3.3.2

D. Electrical Services - UoA Design Standards. FINAL Version 5, May 2023

Version	Authors	Description	Revision	Date
1.0	Vicki Jacobs, Capital Projects Delivery, UoA	D. Electrical Services - UoA Design Standards	DRAFT Version 1	Dec 2017
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4.0	Vicki Jacobs, Capital Projects Delivery, UoA / GHD	D. Electrical Services - UoA Design Standards	FINAL Version 4	August 2018
5.0	Infrastructure, UoA	B. Building and Architecture – Design Standard	FINAL Version 5	

Version	Authors	Revised items	Date
5.0	Infrastructure, UoA	Abbreviations, 1.Introduction, 2.General Requirements removed and reference in Vol.A Project Process Checklist	May 2023

It is envisaged that revisions to this document will be undertaken at intervals of not more than two (2) years.

Director of Infrastructure

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The standards have been developed by Capital Projects with the assistance of UoA staff, external consultants, contractors, and colleagues from other education institutions. The University conveys its thanks.

(refer –Standard Volume A. Project Process Checklist)

(refer –Standard Volume A. Project Process Checklist)

(refer –Standard Volume A. Project Process Checklist)

Where equipment within a space is considered to be critical to the operation of the space, redundant infrastructure, back-up power supplies and the like must be included within the design. Assessment of a space's functionality should provide clarity on whether redundant equipment is required.

Some of the functions within UoA laboratories may require a diverse power supply. Criticality of power supplies in laboratories is to be determined in the early design phase specific to each project.

Plant rooms provide support to the functions within the particular building and generally house safety services plant and control gear that is critical to facilitate safe evacuation during an emergency. The criticality of such areas should match the requirements for the occupation within the building. Power supplies designed for plant room equipment should be in line with essential s

The various aspects of the HV distribution system must be coordinated with architectural design requirements, fire protection strategy and security requirements. Refer to B.

Transformer Circuit Breakers do not require motorisation unless deemed necessary for the design.

Conduits must be sized to conform to AS 3000 and to facilitate pulling cables with ease.

Cable pits and trenches must be sized to facilitate the specified bending radii of the cables and permit cable jointers to work within them.

Concrete Cable Trenches

The size of cable trenches and pathways must be large enough to facilitate maintenance activities and prevent unnecessary bunching of cables.

Direction changes within trenches must be large enough to allow for the bending radius of heavy submains cabling.

Trench covers must be constructed of a material that is easily removed by two maintenance personnel. The top of the covers must finish flush with the finished floor level as to avoid tripping hazards.

All concrete cable trenches must be tanked to avoid ingress of ground water and designed to allow for drainage to prevent flooding.

Adequate ventilation / temperature controls must be provided to ensure that equipment does not exceed maximum ambient temperature ratings of all equipment under maximum operating conditions.

Natural ventilation must be considered primarily, though where impractical, must be by means of air conditioning and / or exhaust fans. Mechanical ventilation / conditioning equipment must be controlled locally and be monitored by the BMCS.

Fans and drive motors must be selected in such a way that 100% design air quantities for a given system are delivered when air handling equipment is operating at not more than 80% of the maximum available design static pressure or design flow (L / s), whichever is less. In general, larger fan sizes that allow lower operating speeds and noise levels are preferred.

Substations must be secured to prevent unauthorised public access. The door locking system selected must comply with H. Security Services. Facilities for emergency egress must be provided at all times.

Electrical designs must be assessed for the need of back-up power supplies. Integration of back-up power may include redundant HV network rings and equipment, uninterruptible power supply (UPS) systems and generators.

Selection of a type of back-up power system will call for assessment of project specific functionality.

The design and installation of diesel generators, battery bank UPS units and automatic transfer switches (ATS) is not mandatory unless specified for the project brief.

Back-up power supply system alarms must be integrated to the BMS for monitoring.

Assessment must be made to determine the type of switching for connection of alternate power sources that is appropriate for the project.

Manual transfer switches would be considered for connection of alternate power for maintenance involving interruption to non-critical loads; for example, connection of a portable generator via a plug connection.

Open transition automatic transfer switching would be considered for non-attended operation and connection of critical loads. In this instance, the re-connection of mains power would involve a break in the power supply and would be appropriate where this momentary loss of power does not compromise the operation of connected equipment. In addition to occurrences of loss of mains power, this momentary loss of power to a critical load would occur during periods of testing the operation of the alternative power supply arrangement.

For any load where such a momentary loss of supply would have a deleterious effect on the performance or operation of the equipment, then th0.31 RG₽W*n7*n86 TJET(i)9(o)-2(n)5( )-3(o)-3t595.44 841.687( )(ly .302 0.302 0.31 rg0..302 0.302 0.31 rg0.302 0.302 0.31 RG[Open)4( )-x)6(amcl2 0.

Generally, generators must be sized such that the maximum connected load is <70% of the generator rating and minimum connected load is >50% of the generator rating. Additional future load must be considered when sizing the generator.

Where transfer switching forms part of the distribution of power across the campus, an ATS logic procedure diagram must be displayed in the associated switch room for maintenance contractor reference.

Standby generators must have fuel supply arrangements that will keep them in operation for the longest credible normal supply outage as determined by risk analysis or as nominated by UoA.

The fuel system must have provision for emptying fuel tanks so that fuel can be replaced if fuel condition monitoring indicates quality has deteriorated.

Generators must be installed in an environment where they can be serviced and maintained in all conditions.

Routine testing must be configured to be undertaken on live loads, but without disruption to the normal operation of the facility. Provision must be made for a load bank connection point rated to >70% of the generator rating.

UPS power supply provisions must be assessed according the criticality and functioning of the load, as appropriate to the specific needs of each project.

All UPS systems must be configured for coordinated distribution of power, required levels of redundancy, autonomy time to suit equipment shutdown or alternative longer term power back up and diverse power flow where required. Determine the appropriate selection of centralised versus distributed systems, fully on-line versus standby operation, positioning of large and potentially heavy plant, energy storage options, system maintainability and functionality.

A complete UPS maintenance plan must be developed and agreed upon in consultation with UoA.

Static UPS units must be designed and installed in accordance with the relevant equipment manufacturer's specifications and relevant Australian Standards.

UPS system batteries must be housed in a suitably designed rack or enclosure. All battery enclosures are to be designed to allow adequate space for maintenance activities. Enclosures must be positioned in a room to allow for sufficient ventilation, cooling and maintenance.

Flywheel energy storage systems must be positioned to suit the structural design of the building. Adequate access for removal must be provided.

All equipment must be provided with adequate clearances to allow safe exit in the case of an emergency.

Where a standalone rack mountable UPS system is to be introduced, heat dissipation must be considered especially for small switch rooms and enclosures. Where the ambient temperature is likely to exceed 25°C a ventilation or air conditioning system must be installed.

A copy of the manufacturer's specifications and commissioning report including test values established at setup must be included in the Operation and Maintenance manuals and in the system's enclosure.

Renewable energy sources must be considered in line with project specific requirements and UoA guidelines.

Where renewable energy sources (for example, solar PV systems) are to be incorporated, all regulatory protocols required must be incorporated into the project, including all necessary consultation with and obtaining the approval of UoA.

The size of switch rooms and switchboard cupboards must be sufficient to accommodate the switchboard, additional associated electrical equipment and the free movement of maintenance personnel carrying out maintenance activities. Switchboard rooms and cupboards must be sized to the requirements of AS 3000, including the use of two points of egress if required.

Provide adequate access and egress pathways, not only for the switch room itself but for surrounding emergency egress areas that may be affected by the switch room positioning. Such areas may include lift lobbies / openings, emergency exits into stairwells and narrow corridors

Allowances must be made for free movement of trolleys and lifting aids where replacement of electrical equipment may be required.

Ceiling height or space between the top of switchboards and under soffit must be adequate to allow for overhead cable containment, sufficient bending radius of cables and ventilation / air movement.

If the building is to be extended in the future, the switch room must be of adequate size to enable the switchboard to expand on both ends.

Hinged panels must be suitably stiffened and fitted with lift-o ge lift-off panels are not favoured, t voidable, must be fitted with appropriate D handles for ease of removal. Such have a means of support such as gu upport ledge for use while fixing screws are being fastened.

Escutcheon covers and hinged panels must be fixed in place w rew able to be loosened without th .

The switchboard must be mounted on a welded, galvanised ch ore-drilled to allow for hold down

Provide type tested assemblies that are identifiable with respe st Certification.

The main switchboard may have front or back access.

Provision must be made for connection of future submain circ ariety of different circuit breaker siz all capacity as noted in Section 3.2 Spare capacity of this document.

Cable containment leading to and within the main switchboar d to accommodate cables for futur

For all switchboards located in cupboards or rooms, the exter t be two coats of gloss enamel paint pproved by UoA. Internal finish colour should be gloss white. Where the s exposed to view and the colour sc uilding requires a different switchboard colour, the actual selection must be to ements and approval. For switchbo essential or critical loads, or requiring clear identification for reasons of functionality or operation, an alternative colour scheme must be developed to UoA's requirements and approval.

During the highest load time-frame of the warranty period a thermographic survey must be carried out on all main switchboards, major toc7t.52 Tf rg0.302 0.302 0.31 RG[.)-3( )4(In)-3(ter)10(nal)-3(fi)11(nish col)9(o)-2(ur)5( )-3(sh)6(o)4(uld be)5( )-3(gloss)9( )-3(w)3(52 Tfta)4(g)-3(n S)12(ta

critical loads.

elevated induced voltage through a lightning strike. Fire protection must be provided on all subcircuit runs to equipment deemed to have critical functionality.

Surge protection equipment must be installed with neon indicators visible through the switchboard escutcheon. The indicators must display the condition of the suppression equipment.

Cables must be supported at all positions along the cable route to deliver a neat, practical and maintainable installation.

Cable support systems may comprise:

- Cable Tray - preferred
- Cable Ladder
- Cable Basket
- Cable Duct / trunking
- Clips, cable ties and cleats.
- Catenary Wire – only used when no system above cannot be utilised; justification will be required.

Cable tray, basket and ladder must be galvanised or stainless steel and be complete proprietary systems. Only the same manufacturer's standard fittings and joining plates must be used.

Trays must be generously sized so that cables are not entangled and it is practicable to remove redundant cables as any become disused.

All activities involved with underground services must be coordinated with other services and be in accordance with J. External Works.

The location and depth of existing underground services in the vicinity must be confirmed during the design phase of the project and verified on site prior to commencement of any earth works or trenching. On-site testing must be undertaken through the use of Ground Penetrating Radar (GPR), potholing and other non-intrusive methods.

Where existing services lay in the proposed route of a trench, provision must be made for trenching by hand to avoid possible damage. Existing services must not be tampered with in any way unless instructed by UoA Service Delivery. Accidental damage to existing services must be reported immediately.

Trenching must be performed at agreed times to minimise disruption to normal personnel movement.

Safety barriers must be erected for personnel commuting in the area.

Conduits must be provided for all underground cables installed beneath paths or roads whether sealed or not. Conduits must extend 1m on both sides of the road or path.

Spare conduits must be provided for mains cable routes.

Cable pits must be provided in cable routes at regular intervals and changes of direction to facilitate the ease of cable pulling and maintenance activities.

Conduit entries must be drilled neatly to the size of the associated conduit. Any gaps around the conduit and entry hole must be suitably sealed. Drainage holes must be drilled in the bottom of the pit.

Trafficable lids must be installed to pits where there is an increased likelihood of vehicle movement.

Pits must be sized to suit the bending radius of largest cable being installed.

Cable pit lids must be labelled as to the service within.

Where conduits are required for cable reticulation, the installation method preferred is PVC insulated cables installed in Class B heavy-duty PVC conduit.

PVC conduit must be used in areas where corrosive gases me0.302 0.31 rg0.302 0.302 0.31 RG 0.0214 Tc[(he)]TJETQ0.000008873 0 9.2 Tm.mTm0.302 0.30

Conduits must have a minimum diameter of 20mm. The number of cables installed in conduits must comply with AS 3000.

Draw wires must be installed in all conduits.

Heavy duty orange conduit and fittings must be used underground and where exposed in plant and switch rooms, service ducts and roof spaces.

Exposed conduits are to be avoided wherever possible.

All services must be seismically restrained to Australian Standard requirements.

Lighting designs must meet all the applicable requirements of the NCC, AS 1680 and AS 1158. All lighting designs must provide adequate functional lighting to suit the tasks of the spaces, create a comfortable working space, complement architectural design requirements, be in accordance with sustainability requirements for the project, be simple to operate, be readily maintainable and flexible for future uses of the facility.

Areas must be illuminated by natural light or artificial means to afford safety and visibility commensurate with the purposes of each area.

Where working positions are fixed, task lighting may be used.

Consideration must be made for occupant safety and security lighting, including adequate provisions for night time.

Over lighting significantly above the Australian Standards (>25%) should be avoided.

Light fittings and components must be assessed against the following points for selection:

- Energy Efficiency
- Maintainability
- Number of compatible lamps
- Switching control method
- Cost

The type and position of fitting selected must allow for easy repair and maintenance.

Recessed fittings must be installed complete with a length of flexible cable and plug top.

Lighting designs must deliver a complete lighting solution that is functional to the space and embraces the following elements:

Environment light is the type of light that provides a blanket wash of illumination. The function of environment light is to facilitate general orientation and activity. Environment light must be the base foundation allowing for additional accent lighting.

Direct lighting can be used to provide contrast. This type of lighting must be employed where the aim is to accentuate focal points and highlight important areas. An example where task lighting may be applied is within a laboratory.

Feature lighting (e.g., the use of coloured lamps and RGB LED fittings) may be used to create a decorative feature to the overall lighting design. Although feature lighting does not necessarily provide practical functionality, it must be considered for public areas and foyers. This aspect of lighting could also assist withBT / F1595.44 862 0.31 RG[(d)5( )-3(als)11(o)-2( )-3(assi)5(st)4( )-3(w)3(it)4(hBT3(pr)3(ouc(assi)5(n-[(b)4(e)-2(

LED fittings must