. They will provide drawings of the actual locations of the heads. Sometimes the heads do not coordinate well with architectural layout of the ceiling. However, the access points must stay in the position shown on CSD information unless they approve changes. A change of position instruction be only accepted, if it is confirmed writing by CSD. The WIFI access points are procured by CSD and free issued to the Installer.

32.13. Cables shall not be grouped in more than 24 number. The Electrical Design Engineer shall specify generous cable spacing and containment accordingly to allow for the adequate dissipation of heat from cabling as a result of the increasing use of power over Ethernet systems (POE).

32.14. The Electrical Design Engineers shall provide 'Engineering Services' fire stopping using HILTI systems or equal approved.

## 33 Building Management System

33.1. Reference for the requirements for the BMS shall be made to University Guide developed by the Senior Mechanical Engineer.

## 34 Critical Alarms

34.1. The Critical Alarms from Brownlow Hill, Greenbank, Leahurst etc are managed at the Central Security Control Room at Bedford House, Brownlow Hill via a Patriot Systems Alarm Management Software.
There is also secondary control room monitoring the alarms managed under contract by a security contractor.

34.2. The local Telemetry Communication Device (TCD) is a dual-path communication device that

fits into the alarm control panel and connects to the Emizon IP monitoring service, providing an 'always on' link between the alarm panel and the 24-hour response centre. TCD connects into the University IP network for the primary and wired communication path and uses the wireless GPRS network for the secondary path.

34.3. In terms of electrical plant, the following items are to be linked via a local Emizon TCD dual-path device back to the Patriot System.

- Phase failure on Essential Supplies.
- Fuel Tank Level's.
- Generator.
- Large UPS**.**
- Fire alarms.
- Intruder alarms**.**
- Essential refrigeration.
- Any other designated item highlighted in the client brief.

## 35 PV installation

35.1. Where PV is called for under the grid connected photovoltaic panel system shall include, but not be limited to, the following:
- The Contractor shall design, supply, install, test and commission a complete photovoltaic panel system for the associated building as required, - The PV system shall cover the approximate area required to achieve the bream targets the layout shall be agreed with the Architectural , structural and electrical engineers,

35.2. - The system shall be designed and installed in accordance with the requirements listed elsewhere, and shall be installed by an accredited Micro-Generation Certification scheme member,

35.3. - All equipment used shall meet with the requirements for the Micro-Generation Certification Scheme (MCS),

35.4. - The system shall include a display screen arrangement to indicate usage of PV and export etc, so the university can utilise as part of teaching,

35.5. - The system shall incorporate G59 relays as appropriate such that it can be connected to the grid,

35.6. - The contractor shall liaise with the DNO/ University Engineer to ensure compatibility of the system with the external network,

35.7. - Provide training to facilities staff on the configuration and setup of the PV systems,

35.8. - Providing all testing and commissioning to comply with standards and this specification,

35.9. - Documentation and as-built documentation.

## 36 Consultant Specification and Engineering Preliminaries

36.1. University of Liverpool operates a framework agreement with several Engineering Services Consultants and Contractors on standard terms and conditions.

36.2. The Engineering Services Consultant shall **NOT** issue contract preliminaries which apply to the main contractor or subcontractor without the approval of the Project Manager and Senior Electrical Engineer.

## 37 Design Process

37.1. When the Engineering Services Consultant is part of a design team. The development of the client brief will involve all input from all relevant Consultants.
The sequence of design will involve the production of room data sheets (RDS) incorporating the required services.

37.2. The Engineering Consultant shall not under normal circumstances issue drawings for construction purposes to the Contractor unless the Lead Consultant (usually Architect) has issued a formal construction issue of co-ordinated ceiling plans and room elevations for review and development by the Engineering Consultant.

When preparing drawings for construction, prior approval from the Lead Consultant, Project Manager, and Senior Electrical Engineer shall be requested before formal distribution.

## 38 Project Milestones

38.1. The Engineering Consultant will follow the RIBA work stage process to develop the design. The following are key milestones to be developed within his programme.

| Consultant Milestones | Consultant Action | University of Liverpool Comments |
|---|---|---|
| Tender deliverables | Servicing strategy presentation | Approval required before proceeding with design development. |
| | Lighting design concept presentation | Approval required before proceeding with design development. |
| | Discrimination and co-ordination study | Approval required before proceeding with design development. |
| | Data and voice containment routes and equipment locations drawings. | CSD sign off required. |
| | Fire, BMS, Control and Security Strategy | Approval required before proceeding with design development. |
| | Review of consultant preliminaries. | Approval required by the Lead Consultant, Quantity Surveyor, Project Manager and Senior Electrical Engineer. |
| | Development of commissioning strategy for the project. | Approval required by the Project Manager and Senior Electrical Engineer. |
| | Room Data Sheets | User Group, Lead Consultant and Project Manager. |
| Construction deliverables | Review changes from tender to construction issue. | Approval required from Project Manager and Senior Electrical Engineer to issue. |
| | Construction issue updates | Review and record the reasons for change. |
| Training, Commissioning and handover | Review and comment on contractor commissioning | Consultant approval mile stone. UoL to approve stage |

| | | |
|---|---|---|
| | results. | contractor payment. |
| | Produce snagging list. | Consultant approval mile stone. UoL to approve contractor stage payment. |
| | Review and comment on the Contractors as fitted drawings-status. When the review process complete advise UoL. | Consultant approval mile stone. UoL to approve contractor stage payment. |
| | Review and comment on the Contractor operation and maintenance documentation. | Consultant approval mile stone. UoL to approve contractor stage payment. |
| | Completion of the Training Programme | Joint Consultant and University sign off. |
| 12-month defects | Final snagging | Retention release dependant on Consultant approval. |

## 39 Drawings

39.1. New drawings will be in accordance with the University's CAD standards and British Standard BS1192:2007+A2:2016 Naming of Document and Drawing Procedure however, exceptions for the Consultants with their own QA processes can be made on formal request to the University Project Manager. Drawings shall be presented to the client so it can be reviewed and commented against. See FM00113 Code of practice for the production of electronically drawn information

39.2. Existing architectural & electrical drawings may be available. Please request from the University Project Manager

## 40 Design Drawings (Riba stage 2 -4)

40.1. Design drawings must be of sufficient standard and detail, so they can be used in most circumstances as installation/working drawings. The design drawings shall be issued to the client so it can be reviewed and commented, no drawings shall be used for installation without agreement/comment received from the client.

Drawings when issued must state on the drawing and in the revision drawing status and reason for issuing at the time of issue ie preliminary, comment, tender etc

40.2. Issues of co-ordination of buildings and services are in the first instance the responsibility of the Design Team.

40.3. When designing 'plug and play' off-site prefabricated wiring systems, the location of all joints & plug connection points, which are only to be located in accessible risers and voids are to be shown on the design drawings.

40.4. Preliminary (DESIGN DEVELOPMENT) drawings should be submitted to the University of Liverpool Project Manager for comments in adequate time for their review before approval to issue for tender purposes.

## 41 Contractor Construction Information (Riba stage 5)

41.1. Under certain forms of contract, University of Liverpool will require the Contractor to

produce 'working & installation drawings'. This should be clarified with the Project Manager. The contract drawings shall be issued to the client so they can be reviewed and commented, no drawings shall be used for installation without agreement/comment received from the client.

41.2. The Engineering Services Consultant on behalf of the University will administer and record an A, B, C commenting process for drawings and technical submittals.

If the Engineering Services Consultant and the Project Manager deem applicable to the project works and associated form of contract, the details of the above two CCI processes will be defined within the main contract tender preliminaries.

41.3. **Contractor Drawings**

The following drawings shall be prepared for construction by the Contractor in Auto-Cad minimum 2014 and full-size paper copies and shall be submitted for comment prior to the commencement of installation / fabrication, prior approval from the Lead Consultant, Project Manager, and Senior Electrical Engineer shall be requested before formal distribution.

41.4. **Installation Drawings: - (produced by the Contractor)**

Notwithstanding the provision of the Contract Drawings the electrical Services Installer shall be responsible for taking his own particulars and providing at his own expense all necessary working and detail drawings as requested by the Contract Administrator, copies of which must be first submitted for approval before the work is put in hand.
Approval of working drawings shall not relieve the Electrical Services Installer of his responsibility to ascertain exact building dimensions, location of other services and co-ordination with other trades.
The working drawings to be prepared for installation purposes in AutoCAD format. The submission shall be as described in the relevant works section contained in this specification and shall include:

a) switch room/Plant room/Service Riser drawings, plans and sections to a minimum scale of 1:20 with service duct sections at 1:10.
b) General layout drawings to a scale of 1:50.
c) General section and switchgear/distribution arrangement drawings to a scale of 1:20.
d) All drawings shall be fully dimensioned, showing plan and section indicating positions and sizes of all cable containment and support runs together with all termination equipment e.g. distribution boards, wiring accessories, luminaires, etc.
e) HV/LV schematic layouts with sizes shown for switches, protective devices, cables atc complete with all associated labelling

41.5. **Builders' work details: - (produced by the Contractor)**

a) In all cases the necessary information to define requirements for builder's work, either by the provision of drawings and /or schedules, or by setting out requirements on site shall be provided.
b) The methods to be adopted shall be agreed with all interested parties but in general shall be as follows:-

i. where builder's work is to be defined, drawings shall be provided
ii. where builder's work is to be cut, it shall be marked on site

41.6. The submission of and subsequent approval to drawings shall in no way relieve the responsibility for the design, accuracy and coordination of the information provided which

shall remain at the sole risk of those preparing the data.

41.7. **Record drawing (refer to main contract preliminaries for submission requirements)**

A final drawing showing the building and services installations 'as installed ' at the date of practical completion. The main features of the record drawings should be as follows:

- The drawings should be to a scale not less than that of the installation drawings.
- Locations of all the mechanical, electrical and public health systems and components installed including ducts, pipes, cables, bus-bars, plant items, pumps, fans, valves, dampers, control devices, strainers, terminals, electrical switchgear and components, security and fire sensors and control equipment.
- The drawing should be labelled with appropriate pipe, duct and cable sizes, pressures and flow rates, address labels.
- The drawings should have marked on them positions of access points for operating and maintenance purposes.
- The drawings should not be dimensioned unless the inclusion of a dimension is considered necessary for location.

41.8. All drawings shall be prepared in accordance with recognised M&E drawings standards and the University's CAD standards .

## 42 As Fitted Drawings (Riba stage 5 -6)

42.1. Within his specification the Engineering Consultant can make reference to that of the Electrical Contractor producing a set of as fitted drawings.

42.2. The Engineering Consultant will release his last set construction issue CAD files to enable the contractor to complete this task. The Engineering Consultant will be responsible for checking all O&M documentation on behalf of the University of Liverpool.

42.3. Installed 'plug and play' off-site prefabricated wiring systems, the associated as fitted drawings shall show the location of all joints plug connection points with annotation to illustrate how plug and play devices and joints will be accessed for testing, adaptation and maintenance.

42.4. The as fitted drawings must be provided in paper form and on USB/CD/DVD or agreed format as part of the handover information at the completion of the scheme.

42.5. For smaller projects changes should be added to the latest copy of the as fitted drawings by the Electrical Design Engineer.

42.6. The Electrical Design Engineer shall request the existing single line diagram for the building or network on commencement of the works from the Senior Electrical Engineer. If no schematic exists then the electrical design Engineer must produce a complete schematic representing the existing and proposed configuration as part of their scope of works

42.7. The Electrical Design Engineer shall update the schematic to include the modifications and additional items as part of their work scope.

42.8. On completion of the works the 'as fitted single line diagram' shall be returned as part of the contract handover documentation and a replacement wall chart diagram shall be installed in all the relevant LV switch room affected by the scope of the project scope.

## 43 Commissioning and Testing.

43.1. The Contractor is responsible for ensuring that the commissioning of all building's services are undertaken in accordance with the methodology contained within the BSRIA guide "BSRIA BG11/2010 Commissioning Job Book – a framework for managing the commissioning process" and shall appoint a suitably qualified person to drive the process and undertake the associated administration of the commissioning process**.**

43.2. The electrical installation shall be inspected and tested in accordance with the current version of the IET Wiring Regulation BS7671.

43.3. The contractor shall be responsible for inspecting his own works prior to being offered as complete and shall implement a bespoke inspection and test plan covering all electrical systems, a sample of which shall be provided at tender. The purpose of the Inspection and Test plan is formalised on site test and inspection procedures, to ensure that all elements of the electrical services installation are tested and inspected, to record any defects and anomalies and to record and demonstrate that these activities are being performed throughout the duration of the works. The plan shall be kept on site and made available for inspection at any time.

43.4. The contractor shall as an on going process continuously inspect the works throughout the duration of the contract and regularly submit 'Snag Sheets' which shall record all defects and subsequent remedial works. No work shall be covered up without first being inspected by the contractor and presented free from defects together with the appropriate Snag Sheet and Inspection Sheets.

43.5. For all equipment, copies of test certification shall be provided. Copies of test certificates shall be included in the O&M manuals.

43.6. Prior to completion, functional tests shall be performed with the design team in attendance to demonstrate the correct operation of interfaces between systems such as the BMS, security systems, fire detection and alarm systems.

43.7. The contractor shall submit a commissioning plan which shall identify critical milestones such as power on, MCC live dates, completion of server room (to permit installation of servers for IP based building services systems such as security).

43.8. Satisfactory completion certificates and test sheets must be made available prior to Practical Completion for the following systems as applicable:

- Fire detection and alarm system
- Telecommunication and CCTV system
- PA system
- PV System & Exporting
- Lifts
- Earthing system
- Emergency Lighting
- Electrical test results
- Electrical Completion Certificate.

## 44 O&M Information

44.1. Please note the University provides detailed Guidance with respect to O&M manuals. The following provides a summary for the assistance of Electrical Design Engineers and contractors as a short form guidance from an electrical perspective.

44.2. The Electrical Contractor is responsible for the provision of Health & Safety files incorporating Operating & Maintenance(O&M) information in a Class D "system-based" format and with contents as defined in Part 2 of BSRIA Guide BG1/2007 "Handover, O&M Manuals and Project Feedback". All O & M documentation is to be issued in electronic format (single PDF) handover ***of each project phase*** with final collated electronic version.

44.3. The Engineering Consultant shall include a specification for the Contractor to produce a set of O&M deliverables in SEARCHABLE digital format.

44.4. The manuals shall comply with The Building Research and Information Association (BSRIA) publication 'Operating and Maintenance Manuals for Building Services Installation'. Unless otherwise stated the manuals shall be prepared to Class 'D'.

The manuals shall include: -

- *Full set of 'As Fitted Record Drawings' in paper and searchable Auto-Cad electronic formation for a CD/ DVD.*
- *Full description and commentary for each system*
- *Schedule of all equipment including luminaires.*
- *Maintenance schedules (quantity, location and the frequency of intervention for planned preventative maintenance).*
- *Standard Operating Procedures – shall be clear and precise to assist the Facilities Manager in the safe and optimal operation of the System and Equipment (inclusive of switching schedules).*
- *Recommended spares.*
- *Health & Safety File.*
- *Building User Guide.*

The commissioning test results, as applicable, shall include:

- *Documentation required under 'Dangerous Substances and Explosive Atmospheres Regulations.'*
- *Discrimination and co-ordination study.*
- *Cable schedule*
- *Breaker setting schedule*
- *Distribution board charts*
- *Electrical certification*
- *All relevant fire alarm certification*
- *Emergency lighting certification.*
- *Lightning protection test results.*
- *Specialist equipment certification.*

44.5. The Engineering Consultant will be responsible for checking that the O&M package including drawings accurately records his design, accuracy, statutory requirements and the University requirements. The documents will include the requisite information to operate and maintain the services installation before issuing to the University of Liverpool.

44.6. On completion of all documentation, the Engineering Services Consultant shall raise a formal approval note to inform the University to release payment to the Services Contractor.

44.7. The Engineering Consultant will upload the final project commissioning data and

drawings as listed above to the appropriate folder on the University of Liverpool electrical share point web page.


Software access to the University share point website can be arranged by contacted the Senior Electrical Engineer.

## 45 Training

45.1. The Electrical Design Engineer shall ensure that training is provided as part of the works for the University of Liverpool staff and maintenance contractor teams. Typical systems may include:

- The timing of training shall be included and clearly flagged as part of the main project programme.
- BMS, alarms and plant conditioning.
- Optimisation and management of systems
- Lighting controls.
- Fire systems and Emergency Lighting.
- Energy monitoring
- Cabinet's configuration.
- Mechanical plant.
- Electrical setting of protective devices and automatic change over.
- Generator and load banks.
- Security and access systems.
- Application of the Building User Guide.

## 46 Health and Safety General

46.1. Information on the University's H&S policy can be found on www.liv.ac.uk/safety/.

46.2. The health and safety adviser for construction works can be contacted for further information at

crowes@liverpool.ac.uk on telephone 0151 794 3172.

46.3. Contractors are responsible at all times for the safety and well being of their staff and others associated with the University of Liverpool when on the University of Liverpool property.

46.4. It is the Contractor's responsibility to ensure the adequate discovery of and understanding of the hazards present in and around the area in which they will be working.

46.5. Reference must be made to the relevant UK National Standards relating to Health and Safety.

46.6. The Contractor is also to take account of the activities of other contractors, University staff , pupils and visitors who may be working in the vicinity of their own work area and to

liaise with these contractors and University personnel accordingly.

46.7. The Contractor shall comply with the requirements of the University's Health and Safety guides. Particular attention is drawn to the University's Permit to Work system, Safety Systems of operation on site and the requirements for all contractors' employees to comply with the University's regulations at all times. This is extremely important when carrying out modifications to operational plant & equipment.

46.8. Access Equipment, Hoisting and Materials Handling , the Contractor shall be responsible for providing and ensuring that all equipment is used in a proper and safe manner and compliance with all codes issued by the Health and Safety Executive.

46.9. The contractor shall make provision for all access equipment as required to safely complete all scope of works detailed within the project specification. This requirement shall include, but is not limited to:

- Fixed Scaffolding
- Mobile Scaffolding
- Cherry Pickers
- Scissor Lifts
- Podium Steps

46.10. The contractor shall make their own assessment of access and routes and make a suitable allowance to cover the safety requirements for all work indicated.

46.11. Asbestos

The University has an on-going programme of surveying, recording, and mitigation of asbestos issues.
Management Survey information (Type 2 Survey) and
Demolition Survey information (Type 3 Survey) is available in electronic format.
Enquiries should be made as a matter of routine for each scheme as early as possible in the project with appropriate investigation and surveys being undertaken in liaison with the Project Manager.

46.12. The University has a policy document on asbestos which must be adhered too.
46.13. Further information is available from Facilities Management's asbestos specialist shall@liverpool.ac.uk on telephone 0151 795 9098 via the Project Manager.

46.14. Access to Electrical Engineering Facilities

Permission for access to electrical switch rooms and substations must be sought only from the University's Authorised Persons. The consultant and contractor will follow the University documented standard operating procedures (available on request).

Contact the University Maintenance for further contact details.

*46.15. **Lifts***

A permit to work is required to access and work in any Lift Motor Room. The consultant and contractor will follow the University documented standard operating procedures (available on request).

## 47 Management of the Works

### *47.1. Electrical Shutdowns*

Electrical shutdowns of buildings can be extremely disruptive, if they are not well planned, and it is essential that faculty communication and arrangements are put in place which often require the provision of temporary supplies by the Consultant and Contractors.

47.2. Project Managers / Contractors are required to submit a request for a permit to work for an electrical shutdown to the Authorised Person.

47.3. The formal request shall be submitted with a minimum of 14 working days' notice (for certain buildings this period maybe much longer) to the Authorised Person.

47.4. The Contractor shall ensure that in the event of an actual disturbance of operational equipment, a process of reporting shall exist to bring this to the attention of the University's designated responsible person on site. In the event of disruption to operational equipment, work must cease immediately, no attempt to reinstate the equipment should be undertaken without prior consultation with the customer's representative.

47.5. The isolation of all equipment shall be at the University's discretion and shall fall within the control of the University's Permit to Work system.

47.6. It shall be the Contractors responsibility to satisfy themselves that the equipment has been correctly isolated and ready for safe working in accordance with the University's Permit to work and isolation procedures.

47.7. Before carrying out any of the electrical works at site the Nominated Contractor shall ensure that personnel attend a Tool Box talk and that a Risk Analysis is carried out for the work.

47.8. The Contractor shall ensure that all personnel carrying out the work are suitably experienced, competent, and qualified to carry out the work.

47.9. No work other than those detailed within the project document shall be carried out without the approval of the Designer and at the specific request of the University.

### *47.10. Out of hours working*

If out of hours working becomes necessary in the execution of the project, it may be necessary to arrange for a University Building Manager to be in attendance.
This will incur an internal charge of approximately £35 per hour which must be accounted for within the scheme budget.

### 47.11. *Underground Works*

The works shall be designed and undertaken in accordance with HSG47 and University of Liverpool requirements as detailed in the list of '**Other FRCS Electrical Information'** table below.
These documents are available on request from the Project Manager**.**

47.12. ***Please*** note existing services information is available on request from the Project Manager, however this does not negate the need for surveys and testing to verify site information.

*47.13.* ***It should be noted services on University Campus are bespoke and do not follow NATIONAL JOINT UTILITIES GROUP (NJUG) Guidance.***

47.14. On the Brownlow Hill Campus, there is an extensive system of electrical underground ducts installed since the year 2016, those routes are marked on the campus existing services drawings.
The majority installation can best be described as a sandwich in its trench build up.

At the bottom – 11kv high voltage cabling enclosed in PVC ducts.
In the middle – 415v low cabling enclosed in PVC ducts.
At the top – 3No communication ducts with manhole access for only the use of Computing Services Department (note only GLASS FIBRE data cabling (magnetic interference risk to metal conductors).

It should be noted that when there are any proposals for data fibre cabling to be drawn into those ducts and /or an adaption to the existing manholes or underground communication ducts that the UNIVERSITY AUTHORISED ELECTRICAL PERSON shall be notified for his comments.

47.15. When work is undertaken the Designer and Contractor shall plan shut down of low voltage and high voltage cabling within the defined trench which shall be only switched with the approval of the UNIVERSITY AUTHORISED ELECTRICAL PERSON.

*47.16.* ***Stripping Out Existing Services***

In the event of any cables and systems passing through a building to supply other parts of the building, it is the Electrical Contractor's responsibility to ensure that they are fully identified and diverted in order to fully maintain the affected parts of the building, All fire stopping should be installed-reinstated as required to maintain the integrity of the penetration through a designated fire wall all associated costs must be included for by the Project Manager within the project

47.17. The Electrical Contractor should allow for a full survey of these areas to ensure that all lighting and power supplies are identified prior to their removal. The Electrical Contractor should not rely on the Drawings or Distribution Board Schedules for definite identification of circuits. They should be used in conjunction with the survey to support the Electrical Contractor's findings. Any anomalies in circuitry identified during the survey should be appropriately marked on the Drawings and issued to the Consulting Engineer.

47.18. ***Retained Small Power and Lighting Circuits***

This procedure is critical to the successful replacement and reconnection works of any retained circuits. On no account is any circuit to be disconnected and withdrawn from the existing Distribution Boards without it being properly identified. The method of identification is to be permanent and is to be agreed with the Consulting Engineer.

47.19. All electrical services that are to be retained are to be made safe and dressed into the new containment layout.

47.20. Once identified, the existing cables that are to be retained can then be pulled back away from the space to allow the builders work to commence. Any retained circuits are to be untangled from any other services and dressed back neatly into the new containment.

47.21. Wiring circuits that are being altered and retained must comply and conform with the latest IET regulation. Any circuits which are to be altered and do not comply must be stripped back to their source and a new circuit installed accordingly all associated costs must be included for by the Project Manager within the project

47.22. Under no circumstances shall the Electrical Contractor work on the installation of new cables into existing containment containing live cables.

47.23. The Contractor shall ensure that all specifications & documentation clearly identifies all equipment As-Built on completion of the works.

47.24. The Contractor shall ensure that the installed electrical equipment is Inspected, Checked, tested, calibrated, Documented, Pre-commissioned & Witnessed to the satisfaction of the University's representative and in accordance with the University's standards.

47.25. All redundant equipment/material removed during these works shall be offered to the University, where they are not required the Contractor shall be expected to dispose of the equipment/material including any waste in a safe manner and in accordance with the University's and statutory environmental standards.

## 48 Other FRCS Electrical Information.

| | | | |
|---|---|---|---|
| | ***Design and Installation Guidance:*** | | |
| FM00088 | Electrical Safety Policy | 2.1 | 1ST March 2021 |
| FM00098 | Project Electrical Briefing Document | V5.4 | 7th January 2021 |
| FM00153 | Standard Specification for Electrical Installation Work | V3.2 | 7th January 2021 |
| FM00240 | High Voltage Underground Cables | V2.0 | 31ST January 2019 |
| FM00241 | High Voltage Switching & Earthing | V2.0 | 31ST January 2019 |
| | ***Standard Operation Procedures:*** | | |
| FM00221 | Low Voltage Safety Rules | V1.0 | 11TH December 2017 |
| FM00220 | Management of the Access to Low Voltage Switch rooms | V2.0 | 22ND January 2017 |
| FM00223 | High Voltage Safety Rules | V2.0 | 29th November 2018 |
| FM00196 | New and refurbishment of passenger and good lifts | | |
| | | | |
| CSD DOC | | | |
| | CCTV Camera design guide | V1.2 | 29TH October 2019 |
| | Network Design Guide | V7.3 | 23rd January 2019 |
| | | | |

**Notes**

Latest edition of British Standards and Design Codes shall be used by the Designer and Installer.

The Electrical Design Engineers attention is drawn to the following:

---

[i] **BS7671 Regulation 341.1 – Maintainability**

The Electrical Design Engineer shall make a formal assessment in accordance with 341.1

[ii] **BSEN 50310 – IT Installation.**

'Application of equipotential bonding and earthing in buildings with information technology equipment'

**BS7671 Regulation 521.10.202** – **Wiring Systems to Escape Routes** Wiring systems in escape routes shall be supported such that they will not be liable to premature collapse in the event of fire. The requirements of Regulation 422.2.1 shall also apply, irrespective of the classification of the conditions for evacuation in an emergency.