OXFORD UNIVERSITY ESTATES DIRECTORATE

MECHANICAL AND ELECTRICAL DESIGN PHILOSOPHY

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INTRODUCTION

The purpose of this document is to provide general guidance to Consulting Engineers and Contractors on the design requirements of electrical and mechanical installations within buildings which will be operated and maintained by the University Estates Directorate (UED).

The principles referred to in this document have been influenced by maintenance and operational requirements, the resources available within the UED and also by the need to standardise the mechanical and electrical services throughout the University's 500,000 m^2 of building stock.

To accommodate the ever increasing demand for continuity of services it is essential that systems are designed so that they can be repaired, maintained, inspected and extended with minimal disruption to the building user.

New systems should be as simple as possible and there **must be adequate, safe and easy access provided to all parts of the installations.**

Designers should note that because of limited staff resources, all routine maintenance work is only carried out during normal working hours. Designers must be aware of who is responsible for the various services so that separate plant rooms can be provided where necessary for UED and departmental plant.

It is essential that the proposed building services for all projects are discussed with the University Head of Building Services as soon as possible after the appointment of the Building Services Consultant or Contractor to ensure that there are no misunderstandings over the contents of this document or the reasons for a particular requirement.

Where the project involves working on or extending existing building services, no work may be carried out on the existing systems without the prior knowledge and approval of the University Head of Building Services. This is particularly important in the case of existing electrical systems where all work must be carried out in accordance with the UED Code of Practice 'Electrical Safety on Low Voltage Systems'.

The UED Direct Labour Organisation (DLO) must also be consulted before any work is carried out on any mechanical services installations within existing buildings. They will assist in the location of isolation valves, provide advice on the draining down/refilling of wet systems, etc. The DLO is responsible for the operation of the majority of the University's mechanical services and it is essential that they are told of any impending work on installations under their control. No contractor is authorised to carry out any work on the University's existing mechanical services installations unless they have been issued with a permit to work by the DLO.

Only contractors who are on the UED Approved Contractor's List will be allowed to carry out work on the University's existing mechanical and electrical installations.

A site visit can be arranged if required to inspect a typical existing installation in order to see at first hand the principles outlined in this document.

The University Head of Building Services must be consulted before any changes are made to an agreed building services design because of a need to reduce project costs. Value engineering should be carried out as part of the project design process and not after tenders have been received.

Plant equipment and systems must be specified at the time of tender. It is **not** acceptable for the selection to be made by the installation contractor.

All work within listed buildings requires careful consideration and all proposals **must** be agreed with the Head of Building and Conservation before any work is carried out.

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SECTION 1 – STANDARDS AND RESPONSIBILIES

1.0 Standards

All plant, equipment and systems shall be designed and installed in accordance with the appropriate British Standard or European equivalent, Codes of Practice, relevant Statutory Instruments and Regulations, Building Regulations, University Environmental Sustainability Policy, UED Policy & Procedures document 'The Control of Legionella Bacteria in Water Systems' and the University Safety Office Policy statements.

1.1 Responsibility

The following table which is taken from the 'Standing Orders for University Functional Buildings and Sites' indicates the division of responsibilities for the operation and maintenance of the listed services. The list is not exhaustive and is intended as a guide only. Designers should check with the UED Project Manager if in doubt.

Responsibility for Mechanical and Electrical Services		
University Estates Directorate		**Department**
Heating installations		Medical gases
Domestic hot and cold water systems		Demineralised water systems
Natural gas		Water treatment plant serving only departmental equipment
Air conditioning		Equipment re-circulating water cooling systems
Ventilation		Hot and cold rooms
Lift installations		Compressed air systems
Steam plant and associated pipework distribution		Steam plant and associated pipework distribution serving **only** department equipment
Fume cupboard extract systems		Fume cupboards
Lightning Protection Installations		Autoclaves, sterilizers and cage washers
Electrical sub-stations and switch rooms		Safety cabinets and associated extract systems
Fixed electrical distribution system including light fittings and associated lighting controls.		Electrical equipment (including UPS) connected to socket outlets and isolators of the fixed electrical installation.
Building management systems		Emergency lighting
External lighting		Fire detection systems

As a general rule, UED plant should be located in separate plant rooms away from Departmental plant.

The University of Oxford 'Standing Orders for University Functional Buildings and Sites', University Environmental Sustainability Policy, UED Policy & Procedures document 'The Control of Legionella Bacteria in Water Systems' and the University Safety Office Policy Statements are available for inspection at the UED.

1.2 Maintenance Philosophy

It is a requirement that all systems should be designed such that they can be repaired, maintained, inspected and extended with the minimum of disruption to the building user. The Consulting Engineer or Contractor must submit a detailed maintenance philosophy to the UED, as early as possible in the design of the project, to demonstrate that the above objectives are being met.

The philosophy should detail for example:-

(i) the effects on the building user of planned maintenance on the various plant items;
(ii) the effect of periodic test and inspection programmes of the electrical installation;
(iii) the provision of any standby plant;
(v) the provision of any alternative sources of electrical supply to maintain essential services, etc.

In the event of a cost cutting exercise, it is important to ensure that the building users are made fully aware of the effects of any changes which will increase disruption to their activities.

1.3 Deviations from the Philosophy Guidelines

The Consulting Engineer shall provide a written report highlighting where the principles of the Design Philosophy cannot be complied with, together with a justification for the alternative solution proposed.

1.4 12 Months Defects Period

The project costs shall include for the mechanical services commissioning contractor (and/or the BMS controls contractor) to visit the new or refurbished building during the 12 months defects period on a monthly basis in order to carry out adjustments/fine tuning of the mechanical services installations throughout the building. A monthly review meeting shall be held with the building administrator or other nominated representative, UED mechanical services engineer and the commissioning engineer and minutes of the meeting recorded.

1.5 12 Months Servicing and Maintenance Agreement

A fully detailed maintenance proposal with a full breakdown of costs shall be provided to the UED a minimum of four weeks before practical completion of the project. The maintenance proposal shall cover only those mechanical services which are the responsibility of the UED (see clause 1.1) and shall detail all of the plant, equipment and installations to be maintained and shall provide a schedule of work to be carried out. The proposal shall be fully comprehensive and include for all necessary consumables such as filters, drive belts, etc. A 365 day, 24 hour emergency call out cover shall be provided with a maximum of a two hour response time to deal with breakdowns.

Servicing and maintenance proposals shall be fully in accordance with the various manufactures' recommendations and also the schedules contained within the Standard Maintenance Specification for Services in Buildings, SMG 2000 published by the Heating and Ventilating Contractors Association.

Subject to approval of the proposal, an order will be placed by the UED Building Services Section directly with the contractor for this work.

1.6 Access Control

In order for the UED to control access to the areas it is responsible for, all lift motor rooms, mechanical services plant rooms, electrical substations, switch rooms and riser cupboards shall have UED suited locks fitted. Lock details shall be as follows:- the main suite is electrical, 'P' suite is for mechanical plant and 'L' suite is for lift motor rooms. There is a grand master key which will unlock all three suites and sub-master keys for each individual suite. Door locks shall be as supplied by Yale Security Products Limited, type GMK suite, ref YN8114(Y). The standard locks shall be type 88, night latch surface fitting in brass, key operation externally with thumb turn on room side for emergency exit purposes and each lock shall be supplied with three keys.

Access into all underground heating ducts is controlled by the UED and entry into the ducts can only be allowed after a risk assessment has been carried out, a method statement approved and a permit to work issued.

1.7 Utility Supplies

The UED Energy Conservation Engineer is responsible for organising the gas, water and electricity supply contracts for all of the University's functional estate. All new utility supplies or alterations to existing utility supplies **must** be arranged by the UED Energy Conservation Engineer.

1.8 Use of Dynamic Simulation Models for Part L (2006) CO2 Calculations

Designers working on all new buildings and extensions to the current Part L Building Regulations must use a dynamic simulation package (approved by the Department for Communities and Local Government [DCLG]) rather than the Simplified Building Energy Model (SBEM) for calculating CO2 emissions. The UED reserve the right to allow the use of SBEM for simple buildings and extensions.

The Designer must send a copy of the BRUKL (Building Regulations United Kingdom Part L) Output Document 1 Compliance with ADL2 (Approved Document Part L- Conservation of Fuel and Power – Part 2 – New Buildings other than Dwellings) to the UED Energy Conservation Engineer prior to Part L submission. A table of the input variables must also be provided which includes occupancy hours, plant running hours, occupancy density, small power load density (W/m^2), internal design temperature and air change rates.

A copy of the 'Asset Rating' BRUKL Output Document 1 Compliance with ADL2 using actual construction data must be handed to the UED Energy Conservation Officer before final handover of the building.

The NCM allows calculation by accredited software, dynamic simulation models or SBEM. See www.ncmbre.co.uk for the latest updates.

1.9 Redundant Installations

It is the policy of the UED that where buildings or areas are being refurbished all redundant equipment, cables, pipework etc shall be removed. It is particularly important that no 'dead legs' are left in the domestic hot and cold water, or natural gas services, all redundant pipework must be removed back to the tee position on the remaining live pipework and capped off.

SECTION 2 – MECHANICAL SERVICES INSTALLATIONS

2.0 General

It is an absolute requirement that all systems are designed to be easily and safely accessible and are straightforward to operate, maintain and replace.

All work within listed buildings requires careful consideration and all proposals **must** be agreed with the Head of Building and Conservation before any work is carried out.

2.1 Plant Rooms including Boiler Rooms

General
All plant rooms must have safe, easy, secure access and, in the case of basement and ground floor rooms, the access must be direct from the outside of the building in which the plant rooms are located.

Access to all plant rooms must be as safe and easy as entering any other room within the building.

The use of vertical ladders will not be accepted as a means of gaining access to any plant room or roof top plant area.

All plant rooms shall have adequate ventilation, floor drainage, good uniform lighting, emergency lighting, a telephone and data point, rcd protected 13 amp socket(s), a fire alarm sounder and appropriate fire detection.

All plant rooms which are located above occupied areas and contain 'wet' services shall be fully tanked and bunded with sufficient drainage points so as to prevent the possibility of water damage to the areas below. All penetrations through the tanked floor shall have a minimum of 100mm upstands all around the openings.

Doors into UED plant rooms **must** be fitted with UED suited locks and adequate access **must** be provided for future plant replacement.

Door Locks shall be as supplied by Yale Security Products Limited, type GMK suite, ref no. YN8114(Y), 'P' suite for mechanical plant rooms. The standard lock shall be a brass surface fitting type 88 night latch, key operation externally, with thumb turn on room side for emergency exit purposes and each lock shall be supplied with three keys.

Adequate space shall be provided around all plant for safe maintenance, inspection and replacement. Headroom under plant, pipes, ducting, etc., along access routes shall not be less than 2000mm with access space around plant being not less than 900mm or more if recommended by the equipment manufacturer.

All plant shall be installed so as to prevent vibration and noise transmission to occupied areas. Appropriately positioned lifting beams shall be provided to enable the safe replacement of large items of plant such as pump motors.

Any plant located on a roof shall be provided with adequate lighting and a non-slip walkway with guard rails to permit safe access.

Tripping hazards must be avoided, particularly low level pipework discharging over floor drains located in access routes.

Access to departmental plant areas, server rooms and electrical switch rooms must not be via a UED controlled mechanical services plant room.

Open flue gas and oil fired heating and hot water heaters must always be located in a separate plant room from supply and extract ventilation plant.

Roof Plant Rooms

Access must be by a staircase having a clear width of at least 800mm. Floors shall be tanked and bunded to prevent water damage to floors below and there must be an adequate number of drainage points provided.

Low Level Plant Rooms

Main plant and boiler rooms should be at ground level and **must** be separate from any electrical intake room. If a ground floor location is not possible then consideration may be given to a lower ground floor or basement location, in which case access must be via double doors from an adequately sited well, with ramped access if possible.

2.2 Equipment Located in Ceiling and Roof Spaces

The designer shall avoid wherever possible positioning equipment such as fan coil units which require regular servicing and maintenance in ceiling voids and roof spaces. However, where this is absolutely unavoidable, then a safe, easy means of access shall be provided, e.g. full sized hinged panels, boarded out walkways in roof spaces and deep ceiling voids, etc. Any equipment which needs to be serviced must not be located above fixed room furniture, etc., and every effort shall be made to locate equipment away from occupied areas.

2.3 Hazardous Areas

All plant and equipment serving hazardous and restricted access areas such as animal rooms, containment rooms, etc., shall be designed and installed such that they can be totally maintained from outside of the actual area. The requirements of the University Safety Office briefing document for category 2 and 3 containment areas must be followed. Visual indication of differential pressures shall be provided where rooms are required to operate at a greater or lesser pressure than adjacent areas.

2.4 Distribution of Piped Services

Horizontal Distribution

Main horizontal distribution pipework shall be at high level in corridors, in a single depth and preferably not hidden above ceiling tiles. If ceiling tiles are unavoidable then they must be easily removable and replaceable.

Pipes must not have fixed equipment or cable and data trays positioned directly underneath them and all valves must be easily accessible from below.

Vertical Distribution

Main vertical distribution pipework shall rise in a wide shallow duct containing a single depth of pipes with access from full height doors at each floor level. Such vertical ducts shall be complete with solid floors at each level, open mesh type flooring is not acceptable.

2.5 Low Pressure Hot Water Heating Systems

All wet heating systems shall be designed as low pressure hot water systems. Medium and high pressure systems are not acceptable.

Radiators should be used in preference to fan coil units and to natural convectors wherever possible. All pipework shall be heavyweight mild steel to BS1387 up to 150mm and to BS3600 for larger sizes.

Pipework up to and including 50mm shall have screwed joints and pipework 65mm and above welded joints. Adequate dismantling points using unions or flanges as appropriate shall be provided to enable appliances to be disconnected and pipework to be repaired.

The use of press-fit jointing systems is not acceptable.

2.6 Domestic Hot and Cold Water Systems

All domestic water systems must be designed to comply with the Approved Code of Practice & Guidance L8, Legionnaires disease: 'The control of legionella bacteria in water systems' issued by the Health & Safety Commission with effect from 8 January 2001 and the requirements of the UED Policy & Procedures document 'The Control of Legionella Bacteria in Water Systems'.

Plate heat exchangers or direct gas fired hot water heaters should be used in preference to storage calorifiers.

Domestic hot water with central storage and associated pipework distribution systems shall only be used if it is impractical to use point of use electric hot water heaters. Spray taps shall not be used.

Galvanised mild steel pipework, fittings and calorifiers shall not be used, only copper, stainless steel or appropriate plastic materials may be used.

In order to standardise across the University estate only Yorkshire Fittings Limited Xpress jointing system is approved as an alternative to traditional methods of jointing of copper pipework.

Dual cold water storage tanks shall be provided to enable supplies to be maintained whilst one tank is taken out of service for inspection/cleaning. A water meter shall be fitted in the mains cold water supply pipework to all cold water storage tanks and these meters together with the water storage temperature of each tank shall be monitored by the building management system.

Where buildings or areas are being refurbished all redundant pipework shall be removed back to the tee on the live pipework and capped off.

The meter on the incoming cold water supply to the building shall be monitored by the building management system.

2.7 Natural Gas Service

A gas shut off valve, operated by a heat detector(s) and/or emergency push button shall be incorporated in the boiler supply pipe, this valve must not be connected to any building fire detection system other than that located within the boiler room. Gas pipework shall be heavyweight mild steel to BS 1387.

Basement and semi-basement boiler rooms shall have a gas detection system installed.

The gas supply to other areas such as kitchens and laboratories shall be separately metered from the heating boilers and hot water heaters.

All gas meters must be monitored by the building management system.

For a gas supply that normally is metered at 21 mbar, the pressure drop between the primary meter and any booster or the plant manual isolation valve, at maximum flow, shall not exceed 1 mbar.

For a gas supply that normally is metered at greater than 21 mbar, the pressure drop in the pipework, at maximum flow, shall not exceed 10% of the design pressure.

2.8 Steam Systems

Steam shall not be used as a primary or secondary form of heating and it is the policy that where steam is necessary, it should be generated adjacent to the point of use. Steam plant which serves only departmental equipment, e.g. cage washers, autoclaves, etc., will be maintained by department personnel and the design proposals should be discussed with both the UED and the building user.

2.9 Isolation Valves

All piped services shall have adequate numbers of isolation valves fitted for future maintenance requirements.

All items of plant shall be fitted with isolation valves.

2.10 Air Conditioning and Ventilation

The use of air conditioning systems shall be avoided wherever possible except where close control of the environment is necessary.

Natural ventilation should always be used in preference to mechanical ventilation.

Design should incorporate free cooling wherever possible.

All air handling plant shall be located within plant rooms and the use of weatherproof outdoor air handling units should be avoided.

Evaporative type cooling towers must not be used under any circumstances.

Ventilation ducting shall be provided with an adequate number of suitably sized access points to enable the ducting to be thoroughly cleaned.

Adequately sized access points shall be provided adjacent to all in-line plant and dampers. See-through vision panels shall be provided adjacent to all motorised dampers fitted in ductwork and air handling units.

Filters shall be of the easily replaceable type and shall be fitted with dirty filter indicators. Bag, HEPA and carbon filters shall have a pre-filter.

Fresh air inlets shall be positioned so as to be unaffected by vehicle exhausts and to be as far away as possible from fume cupboards, other exhaust points and heat rejection equipment such as chillers.

Electric or gas steam humidifiers, with appropriate water treatment, should normally be used for providing humidification.

Separate dedicated cooling systems should be used for server rooms, departmental equipment and the like which require cooling continuously throughout the year.

2.11 Fume Cupboards

Fume cupboard installations shall be in accordance with the current University Safety Office Policy Statement on fume cupboards.

Wherever practical each fume cupboard shall have a dedicated extract system which discharges at least three metres above the highest part of the roof. Extract fans must be easily accessible.

Each fume cupboard shall have a balanced quantity of filtered, heated make-up air introduced into the room in a manner designed to cause the minimum possible disruption to the fume cupboard air flow pattern.

All fume cupboards and associated extract fans shall be numbered in accordance with the UED current requirements.

2.12 Lift Installations

Lift installations shall comply with all disabled persons legislation. Car top controls, a pit stop switch and adequate shaft lighting shall also be provided. An engraved plate with the UED unique lift reference number shall be fixed within the lift car. Lift numbers will be provided by the UED Mechanical Services Engineer.

Where necessary, the facility to send unaccompanied loads such as gas cylinders to their destination floor shall be incorporated in the lift control system.

A 'Windcrest' voice communication system and emergency lighting shall be incorporated into the lift car. The voice communication system shall be programmed to dial up the University Security Services control room which is manned 24 hours a day on 01865 272944.

The lift shall not contain any other services within it, and shall have a pit access ladder and adequate smoke ventilation at the top of the shaft.

Lift motor rooms shall have good uniform lighting, including emergency lighting and emergency stop switches fitted in appropriate positions.

Lift motor rooms shall be adequately heated/cooled and ventilated to suit the type of lift equipment.

All moving parts in the lift motor room must be painted yellow.

There must always be an upward flow of air in lift shafts.

See clause 3.12 in the electrical service section for details of how the wiring serving lift installations shall be configured.

Lift motor room doors **must** be fitted with Yale Security Products Limited, type GMK suite, ref no YN811(Y), 'L' suite for lift motor rooms. The standard lock shall be a type 88 night latch surface fitting in brass, key operation externally and thumb turn on the room side complete with three keys.

Lift installations **will not be accepted for use** by the University until they have been inspected and passed by the University's lift insurance company.

Servicing and maintenance of the lift(s) shall be included in the project cost for the 12 months following handover. Servicing intervals and maintenance of the lift shall be carried out in accordance with the manufacturer's recommendations.

A smoke detector should preferably be located in the lift motor room rather than at the top of the lift shaft, assuming that there will be adequate openings between the lift shaft and the motor room. Where the lift motor room is not directly above the lift shaft or the lift is an hydraulic type or there is no lift motor room, then an aspirated type of smoke detector should be installed at the top of the lift shaft, with that part of the detector which requires calibration/maintenance being positioned outside of the actual lift shaft.

2.13 Automatic Control Systems

Control systems **must** be as manufactured and supplied by Trend Controls Limited. The control system shall be designed to suit the particular building services requirements and shall always incorporate sufficient features to operate the plant safely with the minimum of energy use.

All control systems shall have a manual override facility for maintenance/testing purposes and for use in the event of failure of the automatic controls.

Control panels shall be generally be Form 2 where switching off the electrical supply to the panel does not unduly disrupt the building user. Form 4 should be used where it is necessary to maintain continuous operation of plant serving animal accommodation, computer suites, etc. All adjustable time/temperature controllers fascia shall be mounted on the front door of the associated control panel. All live conductive parts within the panel shall be shrouded.

It should not be necessary for plant attendants to have to go into any control panels in order to make minor adjustments to time/temperature controllers.

All control wiring shall be adequately identified and protected where necessary.

Control panel wiring must be configured so that all types of plant failure are indicated by appropriate warning lights on the front of the control panel.

An Ethernet connector shall be provided, together with a dedicated data point to enable the UED central BMS supervisors to remotely monitor and control the buildings control systems.

The controls package shall include for adding the graphics and user pages associated with the new control system on to the UED's existing three central Trend 963 supervisors. The format of the graphics and user pages added must be the same as those already on the system. The appointed BMS contractor must visit the Malthouse to establish for himself the exact format of the graphics required by the UED. Passwords and pin numbers for any new addition to the Trend BMS network must be discussed and agreed with the UED.

Control panels shall be complete with fascia mounted key pads or network display controllers, as appropriate, to enable local monitoring and operation of the plant.

All gas and water meters shall be monitored by the Trend BMS. Electricity meters must NOT be monitored by the Trend BMS and they shall be monitored as per the requirements of 'Guidance Note on Metering and Instrumentation on the University Fixed Electrical Systems' which can be found in Appendix 5.

2.14 Asbestos

The use of asbestos in any form is forbidden. Existing buildings and services installations may contain asbestos contaminated materials and this possibility must be brought to the attention of any potential contractor. The UED maintains a register of where asbestos has been found and made safe in existing University buildings and there is also an Asbestos Register available based on a 'visual only' survey of the University's buildings. All sightings of suspected asbestos material must be reported to the University Safety Office so that the relevant action can be taken in accordance with the current Asbestos Policy Statement.

2.15 Thermal Insulation

Mechanical services pipework and ductwork shall be insulated as necessary to conserve energy or prevent condensation.

Fibre glass insulation must not be used in any form. Surface finish to the insulation shall be appropriate for the location but in plant rooms 'Isogenopak' sheeting shall be used in preference to aluminium cladding.

Valves and flanges shall be insulated with purpose made easily removable muff covers, **aluminium valve boxes are not acceptable.**

The insulation to pipework either in the open air or in external service ducts, shall be rigid sectional insulation backed with an approved waterproof finish to form an unbroken surface along the entire length.

2.16 Stand-by Plant

A risk assessment shall be carried out to decide whether or not to provide stand-by plant where there is a need to maintain constant environmental conditions at all times. The risk assessment shall consider the vulnerability of the plant in question, the effect of down time for maintenance, the importance of the service being provided and the consequences of failure of the plant to the users.

Where automatic changeover of plant is provided, a suitable alarm shall be provided to alert the appropriate staff that plant has failed and needs attention.

2.17 Energy Conservation

All systems shall be designed to be as energy efficient as possible. Time and temperature controlled zones shall be as small as practicable, with each room being independently temperature controlled.

Appropriate heat recovery measures shall be incorporated wherever practical and cost effective.

Radiators shall always be used in preference to fan convectors and shall be fitted with approved thermostatic radiator valves.

Natural ventilation systems shall be used in preference to air conditioning systems wherever possible.

All electric motors shall be of the high efficiency type.

All air handling units should be fitted with high efficiency aerofoil bladed fans wherever possible.

2.18 Water Treatment

Appropriate water treatment **must** be provided for all steam plant, domestic hot and cold water services and humidifiers.

2.19 Identification and Labelling

All plant and equipment must be clearly labelled to identify their function and the area of the building that they serve.

All control equipment must be clearly labelled to indicate their function.

Labels shall be white traffolyte with black lettering, securely fixed to each item of equipment.

All piped services within plant rooms, service ducts, ceiling voids, etc., shall be clearly identified together with the direction of flow.

2.20 Flexible Connections

Flexible connections shall not be installed on heating, chilled water and domestic hot water pumps sets unless there is a proven need to provide a completely vibration free environment for research purposes.

2.21 Cold Water Booster Pumps

Cold water booster sets should have the following minimum features:

- Duty/assist pumps
- Inverter control on each pump
- Stainless steel or copper manifolds for portable water applications
- Control panel with system monitoring
- Auto rotation of pumps
- Monitoring by the building management system

2.22 Sump, Storm Water and Sewage Pumps

Sewage pumping stations shall have the following minimum features:

- Adequate pit size
- 3 phase duty/assist pumps
- Guide rails and auto pedestals or high level couplings where appropriate
- Suitable weight bearing manhole covers
- Channel/vortex impeller with additional cutter to prevent ragging for heavy duty applications (*)
- Macerators should be considered where there are long discharge pipe runs or an excessive static head (*)
- Coated ductile iron pipework in the pit
- Bronze gate valve and self-cleaning non-return valve for each pump
- Stainless steel chains and shackles
- In-line grease trap on the inlet pipework if serving a commercial kitchen (*)
- Access points for servicing including adequate clearance for tripods or lifting beams
- Twin pump control panel
- Ultrasonic level control
- Facility to manually start pumps on a time basis if the start level has not been reached to avoid stagnant effluent
- System status readout to include the level in the pit
- Automatic duty/standby operation
- Auto rotation of duty pump
- Run and trip indication of pumps
- High level alarm, audible and visual on the panel with volt free connection
- Alarm linked back to the building management system

Sump and storm water pumps shall have similar features as the above but not the items indicated above by an asterisk.

SECTION 3 – ELECTRICAL SERVICES INSTALLATIONS

3.0 General

It is an absolute requirement that all systems are designed to be easily and safely accessible, are straightforward to operate, maintain, extend, replace and allow the carrying out of periodic test and inspections.

All work within listed buildings requires careful consideration and all proposals **must** be agreed with the Head of Building and Conservation before any work is carried out.

Whilst surface mounting of electrical services is preferred, it is recognised that prestigious areas within buildings will require a more sympathetic approach. Within such areas the method of concealment of electrical services should be agreed with the Electrical Engineer.

There is an on-going rationalisation and standardisation of the electrical systems and associated equipment within the University and, therefore, it is essential that the principles outlined in this document are strictly followed.

The selection of equipment, particularly main switchboards **must** be discussed and agreed with the University Electrical Engineer at the earliest opportunity.

All systems must be designed to be simple, symmetrical and easy to understand. Drawing no. 400005 in Appendix C illustrates the layout of a typical UED electrical distribution system complete with labelling requirements.

Systems shall be designed, specified and supervised to ensure full compliance with BS7671 as well as other relevant Regulations, Codes of Practice and HSE Directives to ensure the provision of a suitable electrical system to the satisfaction of the UED.

Circuit protection shall be by circuit breakers – **fuses must not be used**.

The **neutral conductor must be switched** on the incoming supplies and at strategic points throughout the system to ensure complete isolation of sections of the system to simplify fault investigations.

Instrumentation and metering shall be provided with sufficient flexibility to enable load analysis. Current transformer secondary connections shall be brought out to terminals (with appropriate shorting links) to enable instruments to be connected without having to switch off the supply – see Appendix E for details.

All cables shall be LSF type whether armoured or not.

All parts of the electrical installation shall be sized to have a minimum of 25% spare capacity to cater for future growth.

Where the project involves working on or extending existing electrical services, no work may be carried out on the existing systems without the prior knowledge and approval of the University Electrical Engineer. All work must be carried out in accordance with the UED Code of Practice 'Electrical Safety of Low Voltage Systems'.

Only electrical contractors who are on the UED Approved List of Inducted Contractors will be allowed to work on the University's fixed electrical systems.

3.1 Incoming Supply

Depending upon the location, new buildings will take supplies from either the local regional electric company or from one of the privately owned University networks.

The point of supply **must** be discussed and agreed with the Electrical Engineer at the earliest opportunity.

Any reinforcement of the University electrical supply network required because of additional electrical loadings of new or refurbished buildings must be funded by the individual building project(s). The reinforcement work will be designed, organised and implemented as part of the project to comply with the technical details provided by the UED.

The design and installation of all new incoming supplies from the University network will be arranged by the UED based upon the anticipated building electrical loadings provided by the project electrical consultant/contractor.

The UED will advise values of fault level and earth fault loop impedance.

3.2 Low Voltage Switchboards

LV switchboards **must** comply with the latest edition of the UED Standard Specification for LV Switchgear for Substations and Buildings – see Appendix B for details and layout drawings.

For the purposes of this specification, the two types of switchboard are defined as follows:

(a) A substation LV switchboard is a switchboard that is supplied directly by one or more HV transformers and supplies one or more University buildings.

(b) A building LV switchboard is a switchboard that is supplied from either the local REC or a University substation LV switchboard.

The main requirements for both types of switchboard are:

- Form 4b type 6 construction.
- Plug-in moulded case circuit breakers.
- 4 pole isolation on all outgoing circuits.
- The facility to be able to connect future circuits without de-energising the existing circuits.
- Facility for extending to meet the future needs (depends upon the specific project brief).

- Provision of a volt meter and selector switch for each incoming supply.
- Provision of metering and recording indication (see Appendix D for details).
- Single line mimic displayed on the panel front to represent the busbar configuration.
- Two separate incoming supplies with a bus-section switch for maintenance purposes.
- The switchboard shall be sited in a separate purpose built switch room.
- The switch room must be sized to give 1.5m clearance at the front and 0.75m clearance at the rear of the switchboard.
- The switchboard **must** not be located in a mechanical services plant room or any area prone to flooding.
- All floor mounted switchboards must be located on a 100mm high plinth.

There must be no pipework of any kind or other unrelated equipment (e.g. emergency lighting inverters) installed within the switch room.

Access to the switch room must be either direct from outside of the building or from the adjacent circulation space.

The access door(s) must be secured by a Yale Security Products Limited, type GMK suite, ref no YN8114(Y) cylinder type 88 night latch barrel lock.

3.3 Essential Services Switchboard

A separate essential services switchboard shall be provided to supply the fire alarms, intruder alarm, security monitoring equipment, data hub, freezer rooms and any other systems considered to be indispensable.

3.4 Vertical Distribution

The layout of the equipment in all riser cupboards is a designer responsibility and **must not** be left to the installation contractor to sort out on site. The consultant/contractor must produce detailed drawings which show the precise layout of all equipment within the riser cupboard including the position of all busbar joints and the positions of tap-off units. The drawings must provide for a minimum clear working area of 750mm x 750mm for each item of equipment that requires access for operation and maintenance. All riser cupboards shall have solid floors, a level threshold and doors secured with Yale cylinder type 88 night latch barrel locks to the same specification as the switch room locks.

The major distribution system shall be run vertically, to serve all floors, in a central position using busbars where appropriate, with **only one** 3 phase 4 pole tap-off at each level.

Risers shall be sized to take account of future increases in electrical load growth.

Risers shall be located in circulation areas and shall be connected to 'riser' distribution boards located on each floor adjacent to the risers.

Sub-distribution shall be from the 'riser boards' to final circuit boards in research rooms and circulation spaces. Separate lighting and power distribution boards are preferred, but where this is not possible, separate isolation **must** be provided for the lighting and power sections of the distribution board. Distribution board enclosures shall be constructed out of mild steel; plastic or fibre glass material is not acceptable.

Metering instrumentation of the 'riser boards' – see Appendix D for details.

3.5 Horizontal Sub-Distribution

All sub-distribution systems should be installed in accessible circulation spaces up to the point where cables terminate into final circuit distribution boards which shall be sited either in circulation spaces or rooms themselves.

Sub-distribution cables and final circuit wiring on any floor level must be run between the soffit and floor surfaces of that level and must be available for inspection over the complete length of run.

Cable containment systems must be visible and fully accessible throughout their entire length, trunking lids must be easily removable and replaceable wherever they are installed. Dedicated cable trays or basket shall be provided for telecommunication and data cabling.

Each room and circulation space will be given a UED space reference and these references **must be** used to label all circuits in accordance with the latest UED standard.

3.6 Final Circuit Wiring

Listed buildings and other prestigious areas will require a more sympathetic approach and the method of concealment of the electrical services should be agreed with the Electrical Engineer and the Head of Buildings and Conservation.

Where practicable, all distribution equipment shall be run on the surface. Supplies to sockets, data, and telephones within the room should be run in multi-compartment trunking positioned at high level or dado height or using a combination of both.

In most cases, research rooms shall be equipped with their own final circuit distribution boards which shall be complete with recording instrumentation and have facilities for metering if required – see Appendix D for details. Only power circuits within the room shall be supplied from these distribution boards.

Fridges and freezers should be connected using non-standard plug and sockets. Freezers should preferably be grouped together in freezer rooms and fed directly from the essential services panel in the main switch room.

Fume cupboards shall be provided with a dedicated consumer unit fed from the room distribution board.

3.7 RCD Protection

RCDs with a sensitivity of 30 milliamps shall be provided on all 13A socket outlets, except those sockets serving fridges and freezers. Ideally, the RCDs should be situated within the dado trunking located within the body of the room to enable users to be able to reset them. RCDs shall not be located in the distribution board.

3.8 Lighting

Lighting shall be high frequency fluorescent with appropriate control to suit the room use. The circuitry for the lighting shall be controlled and protected from the 'riser board', not the room distribution board.

A method of electrically isolating the various lighting fittings and/or lighting circuits, other than using the mcbs within the lighting distribution boards, shall be provided to enable the building users to safely replace the fluorescent tubes and lamps.

The method of isolation adopted must comply with the 'mechanical maintenance requirements' of BS7671 and the 'secure isolation' requirements of the Electricity at Work Regulations 1989.

3.9 Inter-floor Services

This relates to services which require connection at more than one level, i.e. fume cupboards. A vertical containment system shall be provided and located adjacent to the main riser to accommodate all inter-floor electrical supplies.

3.10 Fire Alarms

The standard of fire detection and alarm systems shall be agreed with the University Fire Officer who can be contacted on 01865 270811 at the University Safety Office. In addition to local fire alarm indicating equipment, any alarm shall be transmitted over the University's communications network to the University Security Centre. The monitoring equipment shall be supplied from the essential services section of the main switchboard.

A standard type of equipment has been adopted for transmitting alarm signals from the building back to the Security Centre control room and details should be obtained from the University Fire Officer.

3.11 Emergency Lighting

The requirements for emergency lighting shall be agreed with the University Fire Officer who can be contacted on 01865 270811 at the University Safety Office.

3.12 Supplies to the Lift Installation (see Appendix E)

A suitably sized cable terminating in the lift motor room with a four pole, lockable isolator shall be provided to serve the lift installation.

A consumer unit type distribution board fitted with suitably rated mcbs and controlled by a double pole lockable isolator shall be provided in the lift motor room to supply all the electrical services which are normally maintained and tested as part of the University lift maintenance contract. Each outgoing circuit shall have its own rcd – 30milli-amp sensitivity. The circuits shall supply the car lighting, the car emergency lighting, lift shaft lighting, pit lighting and any small power associated with the pit, shaft or car.

The lighting for the lift motor room shall be taken off the floor distribution system – it must not be taken from the lift consumer unit. Likewise, socket outlets in the lift motor room which are not part of the lift installation shall also be taken off the floor distribution system.

The above principles given above still apply if it is intended to install machine room-less type lifts.

3.13 Electrical Supplies to Mechanical Services Equipment

Electrical supplies shall be via dedicated distribution boards which shall be fed from the 'riser boards or main mechanical services riser'.

Each individual item of mechanical services plant – pump motors, fume cupboard extract fans, boilers, pressurisation units, water heaters, etc., **must** be connected to the fixed electrical system via an interlocking plug and socket to provide safe isolation for mechanical maintenance. Plug and sockets should not be used for variable speed inverter drives.

Approved interlocking plug and socket isolators up to a maximum size of 63amps shall be used wherever possible, but if a plug/socket cannot be used then an approved lockable isolator shall be used. Isolators for electrical safety must have fully shrouded incoming connections which will permit a person to safely work on the outgoing circuits when the device is in the 'off' position.

All isolators shall be clearly labelled and shall be positioned adjacent to the equipment that they isolate. Isolators positioned external to a building **must** be waterproof.

Where an item of equipment or enclosure contains live parts that cannot be isolated by a single isolator (e.g. compressor crankcase heater) then a permanent warning notice **must** be fixed in such a position that any person intending to work on the equipment/enclosure will be warned of the need to use additional isolation devices to make the equipment/enclosures electrically safe.

3.14 Cable Management Systems for Data/Telecommunications

The requirements for telephones and data will be determined by the user and the Telecommunications Manager who is employed by Oxford Computing Services and can be contacted on 01865 288661. The electrical design shall include for the supply and installation of a dedicated data cable containment system having an adequate capacity for the current phase of works and being sufficiently flexible to facilitate future change and expansion. Cable tray or basket is the preferred standard form for data wiring and the installation of the containment system, cables and wiring will usually form part of the electrical contract work.

The following two specifications have been produced by Oxford Computing Services and should be adhered to when designing and installing new external and internal data/telecommunications infrastructures for new and refurbished buildings:

Appendix F: Specification for New Network Ducting in Public Highways (Project re: 17880, 26 March 2008, issue 6) . *G:\Data\Documents\Building Conservation\DUCTS*

Appendix G: Oxford University Telecommunications Infrastructure Specification Project [oucs] Telecommunications

3.15 Lightning Protection

All new and refurbished buildings shall have lightning protection systems which comply with the requirements of BSEN 62305:2006.

3.16 Special Requirements – Reference Earths

The clean earthing system shall be taken along the same routes as the main distribution. It shall start at the main earthing busbar and connect into a multi-outlet busbar at each level. The interconnections between the busbars shall be via insulated, flexible multi-stranded cable to minimise impedance to high frequency leakage currents. The requirements for reference/special earths shall be determined with the user.

3.17 Electro-Magnetic Compatibility

All systems shall fully comply with legislation on electro-magnetic interference. Details of the precautions that have been taken to comply with the legislation shall be provided to the end user of the building and the UED.

3.18 Power Factor Correction

Any power factor correction equipment provided shall be completely separate from the building's LV switchboard.

SECTION 4 – ONLINE BUILDING INFORMATION

4.0 General

Comprehensive record drawings and operating and maintenance manuals must be provided as part of any project to enable the UED to safely operate and maintain the various building services installations. **The UED will not take over or accept responsibility for the operation of any building services installations unless the necessary approved manuals and drawings are available at the handover of the building services to the UED. In the event of the manuals and drawings not being available, then the contractor shall be responsible for operating the building services installations at his own cost until such time that the manuals and drawings have been approved and handed over to the UED.**

4.1 Online documentation

The following documentation must be provided in electronic format using a web-based online building information system:

- Health and Safety File
- Building structure/fabric operating and maintenance information
- Mechanical operating and maintenance information
- Electrical operating and maintenance information
- Building Log Book

4.2 Specification of requirements for the online building information

For further details of the requirements for the online building information documentation, please see Appendix A.

SECTION 5 – HAND-OVER PROCEDURE

In order for the UED to 'take over' the mechanical and electrical installations within a building from a Contractor it is **essential** that certain requirements are in place.

The table below is an indication of typical items which require a signature to record that an action has taken place **before the project can be accepted by the UED Building Services Section.**

- The contents of the table are intended as a guide only and should be amended to suit the particular project. The final version should be agreed with the UED and should be included in the project tender specification in such a way that the Installation Contractors are left in no doubt that the project will not be considered practically complete until the listed items are completed and signed off by the appropriate person.

ITEM	DATE	SIGNATURE
		Consultants Signature
All tests, inspections and commissioning of the mechanical installations have been successfully carried out and the relevant certificates included in the O & M Manuals.		
All tests, inspections and commissioning of the electrical installations have been successfully carried out and the relevant certificates included in the O & M Manuals.		
		UED Project Manager's Signature
The Project Health and Safety File has been approved and received from the Planning Coordinator.		
O & M Manuals have been approved and received.		
The Building Log Book has been approved and received		
The lift(s) has been inspected by the University's Insurers and passed safe for use and an inspection report issued.		
A 'Written Scheme of Examination' has been received for each pressure system which falls within the Pressure Systems Safety Regulations 2000		
Labelling of the various engineering installations has been completed to UED requirements.		
Attached list of outstanding defects has been agreed.		
		UED DLO Manager's Signature
Adequate training has been received by UED Maintenance staff in the use of all the relevant building engineering services		
Plant room keys have been received (provide list).		
Control panel and other equipment access keys have been received (provide list).		
Spares, tools, filters etc. have been received (provide list).		

Appendix A

STANDARD REQUIREMENTS FOR ONLINE BUILDING INFORMATION

1.0 Scope of Requirements

The following documentation must be provided in electronic format using a web-based online building information system:

- Health and Safety File
- Building structure/fabric operating and maintenance information
- Mechanical operating and maintenance information
- Electrical operating and maintenance information
- Building Log Book

The system shall allow quick and easy access to the above documentation using standard web browser software with the information being stored on a central server accessible to authorised users via the University's intranet.

1.1 Provision of Building Information

All authoring for the O&M manuals shall be carried out by the Technical Author appointed by the online system supplier. Contractors and sub-contractors cannot use their own technical authors unless specifically agreed with the UED.

1.2 Asset Register

A complete list of each and every building, mechanical and electrical asset installed on the project shall be provided in a suitable electronic format so that the information can be transferred directly into the UED Planon estates management system. The asset list shall clearly identify all items of plant and equipment which will require statutory inspections (i.e. lifts, lifting beams, pressure vessels, safety restraint systems, window cleaning gear, etc). The exact format of the electronic information shall be discussed and agreed with the UED in-house Planon system administrator at an early stage in the project.

1.3 Electrical Commissioning and Test Results

All of the electrical test and commissioning reports shall be provided in a suitable electronic format so that the information can be transferred directly into the UED Electrical database. The exact format of the electronic information shall be discussed and agreed with the UED Electrical Engineer at an early stage in the project.

2.0 Content of the Online Manuals

2.1 Health and Safety File

The Health and Safety File should contain as a minimum the following information to be in compliance with the Construction (Design and Management) Regulations 2007:

- A brief description of the work carried out.
- Any residual hazards which remain and how they have been dealt with (for example surveys or other information concerning asbestos; contaminated land; water bearing strata; buried services etc).
- Key structural principles (e.g. bracing, sources of substantial stored energy – roofs, particularly where these may preclude placing scaffolding or heavy machinery there).
- Hazardous materials used (for example lead paint; pesticides; special coatings which should not be burnt off etc).
- Information regarding the removal or dismantling of installed plant and equipment (e.g. any special arrangements for lifting, order or other special instructions for dismantling etc.).
- Health and safety information about equipment provided for cleaning or maintaining the services and structure.
- The nature, location and markings of significant services, including underground cables; gas supply equipment; fire fighting services etc.
- Information and as-built drawings of the structure, its plant and equipment (for example the means of safe access to and from service voids, fire doors and compartmentalisation etc).

Much of the above information will be held in the various building and mechanical and electrical O&M manuals and the online information system should set up cross links between the Health and Safety File and the relevant O&M manuals.

2.2 Online O&M Manuals – General

The online building information system should consist of:

- Separate pre-defined main folders and/or sections containing general discipline information as follows:

  Building structure/fabric
  Electrical
  Mechanical
  Public Health
  Lifts
  Building Management System

- The above folders shall have sub-folders containing more specific information at the individual system level e.g. heating, ventilation, air conditioning, HV and LV electrical distribution, small power, lighting, etc.

2.3 Building Structure and Fabric O&M Manual

This building manual should contain the following information as a minimum:

- Scope of the works.
- Design information – all relevant design and structural calculations, criteria, investigation reports, piling logs etc.
- Suppliers contact list.
- List of building and fabric materials together with manufacturers relevant products sheets.

- Record drawings (architectural, structural, fire, etc).
- Building maintenance – general and specialist recommendations
- Hazards – residual.
- Hazards – materials including all relevant COSHH sheets.
- Planning approvals and consents.
- Relevant building certificates

2.4 Mechanical and Electrical O&M Manuals

For each services discipline (i.e. mechanical, electrical, etc) there shall be a folder in the online database with sections containing the following information:

- General description:
  This should be a general overview of each of the mechanical and electrical services. This should include a list of all systems being installed and a description of all major plant items, the area they serve and the design conditions for each area. This is intended to be a quick overview for the systems and equipment installed.

- Contact list:
  This should include a list of all sub-contractors and suppliers together with the company name, address, email, web address, telephone and fax details.

- Design information:
  This should include all design parameters and a description of the design intent.

- Record drawings:
  All record drawings and the record drawing register should be included here. Drawings shall be provided in both pdf and dwg format, the dwg copy of the drawings shall be provided on CD and the pdf files shall be uploaded onto the online building information system.

- Asset Register:
  A complete list of each and every asset installed on the project shall be provided. Each asset shall have a name, system name, number, make, model number, manufacturer, duty/performance data and supplier details. Specific manufacturers' literature, COSHH sheets, product sheets, health and safety instructions and operating and maintenance instructions shall be provided for each separate piece of equipment (as attached files in the database record). A list of consumables and recommended spare parts required for each item of plant/equipment shall also be provided.

- Inter-related system dependencies:
  This section shall highlight details of faults, alarms or other links which when activated have an impact on another system or building.

- Emergency contact details.

For each system that is installed (e.g. heating, ventilation, lifts, etc) the following system specific information will be provided in a separate sub-folder for that system under the main services folder:

- Detailed system description.
- Details of all utilities serving the project including locations and capacities.
- Operating instructions
- Maintenance instructions
- Fault finding
- Health and safety
- Emergency procedures
- Commissioning and test records
- Certificates

The section on the Building Management System should additionally contain:

- Record panel wiring diagrams
- System structure diagram
- Login diagrams
- Description of operation
- Points schedule and schedule of set points
- Relevant commissioning information
- Manufacturers' literature

3.0 Building Log Book (Part L2)

The Building Regulations Part L2 'Conservation of Fuel and Power in Buildings other than Dwellings' requires the provision of a Building Log Book for all new and refurbished buildings and for existing buildings where significant changes have been made. The Log Book shall be a summary document written in an easily understood style for building managers and non-technical readers.

Typical contents of a Log Book shall include:

- Updates and annual reviews
- Purpose and responsibilities
- Links to other key documents such as O&M manuals and H&S file
- Main contacts
- Commissioning, handover and compliance
- Overall building design
- Summary of areas/occupancy
- Summary of main building services
- Overview of controls/BMS
- Occupant information
- Metering, monitoring and targeting strategy
- Building energy performance records
- Maintenance review
- Major alterations
- Results of in-house investigations
- Appendix – relevant certificates/tests

The online Log Book shall be in accordance with the style and format of the templates provided in CIBSE publication 'TM31 Building Log Books'.

Appendix B

OXFORD UNIVERSITY ESTATES DIRECTORATE

GUIDANCE NOTES FOR LOW VOLTAGE SWITCHGEAR IN UNIVERSITY SUBSTATIONS AND BUILDINGS

SGG Version 2.3

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May 2008

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PLEASE SEE SEPARATE DRAWING PACKAGE

1. INTRODUCTION

This guidance note forms part of the University of Oxford Estates Directorate Mechanical and Electrical Design Philosophy. It details the minimum requirement for bespoke Substation, Building and final switchboards which are owned and operated by the University Estates Directorate (UED).

The principles referred to in the document have been influenced by the maintenance and operational requirements currently employed by the University.

Any deviation from the preferred design shall be agreed with the University Building Services Engineer prior to installation.

2. SWITCHBOARD DEFINITIONS

For the purposes of this guidance the following definitions will apply:

A substation LV switchboard is a switchboard that is supplied directly by one or more HV transformers and supplies one or more University buildings.

A building LV switchboard is a switchboard that is supplied from either the local REC, or a University substation LV switchboard.

A final LV switchboard is any one of the following switchboards that are supplied directly from the building switchboard by cable or busbar riser.

Special Panels, MCCB Final distribution Panel, and Rising Main Panel (Mechanical Plant switchboards are covered elsewhere in the Philosophy document).

3. GENERAL REQUIREMENTS – ALL SWITCHBOARDS

3.1 Construction

Unless otherwise specified the following section applies to all types of switchboards.

All switchboards shall conform to BS EN60439-1:1999 Type Tested and partially type-tested assemblies.

Where top entry switchboards are located below ground floor they shall be mounted on a plinth with a minimum height of 100mm, consideration shall also be given to protect switchboard against ingress of water from above.

Switchboards shall be designed to withstand and disconnect a maximum fault current: this value shall be determined after taking account of all incoming supply characteristics as well as contributions from connected loads. The fault rating shall be determined by calculations but it should not be less than 65kA for one second in substations, 50kA in buildings.

All switchboards shall be designed so that they can be erected by an approved contractor. Prior to despatch, the switchboard shall be factory tested in accordance with BS EN60439-1:1999. The board shall be fully assembled for testing prior to splitting for transport. All test documentation and 'as built' drawings shall be provided at the time of despatch.

When re-assembled onsite, the switchboard manufacturer shall inspect and test the switchboard and certify that it represents the factory-built assembly.

All metalwork shall be finished by an electrostatically applied epoxy powder. Colour – Oxford Blue to BS 3381.105.

A white mimic diagram shall be applied to the front of the switchboard. The mimic shall accurately follow the internal busbar (including height from floor) and all switches.

The switchboard frame shall be manufactured from "Zintec steel" of no less than 2mm thickness. Panels and doors shall be dished and manufactured from "Zintec steel" having minimum thickness of 1.5mm.

Gland plates shall be removable and made out of "Zintec steel" of minimum thickness 2mm.

When top and bottom covers are removed from the cable way, access through the cable way must be unobstructed. If support angles are required across the opening, then these shall be designed to enable them to be removed during installation works, without detriment, to facilitate cabling.

Cables shall be terminated on horizontally mounted gland plates within the cable way. The location of the plate shall ensure that future cables can be installed. A drawing detailing the glanding facility and indicating how a pair of 4c cables up to 185mm ^{2} XLPE/SWA/LSF cables can be terminated at each position shall be submitted at tender stage.

Where bottom entry is to be utilised, the base infill panels of the cableway of the switchboard shall be constructed of 12mm varnished Marine ply or equivalent and fixed from above to ensure that they can be easily removed from within the switchboard. Means shall be provided to gland off cables within the cableway to enable easy connection into each of the devices within the cableway to enable easy connection into each of the devices within a particular section.

3.2 Busbars

All busbar assemblies shall comply with BS EN60429-2: Particular requirements for busbar trunking systems.

All conductors shall be of hard drawn high conductivity copper fully rated.

The current rating of all neutral bars shall be the same as the respective phase bars.

The earth bar shall be run the full length of the switchboard. Each cubicle section shall be positively connected to it. The bar shall be positioned to ensure that connections can be taken easily from it. The section of the earth bar shall be a minimum of two-thirds of the section of the primary busbar.

All spare ways shall be equipped with copper work in the same way as an equipped circuit to enable future additions to be added without the need to switch off the incoming supply.

3.3 Switching Devices

All switchgear and control gear shall comply with BSEN60947 and unless otherwise specified shall be as follows:

All switching devices shall break all incoming phase conductors including the neutral simultaneously.

Switchboard devices up to 630A shall comprise of a suitably sized Plug in Moulded Case Circuit Breaker (MCCB) from the Merlin Gerin NS type H range. The trip unit shall be sized to suit application. There should be adequate discrimination between the MCCB upstream devices.

The fault rating for all switching devices shall not be less than 65kA for Substation switchboards and 50kA for all other switchboards.

Switchboard devices above 630A shall comprise of a withdrawable Air Circuit Breaker (ACB) GEC M-PACT or equivalent, rated to suit application. The circuit breaker shall comply with BS EN60947-2 and IEC947-2. The trip unit shall be sized to suit application.

For both operational and maintenance reasons, the intention is to have inter-changeability between the fixed and moving assembles on the ACBs. The designer shall confirm the availability of spare device for continuity of supply during maintenance and emergencies.

The contact assembly of the circuit breakers and all associated live metalwork shall be double insulated from the operator. The operating mechanism shall be spring assisted via an auto-charged spring; manual charging shall also be provided. The closing time and spring charge times shall be advised at the time of tendering. A manual charging facility shall be provided; it shall be capable of operating both open and close functions in the event of failure of the auto-charging system.

The status of the main contact is to be indicated and shall be such the "OFF" position can only be indicated when all contacts have been parted and separated.

When the moving portion is removed, safety shutters shall automatically cover the incoming and outgoing main circuits and auxiliaries. The shutters shall have the facility for padlocking.

The circuit breaker is to be capable of meeting requirements for isolation as set out in IEC947-2.

The auxiliaries shall isolate all outgoing control circuit wiring when the circuit breaker is in the isolated position.

A test facility shall be provided to allow the auxiliaries to be closed with the main contact open.

The incoming and all outgoing circuits shall be equipped with over-current and short circuit protection using solid state devices. For the air circuit breakers, the device shall be located on the fixed housing. The protection shall have a wide range of time

adjustment to permit flexibility of grading downstream. All units shall be designed to recognise true RMS current and be able to discriminate against system disturbances.

All outgoing circuit breakers shall be able to be plugged into a pre-connected base assembly equipped with a safety trip to prevent plug-in connection to the base unit in the "ON" position. A pre-connected base (rating to be advised by designer) shall be fitted to all spare ways.

Circuit breakers shall be equipped with a "push to trip" mechanism to test the operation of the device. The status of the contacts shall be clearly visible when viewed from the front of the switchboard. The "push to trip" actuator shall be adequately shielded to prevent inadvertent operation.

Trip units shall be solid state to comply with IEC947 and designed to sense only true RMS current.

All devices settings are to be determined and set during commissioning. All trip setting details to be recorded and issued to UED prior to handover.

All switching devices shall be capable of being padlocked using a system which forms an integral part of the switchboard, in both "ON" and "OFF" positions, by means of a Union Cat. No: 3104 padlock.

A minimum of 25% spare ways are required on all new switchboards.

All tenderers shall submit a drawing at the time of tendering. This shall show a general layout of devices, their rating, the configuration of busbars and compartmentisation arrangements to meet required form of separation.

3.3 Metering/Instrumentation

A suitably rated CT shall be fitted to each phase and neutral on all incoming and outgoing circuits. See University Guidance note Metering and Instrumentation on the University fixed electrical system for details.

All incoming circuits and outgoing active circuits to be metered in accordance with the University Guidance note Metering and Instrumentation on the University fixed electrical system.

3.4 Labelling

All Switchboards, and all circuits shall be labelled in accordance with the University guidance note GNL2002 'Labelling of the University Fixed Electrical Installation'.

4. SUBSTATION SWITCHBOARDS

This part of the guidance sets out requirements for switchboards that are to be installed in University Substations. It is based on the standard substation arrangement which comprises 2*1500 kVA liquid cooled transformers. A typical general arrangement for a two transformer substation LV switchboard is shown on drawing E400987.1 A copy of this drawing is attached.

4.1 Construction

All switchboard incoming and outgoing arrangements shall conform to BS EN60439-1:1999 Form 4b type 6.

The IP rating shall be a minimum of IP43.

The switchboard shall be arranged to provide operation from the front with rear access for cabling. It shall be designed to provide for cables to enter from above or below as determined by site conditions.

Access into rear of panel shall be via lift off, padlockable hinged doors using 1.25 Pin tumbler padlocks as manufactured by Union Cat 3104 (UED issue type B locks).

4.2 Busbars

LV supplies shall be arranged and suitably rated, to permit short term parallel operation of the transformers. No interlocking mechanisms are to be fitted.

Primary busbars shall be run vertically and horizontally and shall be fully rated to a minimum of 1600 amps throughout. Distribution busbars shall be used to connect to the outgoing devices. The distribution bars should be sized to meet load requirements but shall not be less than 800 amps continuous rating.

4.2 Switching Devices

Protection shall be graded across the board. The rating of the HV 11kV fuse shall be taken at 80 amps on a 1500 KVA transformer.

Incoming switching devices shall comprise of a suitably rated Air Circuit Breaker (ACB) as above.

The inline busbar device shall be a non-draw out manually operated ACB that meets all requirements for the incoming air circuit breakers: however, the devices shall be non-automatic and therefore will not need protection tripping. All devices must be capable of operating under load conditions and be fully fault rated.

For all sites where the transformer is remote from the LV switchboard i.e. where cables pass outside the substation boundary, Restricted Earth fault protection with HV inter-tripping shall be installed.

For outgoing circuits up to and including 630A a suitably rated pluggable 4p MCCB shall be used.

For outgoing circuits above 630A a suitably rated ACB should be used.

4.4 Metering

Each incoming circuit shall be individually metered using a Power Measurement ION 7550 meter. Meter shall measure all phases including neutral current. See guidance note for details.

Each active outgoing circuit 63A and above shall be metered using a Power Measurements ION 6200 meter. See guidance note for details.

5. BUILDING SWITCHBOARDS

This part of the guidance sets out requirements for main switchboards that are to be installed in University buildings.

5.1 Construction

The switchboard incoming arrangements shall conform to BS EN60439-1: 1999 Form 4b type 6. All outgoing arrangements shall conform to as a minimum to BS EN60439-1: 1999 Form 4b type 3.

A typical general arrangement for a building LV switchboard incorporating 2 incomers is shown on drawing E400987.2.

A typical general arrangement for a building LV switchboard incorporating single incomer is shown on drawing E400987.3.

The IP rating shall be a minimum of IP31.

For single incomer switchboards the designer shall allow for a future second incomer with corresponding bus-section. Sufficient space should also be provided within the switch room for this extension.

5.2 Busbars

Primary busbars on switchboards should be sized to meet load requirements but shall not be less than 400amps continuous rating.

5.3 Switching Devices

For switchboards up to and including 800 amps the incoming device shall be a fixed unit non auto 4p Merlin Gerin MCCB as above.

For switchboards above 630 amps the incoming device shall be a withdrawable ACB as above.

For all outgoing circuits above 250 amps consideration shall be given to segregated sections with pluggable MCCBs as outlined in the Substation switchboard above.

5.4 Metering

All incomers shall be summated onto a single Power Measurement ION 7550 meter mounted in a remote panel. The meter shall be configured to read Earth Leakage.

Each active outgoing circuit 63A and above shall be metered using a Power Measurements ION 6200 meter mounted on the panel.

In addition each active outgoing circuit 63 amp and above shall have a suitably ranged analogue meter indicating earth leakage, mounted adjacent to instrument above.

6. FINAL DISTRIBUTION SWITCHBOARDS

This part of the guidance sets out requirements for final, special and rising main Panels generally up to 400A that are installed in University buildings. (Mechanical Plant switchboards are dealt with elsewhere).

6.1 Construction

The switchboard incoming arrangements shall conform to BS EN60439-1: 1999 Form 4 type 6. All outgoing arrangements shall conform to BS EN60439-1: 1999 Form 4 type 3.

The IP rating shall be a minimum of IP31.

6.2 Busbars

Primary busbars on switchboards should be sized to meet load requirements but shall not be less than 250A continuous rating.

6.3 Switching Devices

The incoming device shall be a suitably rated non-auto 4 pole fixed MCCB as above.

All outgoing devices shall be a suitably rated 4 pole pluggable MCCB, with the following exception:

When assembled into a multi-way MCCB distribution board it is accepted that 3P/IP devices may be used providing the main device controlling the distribution board is 4 pole.

6.3 Metering/Instrumentation

All incoming circuits shall be metered with an ION 6200 meter.

Each active outgoing circuit 63A and above shall be metered using a Power Measurements 6200ION meter mounted on the panel.

Appendix C

OXFORD UNIVERSITY ESTATES DIRECTORATE

GUIDANCE NOTE ON LABELLING OF THE UNIVERSITY FIXED ELECTRICAL INSTALLATION

GNL2002 Version 2.1

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Tidmarsh Lane
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Fax: 01865 278792

January 2007

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Related documents

This guidance note shall be read in conjunction with the following documents:

University Safety Office Policy Statement S1/00
UED Code of Practice "Electrical Safety on Low Voltage Systems"
Drawing: E400005 Typical Distribution Network to Illustrate Standard numbering and labelling system.
Drawing: E400979.1 Labelling Principles
Drawing: E400979.2 Typical Substation LV Switchboard
University Estates Directorate (UED) Distribution Board Chart

PLEASE SEE SEPARATE DRAWING PACKAGE

Labels

Unless otherwise specified all labels shall be black alpha/numeric characters on white background. Font shall be sized to fit label. Label shall be securely fixed in a manner which will allow easy replacement. Location of label will be determined by equipment to which it is fixed but shall at all times be visible from the front of that equipment.

1. SUBSTATIONS

1.1 Compounds/Buildings

All entrances to substation compounds and switch room shall be identified with a nameplate in the following form.

160mm*50mm

PATHOLOGY S/S

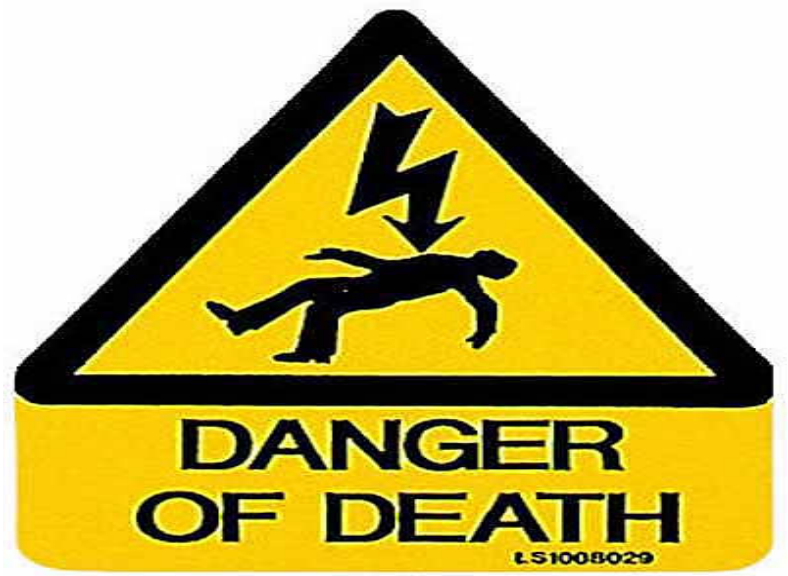
All main entrances to substation compounds and switch rooms shall display an emergency contact number as shown below.

160mm*60mm

IN CASE OF EMERGENCY PLEASE CONTACT UNIVERSITY ESTATES DIRECTORATE THE MALTHOUSE TIDMARSH LANE OXFORD TELEPHONE OXFORD 278750

All entrances to substation compounds and switch rooms shall display a danger label in the following form:

Minimum size of label 300mm*400mm



1.2 HV Switchgear

All HV switchgear shall be labelled as shown; the label shall detail the source of connected cable.

OBSERVATORY S/S

The size of the label shall be dependent upon the label fixing plate located on the switchgear.

1.3 Transformers

Each transformer shall be identified as shown.

Minimum size 200mm*50mm

TRANSFORMER 1

The label shall be securely fixed on the side of the transformer in a position visible from the HV switchgear. Consideration can be given to a stencilled identification.

1.4 LV Switchgear

Adjacent to each incoming and outgoing circuits a label shall be fitted as shown. The number shall be incremental starting from 1 preceded by the substation letter (as issued by the UED).

40mm*20mm

B1

The order of labelling shall be Transformers – Bus-Sections-Final circuits as seen from left to right (see drawing E400987).

In addition to the label above each outgoing circuit shall also be labelled as follows. The label shall identify the building supplied, the circuit reference in that building and the cable size.

100mm*35mm

BUILDING NAME
DB10/001/001.1L123N
2*185mm 4c XLPE/SWA/PVC

2. BUILDINGS

2.1 Main Switchboards

All building switchboards shall be identified as shown below. The label shall be fitted in a prominent position at the front.

125mm*30mm

20/004/002

The label shall be made up of the following parts:

a) First part (2 digits) Level in the form 00, 10, 20 etc.

b) Second part (3 digits) Space number of area.

c) Third part (3 digits) Unique number for the switchgear in the form 002, 034, 135 etc.

The first and second part of the number will be provided by the OUED space management team. The third part to be agreed with the University electrical engineer.

A numbered sequential label shall be fitted adjacent to outgoing circuits as shown. The numbering shall be top to bottom left to right.

45mm*10mm

Circuit 1

In addition to the label above a label shall be fitted adjacent to all incoming circuits as shown; the label shall display the Substation Name, the circuit reference and size and type of cable.

100mm*40mm

SUBSTATION NAME **Circuit ??** **2*185mm 4c XLPE/SWA/PVC**

In addition to the circuit reference above, all outgoing circuit shall be identified as shown. The distribution board number shall be in the form shown above.

100mm*40mm

Distribution Board Number **Circuit ??** **Cable size and Type**

2.2 Distribution Boards

ALL switchgear containing one or more circuit protective devices, including busbar risers, shall be treated as distribution boards and shall be identified as shown below.

125mm*30mm

20/004/002

The label shall be fitted in a prominent position on the front panel.

The label shall be made up of the following parts.

a) First part (2 digits) Level in the form 00, 10, 20 etc.
b) Second part (3 digits) Space number of area in the form 023, 031 etc.
c) Third part (3 digits) Unique number for the switchgear in the form 002, 034, 135 etc.

The first and second part of the number would normally be provided by the OUED. The third part to be agreed with the University Electrical Engineer.

2.3 Final Circuits

All outgoing ways on all distribution boards shall be identified with a sequential tag number and circuit reference. The tag number shall identify the actual location of the protective device within the board with each single module way being identified. The circuit reference shall comprise a way number and phase reference L1, L2 or L3. Where an isolator is fitted within the outgoing part of the board it shall be numbered within the sequential numbering above. Both the tag number and circuit reference shall correspond to the Distribution Board chart. (See below).

In general the numbering sequence shall be configured to be read top to bottom, left to right, starting at the top of the left hand column, following down to the bottom of the column before commencing from the top of the right hand column.

The following examples show various arrangements on the different board types. For non-standard boards contact the University Estates Directorate.

Single phase (Horizontal)
Phase reference marked on chart only. Tag and circuit reference shall be the same.

1	2	3	4	5	6	7	8

Single phase (Vertical)
Phase reference marked on chart only. Tag and circuit reference shall be the same.

1	7
2	8
3	9
4	10
5	11
6	12

Three Phases (Fixed Structure)
Phase reference on both chart and panel. Column 1 and 4 correspond to tag number

1	Single pole device	1L1	7	3L1	3 pole device
2	Two pole device	1L2	8	3L2	\
3	/	1L3	9	3L3	\
4	\	2L1	10	4L1	Single Pole Device
5	3 pole device	2L2	11	4L2	Single pole device
6	/	2L3	12	4L3	Single pole device

Three Phase (Non Fixed structure) for distribution boards where changeable internal links are used

Phase reference on chart only, shown below to indicate examples of non standard phase arrangements. Columns 3 and 4 correspond to tag number and circuit reference.

Single Pole device	L1	1	7	L1	/
\	L1	2	8	L2	/
Three Pole Device	L2	3	9	L3	4 Pole Device
/	L3	4	10	N	\
\	L2	5	11	L3	Single pole Device
Two pole Device	N	6	12	L1	Single Pole Device

2.4 Accessories

All final circuit accessories shall be labelled using free issue paper labels as shown below (available from UED). The label shall be completed using black indelible ink as shown.

CIRCUIT……DB32.1L123
LOCATION DIST.BOARD:-
SPACE……00/32……
ROOM……LIBRARY…….

The **circuit** identifies the distribution board and circuit and shall correspond with the distribution board chart:

For single phase circuits (Single Pole) DB10.5L2

For single phase circuits (2 Pole) DB2.6L1N

For Three phase circuits (3 Pole) DB22.6L123

For Three phase circuits (4 Pole) DB7.10L123N

The space identifies the location of the distribution board i.e.10/20

The room identifies the actual location of the distribution board i.e. Corridor, Room 6 etc.

2.5 Cable Core Marking

All cable cores within the distribution board shall be marked as follows:

Each phase conductor including the neutral shall be identified by its associated way number and circuit reference as shown on the distribution board chart. The label shall be securely fixed in a manner which will allow easy replacement.

The earth conductors shall be identified with their corresponding number detailed above.

For single phase boards the numbering shall be as follows:-

Example Single Phase Distribution Board (New colours)

Position of Device (Way on Chart)	Circuit Device	Phase Reference on chart	Core Colour	Phase Conductor Reference	Neutral conductor and Earth conductor Reference
1	SPARE	1L1			
2	2p Vigi Unit	2L1	Brown	2L1	
3	/	3L1	Blue		2L1
4	Spare	4L1			
5	Spare	5L1			
6	1 Pole Device	6L1	Brown	6L1	6L1
7	Spare	7L1			
8	1 Pole Device	8L1	Brown	8L1	8L1
9	Single Pole Device	9L1	Brown	9L1	9L1

Example 3phase Distribution Board (New colours)

Position of Device (Way on Chart)	Circuit Device	Phase Reference on chart	Core Colour	Phase Conductor Reference	Neutral conductor and Earth conductor Reference
1	\	1L1	Brown	1L1	1L1
2	3 Phase Device	1L2	Black	1L2	
3	/	1L3	Grey	1L3	
4	Spare	2L1			
5	Spare	2L2			
6	1Pole Device	2L3	Brown	2L3	2L3
7	Spare	3L1			
8	1 Pole Device	3L2	Brown	3L2	3L2
9	Spare	3L3			
10	Spare	4L1			
11	1 Pole Device	4L2	Brown	4L2	4L2
12	Spare	4L3			

Example 3phase Distribution Board (Old colours)

Position of Device (Way on Chart)	Circuit Device	Phase Reference on chart	Core Colour	Phase Conductor Reference	Neutral conductor and Earth conductor Reference
1	\	1L1	Red	1L1	
2	3 Phase Device	1L2	Yellow	1L2	1L2
3	/	1L3	Blue	1L3	
4	Spare	2L1			
5	Spare	2L2			
6	1 Pole Device	2L3	Red	2L3	2L3
7	\	3L1	Red	3L1	
8	3 Pole Device	3L2	Yellow	3L2	3L2
9	/	3L3	Blue	3L3	
10	Spare	4L1			
11	1Pole Device	4L2	Red	4L2	4L2
12	Spare	4L3			

For non-standard type distribution boards contact UED.

2.6 Submain Cables

Where multiple multicore cables are installed a label shall be fitted to each end of each cable detailing the location of the remote end of the cable.

The label shall be securely fixed and visible from the front of the distribution board.

The label shall display local distribution board reference followed by remote distribution board reference in the form shown.

Local end

DB001-DB10

Remote end

DB10-DB1

2.7 Distribution Board Chart

A protected paper chart shall be fitted adjacent to each distribution board. The chart shall be visible without the need to open the distribution board door or panel.

The minimum information for each chart is as shown on the standard University Chart shown below:

A brief description of the University chart is as follows

<table>
<tr><td colspan="5">BUILDING NAME
Short description of location of DB</td></tr>
<tr><td colspan="2">DB Nos
Bld Ref 10/13/008</td><td colspan="2">Designation i.e. Clean, Dirty, Plant etc</td><td>Manufacturer and Type

MERLIN GERIN 6W TPN</td></tr>
<tr><td colspan="2">Local Isolator

Type and size of local Isolator/CPD
Either on the DB or adjacent</td><td colspan="2">Submain details

Type and size of cable between remote and local isolator</td><td>Remote Isolator/Location

Type and size of remote isolator/CPD with location and reference number</td></tr>
<tr><td colspan="5">Zs and PSC readings at Distribution board</td></tr>
<tr><td>Way

Physical location of outgoing device counting top to bottom left to right</td><td>Size Amps

Protective device size and Type</td><td>Circuit Ref

Reference as seen on top line of Accessory label</td><td>Circuit

Description of circuit, to include space number(if known) and local space identity i.e. S/O: 10.24 Office 2</td><td>Cable Size

Final circuit cable type and size</td></tr>
</table>

UED/ DPB **University Estates Directorate Distribution Board Chart** 28-Mar-06

THE MALTHOUSE

MILL WORKSHOP

DB Nos	*Designation*	*Manufacturer/Type*
174 **00 /025 /18**		**MERLIN GERIN** **12 Way TPN**

Local Isolator	*Submain Details*	*Remote Isolator/Location*
3 Pole 125A ISOLATOR INTEGRAL	**25.0sqmm PVC SINGLES**	**60A TP ISOLATOR** **00/025/029**

Way	Size Amps	Circuit Ref	Circuit Description **ZS 0.22 ohms PSC 1.34 kA**	Cable size	Type
1	20 C	18. 1 L1	\ 906	2.5mm	PVC
2	20 C	18. 1 L2	TP&N ISOLATOR 00.25 WADKIN SAW	2.5mm	PVC
3	20 C	18. 1 L3	/	2.5mm	PVC
4	10 C	18. 2 L1	\ 909	4mm	PVC
5	10 C	18. 2 L2	15A TP&N ISOLATOR SANDER	4mm	PVC
6	10 C	18. 2 L3	/	4mm	PVC
7	16 C	18. 3 L1	\ 907	2.5mm	PVC
8	16 C	18. 3 L2	20A TP&N ISOLATOR 00.25 WADKIN PLANER	2.5mm	PVC
9	16 C	18. 3 L3	/	2.5mm	PVC
10	10 C	18. 4 L1	\ 924	2.5mm	PVC
11	10 C	18. 4 L2	TP&N ISOLATOR 00.25 MOULDING MACHINE	2.5mm	PVC
12	10 C	18. 4 L3	/	2.5mm	PVC
13	6 C	18. 5 L1	\ 904	2.5mm	PVC
14	6 C	18. 5 L2	20A TP&N ISOLATOR 00.25 GRINDER	2.5mm	PVC
15	6 C	18. 5 L3	/	2.5mm	PVC
16	32 C	18. 6 L1	\ 905	4mm	PVC
17	32 C	18. 6 L2	20A TP&N ISOLATOR 00.25 SANDER	4mm	PVC
18	32 C	18. 6 L3	/	4mm	PVC
19	10 C	18. 7 L1	\ 908	2.5mm	PVC
20	10 C	18. 7 L2	20A TP&N ISOLATOR 00.25 BANDSAW	2.5mm	PVC
21	10 C	18. 7 L3	/	2.5mm	PVC
22	16 C	18. 8 L1	\ 901	4mm	PVC
23	16 C	18. 8 L2	16A TP S/O : CROSS CUT SAW 00.25	4mm	PVC
24	16 C	18. 8 L3	/	4mm	PVC
25	20 C	18. 9 L1	\ 926	6mm	PVC
26	20 C	18. 9 L2	32A TP&N SOCKET OUTLET 00.25 DUST EXTRACT	6mm	PVC
27	20 C	18. 9 L3	/	6mm	PVC
28	6 C	18. 10 L1	\ 902	2.5mm	PVC
29	6 C	18. 10 L2	TP&N ISOLATOR 00.25 MORTICE MACHINE	2.5mm	PVC
30	6 C	18. 10 L3	/	2.5mm	PVC
31	16 C	18. 11 L1	\	4mm	PVC
32	16 C	18. 11 L2	16A TP S/O : WOODLATHE 00.25	4mm	PVC
33	16 C	18. 11 L3	/	4mm	PVC
34	10 C	18. 12 L1	\ 910	2.5mm	PVC
35	10 C	18. 12 L2	TP&N ISOLATOR PILLAR DRILL	2.5mm	PVC
36	10 C	18. 12 L3	/	2.5mm	PVC

Appendix D

OXFORD UNIVERSITY ESTATES DIRECTORATE

GUIDANCE NOTE ON METERING AND INSTRUMENTATION ON THE UNIVERSITY FIXED ELECTRICAL SYSTEM

GNMI 2002 Version 2.1

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January 2009

INTRODUCTION

The following guidance note outlines the requirements for Energy Metering and Monitoring of the Electrical systems defined as being the responsibility of the Director of Estates.

The guide details the metering/instrument requirements from the substation through to the final sub-distribution within a University building and should follow the general principles as shown in the Standard University Metering and Instrumentation diagram E400978 Sheet 1.

The guide shall be read in conjunction with CIBSE Guide TM39 Building Energy Metering as required by Part L2 of the Building Regulations.

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PLEASE SEE SEPARATE DRAWING PACKAGE

1. CURRENT TRANSFORMER GENERAL ARRANGEMENTS

Core type current transformers (C/Ts) shall be to BS7626-1993.

C/Ts shall be installed such that they can be replaced without disrupting other circuits.

All C/Ts shall be Class 1 with a minimum capacity of 5VA.

C/T Ratio shall be dependent on site. CT secondary shall be 5A.

C/Ts shall be fitted on all phases including the neutral.

All C/T secondary wiring shall be wired to separate terminal blocks (KLIPPON or equivalent) with shorting links such that connections and alterations can be carried out whilst switchboard is in use. See E400978 Sheet 2.

A label detailing the C/T type, size and ratio shall be fitted adjacent to this terminal block.

C/T configuration for metering shall take place from terminal block.

2. VOLTMETER MONITORING GENERAL ARRANGEMENTS

A three phases and neutral reference voltage via fuses shall be provided for each section of the switchboard.

Fuses required for instrumentation and metering shall be sited such that the fuses can be removed safely without the need to isolate any part of the switchboard. All fuses shall be labelled with size and circuit details.

Voltage measuring arrangement along with instrument or meter requirements shall be as outlined elsewhere in this guide.

Fuse size and cable size shall not be less then 10A rating.

3. METERS AND INSTRUMENTATION SYSTEM

It should be noted that the University currently operates an existing remote metering system using Power Logic devices, see 3.1, and that all electronic meters and instruments shall be compatible with this system. All electronic meters to be provided by C-Matic Systems (see below).

Contact:	C-Matic Systems Limited The Forge Park Road Crowborough East Sussex TN6 2QX
Tel No:	01892 665688
(Note:	Indicate that meters shall be configured for University)

3.1 Main Meter Type

A Power Logic ION 7550 shall be fitted to each University Transformer and each building main switchboard. A data connection (FRODO) shall be provided adjacent to at least one of the ION7550 meters to enable the devices to be remotely read by the University Estates Directorate (UED).

All main metering equipment shall be mounted separately and remotely from the switchboard.

A twin 13A socket outlet shall be fitted adjacent to each meter. The socket shall be wired as a 16A radial circuit from the local distribution board.

The network connection shall be made available adjacent to the meter cabinet.

3.2 Sub-Metering/Instrumentation

For sub-metering the device shall be a Power Logic ION 6200 device.

All sub meters shall be wired together using a screened twisted pair cable in the form of a ring circuit. The circuit is to include the main meter above.

3.3 Earth Leakage Instrumentation

An earth leakage ammeter shall be fitted on all building switchboard outgoing circuits and sub-distribution panels. Instrument type shall be agreed with UED.

3.4 Meter Networks

Meters shall be connected to the local LAN (FRODO) using a CAT 5e type cable as shown on attached drawing. Up to 15 of ION6200 devices can be connected to the main meter using the Modbus protocol with Beldon 9841 type cable as shown. Where more than 15 meters are to be connected the designer should consult with the Electrical Engineer in the Estates Directorate.

4. UNIVERSITY SUBSTATIONS

4.1 HV Switchgear

No metering/Instrumentation required.

4.2 LV Switchboard Definition

For the purposes of this guide the substation LV switchboard is defined as being a switchboard which is supplied directly by one or more HV transformers, and feeds one or more University buildings.

4.3 LV Switchgear Incoming Circuits

An analogue voltmeter and selector switch, mounted adjacent to the incoming LV isolating device shall be fitted reading ph-ph and ph-n volts. A separate switch will select incoming volts or busbar volts. Potential fuses shall be placed such that connections can be made without need to isolate any part of the switchboard.

A C/T shall be fitted on each incoming phase and neutral connection and wired to a terminal block as shown on drawing E400978 sheet 2. The location of the terminal block shall be such that access can be obtained without the need to isolate any part of the switchboard.

An ION 7550 (see section 3.1) shall be installed on each transformer circuit.

The meter shall be configured to read all phases and neutral current.

The meter shall be correctly calibrated with all previous energy readings and maximum demand readings reset to zero. Thermal demand shall be set at 30 minutes.

4.4 LV Switchgear Outgoing Circuits

For all outgoing circuits that are to supply variable loads greater than 60A(50KW), an ION 6200 meter shall be installed.

In all cases a C/T shall be fitted on each phase and neutral as shown on drawing E400978 sheet 2. The location of the terminal block shall be such that access can be obtained without disruption to normal switchboard operation.

5. UNIVERSITY BUILDINGS/DEPARTMENTS

5.1 LV Switchboard Definition

For the purposes of this guide the building switchboard is defined as being a switchboard which is supplied from either the local REC or a University substation LV switchboard above.

5.2 Main Switchboard Incoming Circuits

An analogue voltmeter and selector switch, mounted adjacent to each of the incoming LV isolating devices, reading ph-ph and ph-n volts shall be installed. A separate switch will select incoming volts or busbar volts. Potential fuses shall be placed such that connections can be made without need to isolate any part of the switchboard.

The C/T's shall be wired as shown on drawing E400978 sheet 2. The location of the terminal block shall be such that access can be obtained without disruption to normal switchboard operation.

5.3 kWh Metering

Each building/department switchboard shall have a single ION 7550 meter fitted in a separate enclosure adjacent to the switchboard.

Where switchboards comprise of two incoming circuits, C/Ts shall be summated onto single meter.

The C/T wiring shall be configured to read all phases and earth leakage current.

The meter shall be calibrated with all previous energy readings and maximum demands reset. Thermal demand shall be set at 30 minutes.

5.4 Main Switchboard Outgoing Circuits

For all outgoing circuits that are to supply variable loads greater than 60A, an ION 6200 shall be fitted. Where space constraints restrict the size of the main switchboard, the instruments may be installed at the remote end of the above circuits.

The C/T's shall be wired as shown on drawing E400978 sheet 3 including earth leakage. The location of the terminal block shall be such that access can be obtained without disruption to normal switchboard operation.

5.5 Departmental Risers Tap Offs

For the purpose of this guide the riser is defined as being the vertical/horizontal distribution system, cable or busbar, supplied from the building switchboard and or other riser.

For all tap off circuits that are expected to supply variable loads greater than 60A (50KW) instruments shall be fitted as outlined in section 3.

The C/T's shall be wired as shown on drawing E400978 sheet 3 including earth leakage. The location of the terminal block shall be such that access can be obtained without disruption to supplies.

5.6 Building Sub-Distribution Boards

For the purpose of this guide the sub-distribution board is a distribution board which supplies one or more distribution boards with a combined variable load in excess of 60A. It may be supplied from either the building switchboard or riser.

For all sub-distribution boards that are expected to supply a variable load greater than 60A an ION6200 meter shall be installed.

A C/T shall be wired on each phase and neutral as shown on drawing E400978 sheet 3. The location of the terminal block shall be such that access can be obtained without disruption to normal switchboard operation.

Appendix E

ELECTRICAL SUPPLIES TO LIFT INSTALLATIONS

General:

The following notes are intended to provide general guidance for the provision of electrical supplies to serve new and refurbished lifts and to identify the UED and lift installer's areas of responsibility.

The lift is to be considered as a 'factory built assembly', with the design, installation, commissioning and testing being the sole responsibility of the lift installer working under the direction of the appointed Lift Consultant.

All lift electrical installations shall comply with the relevant sections of section 3 of this document.

The notes below should be read in conjunction with the attached schematic wiring diagram.

Lift Refurbishments:

(1) UED electrical responsibilities:

(a) A suitably sized cable terminating in the lift motor room with a 4 pole, lockable isolator will be provided based up on electrical loadings provided by the Lift Consultant.

(b) A consumer type distribution board, fitted with suitably rated mcbs and controlled by a double pole, lockable isolator will be provided in the lift motor room to supply all of the electrical services which will normally be maintained and tested under the Lift Maintenance Contract. RCDs shall be provided for all power circuits to be taken from this board.

(c) The following motor room services will be supplied from the normal building distribution system:

Lighting
Emergency Lighting
Local heating if necessary
Ventilation fans if necessary
RCD protected twin socket outlet

The positions of the above equipment shall be agreed with the Lift Consultant and the electrical supplies shall be taken from a suitable distribution board located on the same level as the lift room or from one floor below, where the lift motor room is on the roof.

(2) Lift Installers electrical responsibilities:

The lift contractor and/or Lift Consultant will be responsible for the design, supply, installation and testing of all circuits taken from the lift isolator and distribution board provided by the UED in (1a) and (1b) above.

The circuits to be supplied from the distribution board shall be:

Car lights and emergency lighting
Lift shaft and pit lighting
Car and pit small power

On completion of the lift electrical installation, a complete set of documentation, inclusive of all test data as required by BS 7671, must be submitted for approval by the UED before an electrical supply can be made available. The documentation shall clearly identify the designer, installer and tester of the lift electrical installation.

New Lift Installations:

The contractual arrangements will differ, but the final arrangement of electrical supplies to serve the lift installation must be as outlined above.

PLEASE SEE SEPARATE DRAWING PACKAGE

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Appendix F

SPECIFICATION FOR NEW NETWORK DUCTING IN PUBLIC HIGHWAY

***(to be found at** G:\Data\Documents\Building Conservation\DUCTS)*

Appendix G

OXFORD UNIVERSITY TELECOMMUNICATIONS INFRASTRUCTURE SPECIFICATION PROJECT

Oxford University Telecommunications
Infrastructure Specification Project

1 OVERVIEW

1.1 This document is an overarching summary intended to help with the design, specification, installation and testing of telecommunications infrastructure within individual colleges and university buildings

1.2 The full more detailed documents are intended as a guideline to the owners of those buildings when either building a new facility or undertaking refurbishments of existing buildings which have an impact upon the Telecommunications infrastructure, voice and/or data.

1.3 The documents will cover the termination of incoming services from the Oxford University Telecommunication Network (OUTN), the demarcation of these services, the design and specification of internal services, the internal installation and termination of services and testing of services within the owned or occupied building.

1.4 The documents will also cover the environmental and physical requirements of the cabinet room to terminate the services.

1.5 Both copper and fibre services will be covered by the set of documents.

1.6 Reference will be made to the relevant national/international cabling standards throughout the document as required. The users of this document are not expected to have a detailed understanding of these standards however the installers of any cabling structure should have the necessary understanding.

1.7 The responsibility of service provision into the buildings will be the OUTN up to the cabling demarcation point, internal service provision from the demarcations point will be the building owner/occupier responsibility.

1.8 The application of the design and specification of a cabling infrastructure will require dialogue between, the building owner/occupier, OUCS and OUED (for University buildings) as a minimum to help in the design and specification of the network. The output from this dialogue should be a final specification that conforms to relevant standards.

1.9 These guidelines will allow the development of user requirements that will automatically feed into a design principles document and detailed model specification for use by all participants within the process.

2 DESIGN CONSIDERATIONS

2.1 The three main areas of design cover the incoming services, demarcation point and internal services. It is the responsibility of the building owner/occupier to develop the specification for the demarcation and internal aspects and OUCS to ensure the external services meets the needs of the internal users.

2.2 The design of the infrastructure should start with the initial user requirements including all services that are connected to the services, the number of these services, transmission speeds of services, reliability and resilience requirements of the services.

2.3 Consideration will need to be given to the density of outlets required either based on full flood wiring, partial flood wiring, or allocated outlets to individual services and users.

2.4 The outlet positioning will also require consideration. The options are:

- power pole (not recommended)
- wall mounted in trunking either above or below work surface or below work surface or floor mounted.

In all instances it is important to ensure that changes to the room layout during the overall building design are captured and adjustments made as required. A mix of types is acceptable.

2.5 When considering the type of outlet positioning especially in large offices, with a mix of desks either against a wall or centrally positioned a mixture of positioning type may be required.

2.6 The space usage needs to be taken into account as this could have a significant impact on the number of outlets installed. Usage could include open plan offices, individual offices, laboratories, lecture rooms, etc.

2.7 The amount of flexibility required within the buildings is also a key factor the more flexible and future proofed the building space needs to be the higher the density of outlets that will be required to limit additional cabling and disruption in future years.

2.8 To ensure that the needs of the users are met, OUCS will need to understand the performance, capacity and design constraints to ensure the building owners/occupiers requirements are fully accommodated for any incoming services.

2.9 Pathways for the cabling infrastructure should be identified as part of the process.

2.10 Where possible consideration should be given to both initial and future user requirements.

2.11 Any constraints within the buildings, such as listed building requirements and any known hazardous materials, must be identified.

2.12 The size of any termination enclosure (cabinet/frame) will be determined by a number of factors including the volume of cabling, active equipment and future requirements.

2.13 The type of distribution cable to be used will conform to BT CW1308 standards or Cat5e cabling standards, as a minimum.

2.14 There are two options for telephony internal cabling either CW1308 cabling (traditional telephony cabling) or a minimum of Cat5e cabling between the outlet and the distribution point/patch cabinet.

2.15 The traditional telephony installation will have multicore cables distributed from the demarcation point of incoming services (BDF) to various distribution points (DP's) within the building, individual outlets are then cabled back to the (DP).

2.16 The use of a merged cabling infrastructure (Minimum Cat5e) differs in two main parts. The multicore cable is terminated on Cat5e patch panel with RJ45 outlets and distribution to the outlet is via the standard Cat5e cabling. (This is the recommended approach for new/refurbished buildings).

2.17 Where IP telephony is being considered the incoming service to the building will be via fibre and internal distribution will be via a mixture of fibre and copper multicore to local patch cabinets for pure IP to the desk or analog IP to the desk.

2.18 Model design principles are included within the documentation based on best practice covering each type of installation.

3. SPECIFICATION DEVELOPMENTS

The following document assist in the production of the final specification. They should be used in the following order to facilitate the production of the final specification

Documents flow:

Oxford University Telecommunications overview

Best Practice Guidelines

Cabling Infrastructure

Internal Design requirement (new build/refurbished)
Horizontal cabling requirements check sheet

Cabling infrastructure Output specification (new build/refurbished)

Supporting documentation

All documents can be found on the telecommunications web site at [oucs] Telecommunications

Appendix H

CAD LAYER DETAILS

OXFORD UNIVERSITY ESTATES DIRECTORATE

SPACE MANAGEMENT TEAM

DRAWING LAYERING CONVENTIONS

1.0 BACKGROUND

The University Estates Directorate has a long-established list of layering conventions. It was intended that this should be used for recording information on existing buildings and to ensure that new record drawings use the same conventions. Many consultants have their own layering conventions and appear reluctant to use the UED's layering list.

The implementation of a new Estates-wide database means that the there is a critical need to have drawings produced to a consistent standard and layering convention in order that space and record drawings can be accessed universally across the University. The list below establishes the key layers (and elements to be combined on each layer) for the University's standard architectural master drawings. Consultants can have additional layers suited to their own purposes, provided that core information is provided in the layers listed below.

Where these layering conventions are not followed projects will be cross charged for sending drawings to an external agency for them to be re-drawn to suit these standards. Design team/contractors payments will be reduced to compensate.

The following layering standards must be followed therefore. In the event of any perceived difficulties, Joyce Thompson, will be pleased to help.

The list below covers drawing layers related to architectural and building surveying type matters. The list is based on the British Standard CAD layering convention. It does not cover mechanical and electrical systems within buildings. Reference should be made to the UED's Mechanical and Electrical engineers in this case.

The list covers 'General Arrangement drawings'. These need to be supplied early enough in the design development process to allow for space numbering (to be undertaken only by The UED's space team) and for early loading onto the space management element of the UED's estates database.

At Practical Completion we expect to receive copies of **all drawings** in CAD format (e.g. construction details).

The UED currently uses Autocad 2006 for connecting drawings to the database. Therefore drawings should be provided in a .dwg format capable of being read by Autocad 2006.

2.0 LAYER LISTS – ARCHITECTURAL/BUILDING-RELATED ELEMENTS

Layer ref.	Colour (Autocad colour ref)	Converted for Planon CADViewer	Elements	Notes
0	**White**	**Y**	**Autocad default**	No information expected on this layer – assumed Autocad default
A-200-25	**09**	**Y**	**External and internal walls**	Thin line detail
A-200-50	**10**	**Y**	**External and internal walls**	Thick line detail. (Lines to be closed around door and window openings). **Wall build-ups should not be shown on this layer**
A-213-25	**12**	**N**	**Fire compartmentation**	
A-229-25	**15**	**N**	**Gridlines**	
A-230-25	**White**	**N**	**Text - OUED space code**	
A-231-25	**13**	**N**	**Text - other text info**	Cill heights, floor to ceiling heights etc.
A-232-50	**09**	**N**	**Floors**	For use in sections only
A-233-25	**White**	**N**	**Text - Room names/uses**	
A-235-25	**White**	**N**	**Text – Dept. space code**	
A-240-25	**Cyan**	**Y**	**Stairs**	
A-270-25	**Cyan**	**Y**	**Roofs**	
A-287-25	**Cyan**	**Y**	**Small/unidentified ducts**	Ducts within a main space having no separate space code e.g. pipe boxings, cistern housings etc.
A-300-25	**15**	**Y**	**Windows and doors (external and internal)**	Frames, swings, etc.
A-359-25	**Magenta (dashed line)**	**Y**	**Overhead details**	Ceiling features e.g. downstand beams, vaults, etc.
A-700-25	**11**	**N**	**Fixtures and fittings**	Built-in furniture etc. e.g. cupboards, lab benching, vanity units, fixed seating (not loose furniture)
A-725-25	**Cyan**	**N**	**Loose furniture**	Loose tables, chairs, desks etc.
A-900-25	**11**	**Y**	**External features**	Roads, fences, boundary walls, gates, landscape features, etc. (usually on entrance level drawing)
B-500-25	**Green**	**N**	**Services (external, building entry)**	e.g. mains stop valve locations, fire hydrants, and other features that may be needed to be identified in fire or flood situation)
B-523-25	**Green**	**N**	**Foul drainage**	SVPs, manholes, drain runs
B-525-25	**15**	**N**	**Surface water drainage**	RWPs, manholes, drain runs
B-528-25	**11**	**N**	**Other services**	Lightning conductor pits, unidentified ducts etc.
B-740-25	**Blue**	**Y**	**Sanitary fittings**	Incl sinks, WCs etc.
E-625-25	**Cyan**	**N**	**Data and telecoms**	External ducts, inspection chambers, etc.
E-683-25	**12**	**N**	**Fire protection systems**	e.g. fire extinguishers, sprinkler systems etc.
M-115-50	**12**	**Y**	**Significant internal ducts**	Ducts having own space numbers e.g. mechanical, electrical and other risers
M-520-25	**11**	**Y**	**Other mechanical services**	Plant etc. occupying space .e.g chillers, air handling units etc.
M-563-25	**11**	**N**	**Central heating**	Boilers, radiators etc.
FICM	**Yellow**	**Y**	**Individual space polyline**	Separate polyline around 'room side' of each space with its own space code. Measured at 1.5m above floor level i.e. not into eaves
FICM-net	**Blue**	**Y**	**Gross internal area polyline**	Polyline around internal face of external walls
FICM-gross	**Blue**	**Y**	**Gross external area polyline**	Polyline around external face of external walls
FICM-void	**Blue**	**N**	**Polyline around internal voids**	

3.0 OTHER MATTERS

3.1 Other dos and don'ts

- Each floor should be a separate drawing
- Drawings should not be x-refed
- On staircases the plan should look upwards e.g. any understairs areas on the lowest floor should register on that floor
- Staircases must be properly drawn with break lines that coincide on the different floor levels (other wise space is lost or over-provided)
- Arrows on staircases should point upwards only
- Do not try to pre-determine the UED's space numbers. Please allow the Space Management Team to provide these – and give them enough time to do it – they cannot be done overnight. If spaces are added after an initial allocation then please check before randomly attributing space numbers to such spaces.

3.2 Contacts

Contacts for the UED Space Management Team for drawing and space numbering queries:

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CG 17.11.2006