

## 07 – Electrical Services

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## Preamble

### 07.01.

**07.01.** This document contains the Electrical Design Guide, a section of the Campus and Building Requirements Manual (the CBRM, the Requirements or the Manual) which briefly describes the design objectives for the Australian National University (the ANU or the University) electrical installations.

**07.02.** A separate electrical specification which establishes a base level of quality for ANU electrical installations is available and is to be integrated in all designs, titled the [ANU General Electrical Specification](#).

**07.03.** The ANU is committed to energy efficient design and long-term, low maintenance costs. Consultants shall familiarise themselves with the existing services and systems on the campus' on which they may be involved with prior to the commencement of feasibility and planning.

## Introduction

### Campus and Building Requirement Manual

**07.04.** The CBRM documents the minimum design and construction requirements for new, refurbishment or repurposed building works, landscapes and engineering/infrastructure projects on buildings, facilities and campuses of the ANU. The Requirements are prepared for the direction of a Consultant, Designer or Project Manager in the preparation of project specific documentation and in the delivery of project works.

**07.05.** Notwithstanding any Consultant's particular discipline or area of responsibility, each Consultant and/or designer shall consider the document in its entirety. The complete CBRM consists of the following Sections which may be referred to within this Section:

Campus and Building Requirements Manual	
<b>Section 01</b>	General Requirements
<b>Section 02</b>	Architectural Requirements
<b>Section 03</b>	Roads, Car Parking & Civil Works
<b>Section 04</b>	Soft Landscaping
<b>Section 05</b>	Roofing, Roof Fabric & Roof Safety
<b>Section 06</b>	Building Management Systems
<b>Section 07</b>	Electrical Services
<b>Section 08</b>	Fire Protection Systems
<b>Section 09</b>	Hydraulic Systems
<b>Section 10</b>	Mechanical Services
<b>Section 11</b>	Lifts, Cranes & Vertical Transportation Systems
<b>Section 12</b>	Security, CCTV & Access Control

## Scope

07.06. This section of the CBRM addresses the following electrical services:

### Inclusions

- Liaison with electrical supply authorities
- High voltage where applicable
- Power supplies, consumers mains and sub mains
- Earthing
- Electrical safety
- Switchboards
- General light and power
- Lighting and lighting controls
- Emergency lighting
- Metering and energy management
- Electrical “green” initiatives
- Emergency back-up power and UPS equipment
- Co-generation and tri-generation advice
- Variable speed drives
- Electro-magnetic compatibility (EMC) compliance
- Power factor correction (PFC)
- Lightning and surge protection

## Exclusions

- Emergency warning and communication systems
- Datacoms
- Fire alarms
- Electronic security and access control
- CCTV
- Audio visual systems

## Electrical Design Guide

### Overview

**07.07.** The Facilities and Services Division (F&S or the Division) is required to maintain an overview of the electrical services installed on all campuses, buildings, structures and facilities owned and managed by the ANU in the various states and localities of Australia.

**07.08.** Consultants, Designers or Project Managers who are engaged by the ANU to produce project documentation may use the [ANU General Electrical Specification](#) if appropriate or alternatively provide a project specific electrical specification incorporating all the ANU's requirements as identified in the CBRM.

### Standards and Codes

**07.09.** For all new facilities, particular attention shall be paid to the design and selection of appropriate electrical plant, equipment and systems which shall be tested, commissioned, maintained and serviced in accordance with relevant Codes and Standards. Reference shall also be made to the latest issue of relevant Australian Standards, Codes of Practice, Local Authority regulations, Acts and the like. If there is no relevant Australian Standard then reference shall be made to ISO/BS/ANSI/ASTM standards.

**07.010.** For electrical services associated with buildings under refurbishment, the plant and equipment (where replaced) will be selected to meet the optimum design performance parameters. The Consultant will determine whether compliance with the National Construction Code (NCC), and specifically the energy efficiency requirements of Section J of the NCC, in full or part is required. The Codes and Standards to be followed will be as for plant in new buildings.

### The Sites - Electrical Reticulation

**07.011. Acton campus, Canberra ACT:** Expansion of the Acton campus beyond its original site boundary has resulted in multiple electrical connection/disconnection points provided by the supply authority, ActewAGL.

**07.012.** A large portion of the Acton campus is serviced from a network of interconnected 11 kV ring mains and 11kV/415V/240V 50 Hz substations originating from one bulk supply substation and back-up connections located on the campus boundaries. There are approximately 50 sole-use substations located on the campus. A single, high voltage monthly invoice is received by the

ANU for all the energy consumed by these substations. The ANU Acton campus HV network is owned and maintained by the local supply authority, ActewAGL.

**07.013.** Most of the HV reticulation is by underground cable but there are remnants of supply authority HV aerials. Note that there is also a section of ANU privately-owned HV equipment (used in scientific experiments) located at the Research School of Physics and Engineering (RSPE).

**07.014.** ANU acquisitions in recent years such as the School of Music and the School of Art are not on the ANU HV grid and are supplied via district substations. Similarly more recent acquisitions such as Unilodge and Student Accommodation 4 (SA4) are supplied from district substations. These facilities receive individual billing from the Electricity Retailer.

**07.015.** ANU staff and contractors CANNOT access HV equipment and substations without prior approval from ActewAGL.

**07.016.** Small off-site facilities such as North Oval take power from the local aerial reticulation.

**07.017. Paleomagnetic Laboratory, Black Mountain ACT:** Low voltage aerials are provided by the supply authority to an ANU point of attachment pole and meter box located at the ANU's site boundary.

**07.018. Mt Stromlo campus, Canberra ACT:** The RSAA Mt Stromlo facility takes LV power from a number of district substations and receives multiple electricity consumption invoices from the Electricity Retailer. There are also some commercial/government facilities on the Mt Stromlo site not connected with the ANU that are also serviced by the local supply authority. All HV aerials and substations are owned and maintained by the supply authority.

**07.019. Siding Spring Observatory (SSO), Coonabarabran NSW:** The SSO facility takes power from two district substations and receives multiple electricity invoices from the Electricity Retailer. All HV aerials and substations on the SSO site are owned and maintained by the supply authority.

**07.020. Other Sites:** Refer to the Principal's Representative (the Principal or the Principal's Project Manager) for details

### **Building Controls and Monitoring**

**07.021.** Refer to [Section.06 Building Management Systems](#).

### **Emergency Electrical Supplies and Uninterrupted Power Supplies**

**07.022.** The ANU has a large number of emergency power generator plants and Uninterrupted Power Supply (UPS) systems across the various operations. Emergency power and UPS provisions shall be discussed with the Principal's Representative as early as practical in the planning stage.

### **Emergency Alarm and Communication Systems**

**07.023.** [Refer to Section.08 Fire Protection Systems](#).

## Loading

**07.024.** Any proposed alterations to the electrical loads on a site shall be discussed with the Principal's Representative at the earliest opportunity. The Division has information on site loads and has equipment to do load measurements. It is important that the local reticulation has evenly balanced phases.

## Metering

**07.025.** As the ANU has a number of facilities located across various states, regional areas and local authorities, the metering requirements will need to be specifically tailored on a project by project basis. Accordingly, early discussion is necessary with the Principal's Representative to confirm project requirements.

**07.026.** The metering needs at the ANU will meet two basic requirements being:

- revenue collection; and
- energy management and energy monitoring.

## Revenue Collection

**07.027.** Typically a meter is required at the head end of an electrical installation. This is traditionally the supply authority meter that must be installed in accordance with the local requirements. Revenue collection metering however, does vary across the ANU facilities.

## Energy Management and Energy Monitoring

**07.028.** The ANU is committed to continuing improvements in energy efficiency and requires accurate energy consumption data to manage individual operations. The strategic direction is that sub meters shall be deployed. The minimum level of energy management metering required is as identified in the NCC. Where appropriate the ANU may wish to go beyond the NCC and this will be identified within the project brief.

**07.029.** The type of energy management metering required is detailed in [Section.06 Building Management Systems](#).

**07.030.** Electrical designers must make due allowance in their documentation for all the metering requirements on ANU projects. Particular emphasis shall be made for correct current transformer (CT) provisions, potential fuses, shorting out test blocks, spatial allocation for the required meters, connection of the meters to the Energy Management Systems (EMS) where appropriate and testing and commissioning of the entire metering system.

## Indoor Lighting

**07.031.** Indoor lighting shall be designed in accordance with the relevant sections of *AS 1680 Interior and workplace lighting (Lighting Code)*. Energy efficiency measures shall be in accordance with the NCC Section J.

**07.032.** Emergency evacuation lighting shall be provided in accordance with the requirements of *AS 2293 Emergency evacuation lighting for buildings*. Fixtures shall be the LED single point type. Refer to [ANU General Electrical Specification](#) for further details.

**07.033.** Luminaires considered in the design shall be energy efficient, robust in construction and be installed in locations that are easy to maintain without the need for sophisticated access equipment. All luminaires and internal components shall have approval for use in Australia. Where diffusers are used they shall be tight fitting and be appropriately IP rated to prevent the ingress of dust and insects.

**07.034.** The illumination levels as recommended in AS 1680 for various applications such as offices, educational, workshops and laboratories shall be adopted. Glare and veiling reflections where considered a problem shall be accommodated in the design.

**07.035.** Lighting designers are encouraged to include the use of LED type lighting in lieu of traditional forms of lamp technology. Proposals shall be submitted at the Preliminary Sketch Plan (PSP) stage.

**07.036.** Lighting designers proposing luminaires fitted with linear or compact fluorescent lamps (CFL) shall consider single lamp technology with high efficiency internal reflectors. Inefficient incandescent or low-voltage dichroic lamps shall not be used.

**07.037.** The ANU has standardised on lamp colour temperature and unless otherwise indicated this shall be 4000 K with a colour rendering index (CRI) between Ra 80-90.

**07.038.** Energy management lighting control systems shall be considered for major and minor lighting installations such as:

- proximity/motion detectors in offices teamed with local switches;
- proximity/time controls for corridor, egress and entry paths;
- after hours controls;
- daylight harvesting;
- automatic dimming systems;
- individual control of lighting near perimeter windows;
- time switches; and
- proprietary lighting BMS.

**07.039.** Lighting controls shall be determined on a project-by-project basis after discussion with the Principal's Representative.

**07.040.** Lighting designs for lecture theatres, large conference rooms may require integration with audio visual systems. Refer to the Principal's Representative for details.

**07.041.** Lighting designers shall submit brochures of all proposed luminaires and lighting controls at the PSP or the Final Sketch Plan (FSP) stage.

## Outdoor Lighting

**07.042.** Outdoor lighting is segregated into the following categories:

- footpath, cycleway lighting;

- road lighting;
- pedestrian crossings;
- car park lighting including disabled access;
- fixed lighting to buildings;
- architectural, feature, sports, signage, CCTV and landscape lighting;
- special application lighting for sensitive areas such as Observatories etc.; and
- public activity areas.

**07.043.** As the ANU has diverse applications for exterior lighting, early discussion with the Principal's Representative will provide further guidance to the designer on the best approach for a particular application.

**07.044.** Outdoor lighting where applicable shall comply with the various sections of *AS 1158 Lighting for roads and public spaces*. In addition the design guide principles as identified in *AS 4282 Control of the obtrusive effects of outdoor lighting* shall also be followed.

**07.045.** For sports lighting, the relevant sections of *AS 2560 Sports Lighting* are applicable.

**07.046.** Lighting designers should also be aware of the [National Capital Authority Outdoor Lighting Policy](#) where large areas of the ACT are now located in a designated area requiring the application of specific lighting design principles

**07.047.** Luminaires installed in external environments shall be sealed to prevent the entry of water, dust and insects and shall be rated at IP65. Lamps shall have a colour temperature of 4000 K. Colour rendering shall be CRI Ra 80-90. Luminaires shall be selected to minimise light pollution above the horizontal plane. Outdoor lighting shall be of the LED type.

**07.048.** External lighting shall in general be automatic in operation and be controlled by either a central photo-electrical cell or a Building Management System (BMS) if one is available. For most operations at the Acton campus, exterior lighting is controlled by a signal from the BMS linked to a photoelectric cell (PE Cell). Switchboards shall incorporate override switches so that external lighting can be tested during business hours.

**07.049.** Lighting columns where used shall be galvanised tapered steel with a hand hole at the base. There may be a requirement for columns and associated luminaires to be painted a specific colour. Columns shall be flange mounted with rag bolt footing assembly. Columns shall be engineer-designed for the particular soil, terrain and wind conditions. A Residual Current Device (RCD) breaker shall be installed in the hand hole at every column. Column heights and the general configuration of the column (i.e. outreach arms) shall be discussed with the Principal's Representative. All columns shall be fitted with a column number label obtained from the Principal's Representative.

**07.050.** In some circumstances it may be appropriate to consider stand-alone solar powered lighting with back up batteries; however any proposals like this shall be discussed with the Principal's Representative.

### Footpath and Cycleway Lighting

07.051. Footpath and cycleway lighting shall be designed to meet the P2 performance category as described in AS 1158.

07.052. Where footpath and cycleway lighting is required to be mounted on columns, column height shall generally be 5.0 m above ground.

### Road Lighting

07.053. The ANU has numerous campuses and facilities with significant variations in road configuration and traffic density. Prior to commencing any design work, lighting designers shall contact the Principal's Representative to establish the design parameters for the particular road.

### Pedestrian Crossings

07.054. Lighting for pedestrian crossing shall be designed to meet the requirement of AS 1158.

07.055. The lighting designer shall make a recommendation for the lighting category based on the operational specifics for the road.

### Outdoor Car Park Lighting

07.056. Outdoor car park lighting shall be designed to meet the P11c performance category as described in AS 1158.

07.057. Parking spaces intended to be used by people with disabilities shall comply with P12.

07.058. Where car park lighting is required to be mounted on columns, column height and column configuration shall be discussed with the Principal's Representative. Generally luminaire heights for car park lighting should be in the order of 6.5 m

### Fixed Outdoor Lighting to Buildings

07.059. The selection of external luminaires located on building facades should be under the control of the Consultant. The Consultant shall seek approval from the Principal's Representative and submit luminaire brochures for approval at an appropriate point such as the PSP or FSP stage. Luminaires shall be low maintenance, of robust construction, have IP ratings as previously identified and be installed in readily serviceable locations. Diffusers if provided shall be glass rather than acrylic or polycarbonate.

### Architectural, Feature, Sports, Signage, CCTV, Public Space Lighting

07.060. These are all specialised areas and where required, further advice should be sought from the Principal's Representative prior to commencement of work. The use of low-height bollard luminaires and step lights is not supported due to maintenance issues.

### Special Applications - Observatories

07.061. The ANU maintains deep space observation facilities at Mt Stromlo, ACT and Coonabarabran, NSW. Outdoor lighting to these facilities will need special consideration. Lighting designers shall make reference to AS 4282.

### Telephone and Data Communication Cabling

07.062. The ANU Information Technology Services (ITS) is responsible for all matters pertaining to telephone and data services at the ANU. The Principal's Representative is responsible for ANU ITS input for the Project.

07.063. Because of the commonality with electrical and datacom services, designers are required to liaise with the Principal's Representative in the planning and design of these services.

07.064. The ANU ITS [Cabling Specifications](#) should be access in all cases for guidance on the specification and installation requirements for data cabling.

### Power Factor Correction

07.065. Where a new construction project is planned, Consultants will be required to include for adequate power factor equipment to ensure that the installation will operate at a lagging power factor not below 0.98. PFC equipment shall have high level communication capability to provide status output to the ANU BMS. Proposed power factor equipment shall be discussed with the Principal's Representative during the early design stage. Power factor associated with mechanical plant shall also be addressed.

### Surge Protection

07.066. All new main switchboards or existing main switchboards subject to major changes shall be fitted with surge protection devices. Refer to [ANU General Electrical Specification](#) for further details.

### Lightning Protection

07.067. Consultants shall seek confirmation from the Principal's Representative if their commission extends to providing lightning protection risk assessment advice and subsequent lightning protection design.

07.068. If it is deemed that lightning protection is required for the project, it shall be designed and installed in accordance with the requirements of *AS 1768 Lightning protection*.

### Solar Voltaic Arrays

07.069. Consultants involved in the design and specification of solar voltaic arrays shall discuss proposals with the Principal's Representative at the early planning stage before proceeding with the design.