Australian Government

Department of Defence

MANUAL OF INFRASTRUCTURE ENGINEERING – ELECTRICAL

EDITION 2

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3 https://www.legislation.gov.au/Series/C2004A03712
4 http://drnet/AssociateSecretary/security/policy/Pages/dspf.aspx

Enquiries and Amendments:

For further clarification of matters outlined in this Manual or proposals for amendment, contact the Electrical Engineering Section.

AMENDMENTS

Amendment number	Amendment	Amendment type	Effective date

CONTENTS

CHAPTER 1
Framework

This manual

1.1 The Secretary and the Chief of the Defence Force are committed to ensuring that appropriate levels of electrical infrastructure compliance and conformance are achieved for the *Defence Estate*. Achieving compliance and conformance across the *Defence Estate* is technically complex and requires the involvement and oversight of skilled practitioners in electrical engineering.

1.2 The Manual of Infrastructure Electrical Engineering (MIEE) specifies the *compliance* and *conformance requirements* for *Defence Estate* for the protection of Defence personnel and assets in support of Australian Defence objectives.

1.3 This chapter describes the policy framework of the MIEE.

Rationale

1.4 The rationale of this policy is to:

a. reinforce the requirement that electrical installations and infrastructure work on the *Defence Estate* must comply with the State and Territory Legislation and Regulations for electrical works and all relevant Defence policies;

b. align the administrative requirements for electrical installations and infrastructure on the *Defence Estate* to State and Territory Legislation and Regulations for electrical works as much as practicable; and

c. ensure systems are enabled to support Defence operations at sufficient levels including at degraded states.

Expected outcomes

1.5 *Defence electrical distribution systems* and *electrical installations* will comply with State and Territory Legislation and Regulations for electrical works, AS/NZS3000– Wiring Rules and all other Defence policies applicable to *Defence electrical distribution systems*.

1.6 *Defence electrical distribution systems* and *electrical installations* supports Defence capability in defined operating conditions including both normal and abnormal conditions and in a physically and cyber contested environment.

Policy statement

1.7 The Secretary and the Chief of the Defence Force prescribe the Defence framework for *electrical installations* and infrastructure in this manual.

1.8 The Secretary and the Chief of the Defence Force require Defence personnel, and contractors, consultants and outsourced service providers – where it is a term of their contract – to comply with the requirements of the following:

a. State and Territory Legislation and Regulations for electrical works; and

b. applicable Defence policies related to electrical installations and infrastructure.

1.9 The MIEE also provides the procedural framework for involving appropriately skilled practitioners and prescribed levels of oversight to meet Defence's regulatory obligations.

Key roles, functions and responsibilities

1.10 The Director of Estate Engineering Policy (*DEEP*) is responsible for administration of this policy. This includes responsibility for ensuring the manual remains current and for monitoring the implementation of the requirements described in the manual.

1.11 This manual will be reviewed within five years from its date of issue. A review may occur sooner to ensure it continues to meet the intended policy outcome/s. The Policy Owner is authorised to approve amendments. Minor amendments may be approved by the Assistant Secretary Environment and Engineering Branch (ASEE).

1.12 The *Delivery Authority* is responsible for implementation of the requirements of this manual and for ensuring *delivery agents* provide evidence of *compliance* and *conformance* with the provisions herein.

1.13 The *Operations Authority* has the responsibility and authority for ensuring acceptance, energisation and the ongoing operation is in accordance with the provisions herein.

1.14 The *Maintenance Authority* has the responsibility and authority for ensuring maintenance is in accordance with the provisions herein.

Annexes:

1A Definitions
1B Acronyms and Abbreviations
1C Related Documents

ANNEX 1A

Definitions

The following list of terms are defined in Defence Instruction – Administrative policy. The definitions are intended to apply to their use in administrative policy framework documents:

- Accountable officer
- Administrative policy
- Australian Public Service employee
- Commander
- A person/s engaged under a contract
- Defence
- Defence civilian
- Defence locally engaged employee
- Defence member
- Defence personnel
- Defence-wide administrative policy framework document
- Framework documents
- Manager
- Period of effect
- Policy domain
- Policy owner
- Supervisor

For the purpose of the policies described in this document, the following defined terms apply and are printed in italics throughout the document. Further definitions related to the MIEE and supporting Guidelines are included in Guideline 002 – MIEE Definitions.

Accreditation. A permission accepted by or given by a State or Territory to a person which allows them to lawfully provide services or carry out work in their area of practice and includes occupational registration or licensing as required in the State or Territory where the work is being performed.

Availability. The percentage of time a system is available to operate satisfactorily when required to do so. Calculated over a year, or otherwise agreed timescale, as

$$\frac{(\text{the period a system is able to provide the service function it is intended to})}{(\text{the period a system is required to provide the service function it is intended to})}$$

Where a system is not required to operate at all times the required time to operate excludes the periods it is not required to operate, for example, streetlighting systems would exclude daylight hours from the period the system is required to provide the service function.

For example – a Central Power System is required to supply power to a base at a given capacity at all times with an *Availability* of 99.99%. This would mean the system must be able to supply that capacity for 99.99% of a year or, alternatively, be not available for no more than approximately 52.60 minutes over a given year.

Building. Includes a structure and unless the term ‘entire building’ is used, includes a part of a building.

Capability Manager. The Capability Managers for Defence are:

a. the Chief of Army – Land Capability;

b. the Chief of Navy – Maritime Capability;

c. the Chief of Air Force – Aerospace Capability;

d. the Chief Joint Capability Group – Joint Capability; and

e. Deputy Secretary Strategic Policy & Intelligence – Strategic Intelligence and Cyber Programs and Geospatial Intelligence and Information and Services.

Certificate of completion. Certificate issued by a *building surveyor* indicating that a *building* is *substantially complete* and occupancy of the *building* associated with the *building approval* is permissible.

Competent and experienced person. A *competent and experienced person* will have been assessed by the *Delivery Agent* for the work as competent and experienced to practice in the area of the services been delivered because of the individual's skill, experience and qualifications. The *competent and experienced person* must:

1. Where registration / accreditation / licencing is available or is required, be registered / accredited / licenced in the relevant area of practice by the body in the State or Territory where the work is to be undertaken.

2. For engineering practitioners where registration / accreditation / licence for the area of practice is not available in the State or Territory where the work is to be undertaken:

    a. hold appropriate registration / accreditation in the relevant area of practice in another Australian State or Territory; or

    b. comply with the requirements as a Registered Professional Engineer (RPEng) as provided by an appropriate Professional Engineers Body.

Compliance. Meeting the requirements of the National Construction Code, the *Wiring Rules* and relevant standards and legislation.

Conformance. Meeting the requirements set out in relevant Defence policy and related documents.

Contribution Factor (CF). Refers to a facility's importance to Defence capability. It is measured on a scale of 1 to 5, with 1 being the greatest rating. Refer to the Guidelines for Contribution Factor Forms located at the Building Works page of the Defence Estate Quality Management System (DEQMS) website for further information.

Construction Agent. The party responsible for delivering Construction Phase activities including all activities related to Fabrication, Construction and Installation and Testing and Commissioning of new or modified plant and equipment and, where applicable, demolition and removal of plant upon the *Defence Estate*.

Controller. The device used to automatically process data and control equipment based upon programmable algorithms as either firmware or software (e.g. PLC)

Defence Electrical Distribution Systems. The Defence electrical distribution system is defined as an electrical power distribution system that is owned, operated and/or maintained by Defence. Refer Chapter 7 for extent of these systems

Defence Estate. Commonwealth owned land managed by the Department of Defence.

Defence Project Manager. The Defence *Project Officer* or staff member who is responsible for procuring and managing the delivery of an estate product.

Defence Project Sponsor. The Defence staff member who is representing the business unit, i.e. the branch or directorate, responsible for delivering an estate product.

Delivery Agent. The agent engaged by Defence responsible for implementation of the requirements of this Manual and for ensuring contractors, consultants and outsourced service providers provide evidence of compliance with the provisions therein. Examples, PMCA, MC, PDS

Delivery Authority. The Defence Agency / Directorate responsible for the delivery of the *Project*.

Design. The intent of the works to be installed by the *Construction Agent* in a *Project.*

Design Verification. The review of the *Design*.

Designer. The party engaged to perform a *Design* function for Defence for a given *Project*.

Director of Estate Engineering Policy (DEEP). *DEEP* is responsible for administration of this policy. This includes responsibility for ensuring the Manual remains current and for monitoring the implementation of the requirements described in the Manual.

Dispensation. An approved variation to Defence policy requirements.

Distortion (individual). Ratio between the RMS value of an nth order harmonic and the RMS value of the fundamental.

Distribution Substation. A substation used to directly supply loads (typically at 400/230V) consisting of facilities or processes. The distribution substation typically consists of the following major components: RMU, Transformer and LV Switchboard. However either or both of the RMU or LV switchboard can be located remote to the substation.

Electrical Infrastructure. All electrical equipment on Defence Estate including *Defence electrical distribution systems* and systems within Defence facilities.

Electrical Installation. As defined by the AS/NZS 3000 – Electrical installations “Wiring Rules”.

Electrical Operating Authority / Network Controller. The agent responsible for the compliance and operational performance of *Defence Electrical Distribution Networks* and *electrical installations* and its systems.

Electrical Maintenance Authority. The maintenance agent responsible for compliant maintenance outcomes for the *Defence Electrical Distribution Network* and its systems.

Estate product. The major Security and Infrastructure Group (SEG) planning, delivery and sustainment products which together manage, maintain and upgrade the *Defence Estate* (e.g. Initial Business Case, Designs, Estate Works Program, Disposals).

Failure Rate. The number of failures of an item per unit measure of life, where life is expressed cycles, time, events, etc., as applicable for the item.

Garrison and Estate Management System (GEMS). *GEMS* is a single, integrated system to manage the *Defence Estate* and service delivery, and support the Defence Estate Life Cycle. *GEMS* provides a single source of information for all estate management activities.

Generator Control System (GCS) Station. The master *controller* in the GCS Controller network. It performs overall power station coordination functions.

Harmonic Analysis. Harmonic Analysis is the determination of the harmonic content of the load or supply.

Harmonic Distortion (total) THD. Ratio between the RMS value of all harmonics of a non-sinusoidal alternating periodic value and that of the fundamental.

Harmonics. Distortions of the sine wave that characterises normal AC current. Harmonics are transmitted into an AC line by non-linear loads (i.e., loads that do not draw power in regular sine waves), such as computers, copiers, FAX machines, and variable-speed motors. Harmonics can cause communication errors and equipment damage.

HV Feeders. HV cabling from the NSP to the Defence establishment ISS.

HV Rings. HV cabling on the Defence establishment on which substations and switching stations are connected, but not the Feeders or Interconnectors.

HV Switchroom. Normally an indoor arrangement provided for HV circuit breakers and HV switchgear panels

Indoor Substations. Substations where the various major components are housed within a building, either as a freestanding structure or part of a larger structure.

Interconnector. A direct intertie HV power cable connection between two (2) PSSs or PSS/ISS/CEPS, that facilitates power flow used to transfer power between them.

Intake Substation. Substation that form part of the primary electrical distribution system, to which Incomers and Interconnectors are connected and at which the intake voltage is stepped down to the distribution voltage.

Intake Switching Station. see *Primary Switching Station*.

Kiosk Substations. Stand alone, freestanding substations, where the various major components are housed within a metal or composite enclosure. This form of construction is limited to distribution substations.

Legislation and Regulations. See Statutory Requirements

Low Voltage (LV). As defined in AS/NZS3000.

Maintainability. The ability to retain and restore an item to its functional state when maintenance is performed under stated conditions and using prescribed procedures and resources. Measures include probability to repair within a given time, repair rate, and mean time to repair.

Maintenance Agent. The agent responsible to the Defence Maintenance Authority for the provision of maintenance services for the electrical installation or system.

Maintenance Authority. The Defence Agency accountable for the maintenance of the specific electrical installation or system.

Motor-Generator (M-G). Power systems that use a rotating AC generator to generate the needed output power. A motor-generator that is powered by a battery or a diesel or gas-powered engine when utility power is lost, constitutes a rotary or hybrid UPS.

Network Service Provider (NSP). The owner and operator of the assets used to provide mains power in the locality where the Defence establishment is located.

Objective. The primary recordkeeping system for Defence.

On-Line UPS. An UPS that continuously powers the load from the inverter under normal operation.

Operations Agent. The agent responsible to the Defence Operations Authority for the provision of operations services for the electrical installation or system.

Operations Authority. The Defence Agency responsible for the operation of the specific electrical installation or system.

Outdoor Substations. Substations where the various major components are outdoors without further enclosure.

Performance Solution. A performance solution is a designed solution which meets the performance requirements of this Manual, the Manual of Fire Protection Engineering and/or the National Construction Code. Performance solutions must be demonstrated using approved assessment methods to meet the requirements. Importantly performance solutions are not a dispensation.

Point of Supply. (see AS/NZS 60038) The point where the distribution system of the NSP and the electrical system of the customer are connected.

Policy contact. The nominated contact of the directorate responsible for the policy is listed on the Legislation & Policy page on DEQMS.

Power Factor. The power factor is the mathematical relationship between apparent or effective power, measured in kVA, and real or average power, measured in kW. When the current and voltage are in phase, purely resistive load, the power factor is 1. In a purely reactive load in which voltage and current are 90° out of phase, the power factor is 0.

Power Failure. See AS 62040.3

Project. Common industry term for *Estate Product*. Any activity (or series of activities) including the planning, design, construction, commissioning and decommissioning of any works that are performed in relation to an *Estate Product* providing new infrastructure or replacing existing infrastructure.

Primary Network. The Defence HV networks comprising the incoming supply from the NSP, the ISS or PSS and CEPS, CPS, CEP, CPCS and interconnectors

Primary Power. See AS 62040.3

Primary Switching Station. Are switching stations/substation that form part of the primary electrical distribution system, to which Incomers and Interconnectors are connected.

Project Delivery Agent. See *Delivery Agent*

Project Delivery Authority. See *Delivery Authority*

Recommended. Desirable but not mandatory. Similar to *'should'*.

Redundancy. Refers to the duplication of systems or components such that, in the event of a failure of one of more components, the system is able provide the equivalent service.

Related persons. Defence considers that multiple service personnel occupying a building are related for the purposes of determining the requirements for sole-occupancy units under the NCC.

Reliability. The probability that an item will perform as intended for a specified period of time under a stated set of conditions. Usually measured as a probability, a failure rate, or a mean time between failures.

Resonance. Resonance results in voltage surges and transients of several times the supply voltage. PFC connected to a supply can cause resonance between the supply and the PFC capacitors or between other equipment and the PFC capacitors.

Ring Main Unit (RMU). *RMU*, compartmentalised HV switching/protection panels normally switch/fuse switch disconnector unit. Switchgear normally used at substations

Sag. A low-voltage condition in which the voltage on one or more phases of AC power falls below 80 to 85 percent of the nominal value for more than one cycle (1/50th of a second for 50-cycle AC). Can be caused by ground faults, starting large loads, inadequate power supply, utility switching, utility equipment failure, and lightning. Can cause computer crashes and damage equipment.

Statutory Requirements. Commonwealth, State and Territory Legislation, Regulations, Codes, Guidelines, Directives, Standards, etc applicable to the works or operations been undertaken.

Should. Desirable but not mandatory. Similar to *'recommended'*.

Standby Power. See AS 62040

Static Bypass. See AS 62040

Static Switch. Synchronous Bypass Facility. The combination static (semiconductor) and electromagnetic switch that bypasses the UPS to connect the critical load to the bypass power source.

Substation (SS). A facility in the electrical distribution system at which voltage transformation occurs, i.e. the voltage is changed from one voltage to another. The typical substation generally comprises as a minimum a power transformer. Substations may also include the associated switchboards, however either or both of these can be located remotely.

Surge. A high voltage condition in which the voltage on one or more phases of AC power exceeds 100 percent of the nominal value for more than one cycle (1/50th of a second for 50-cycle AC). Can be caused by a rapid load reduction or switching, and can damage equipment.

Switching Station (SWS). A facility in the electrical distribution system that is specifically designed for electrical switching. Normally housing HV RMUs.

Systems Project Office (SPO). Defence agency responsible for the engineering integrity of aircraft systems, subsystems and interfaces

Thermal Runaway. A condition that is caused by a battery charging current that produces more internal heat than the battery can dissipate. This condition ultimately causes cell venting and premature failure.

Transients. Disturbances to electrical power lasting less than one cycle (1/50th of a second for 50-cycle AC). Also referred to as voltage spikes. Can be caused by lightning strikes, sudden load-shedding on the primary power system, and shutdown of equipment that was drawing an extremely large amount of power, or a general rise in voltage on the primary power system after use by a large number of consumers. Voltage spikes can blow fuses or trigger circuit breakers, destroy electronic circuitry, and corrupt stored data.

Uninterruptible Power System (UPS). Refer to AS 62640, an electrical device or system providing an interface between the mains power supply and sensitive loads (computer systems, instrumentation, etc.). The *UPS* supplies sinusoidal AC power free of disturbances and within strict amplitude and frequency tolerances. If input power is removed from the *UPS*, it will continue to supply the load without interruption.

UPS, Rotary. An UPS in which a Motor-Generator (M-G) set is used.

UPS, Static. A solid-state UPS relying normally on battery power.

Useful Life (battery). The time over which a battery can deliver a useful amount of power (normally defined as 80 percent or more of the battery’s capacity).

Wiring Rules. AS/NZS 3000 – Electrical installations (known as the Australian and New Zealand Wiring Rules) as applicable at the time.

ANNEX 1B

Acronyms and abbreviations

AC	Alternating Current
ADRM	Airworthiness Design Requirements Manual
AEMC	Australian Energy Market Commission
AEMO	Australian Energy Market Operator
AER	Australian Energy Regulator
AGL	Aeronautical Ground Lighting
AGLCS	Aeronautical Ground Lighting Control System
AGLMA	Aeronautical Ground Lighting Maintenance Agent
ALER	Airfield Lighting Equipment Room
AS	Australian Standard
AS/NZS	Australian and New Zealand Standard
ASEE	Assistant Secretary Environment and Engineering
ATC	Air Traffic Control
AVRM	Aviation Risk Management
BMS	Building Management System. Building automation system used to control and monitor building services
CB	Circuit Breaker
CDR	Concept Design Report – 30% design
CCR	Constant Current Regulator
CEP	Central Energy Plant. A centralised power station used to offset power purchases from the grid.
CEPS	Central Emergency Power Station.
CFI	Capital Facilities & Infrastructure Branch
CPCS	Central Power Conversion System
CPS	Central Power Station.
CF	Contribution Factor
CTAF	Common Traffic Advisory Frequency
DC	Direct Current
DDR	Detailed Design Report – 90% design
DEEP	Directorate of Estate Engineering Policy
DEIS	Defence Estate Information System
DEMS-FM	Defence Estate Management System - Facilities Management
DEOS	Directorate of Explosive Ordnance Services
DESN	Defence Engineering Services Network.

DOS	Directorate of Ordnance Safety
DEQMS	Defence Estate Quality Management System
DRUPS	Diesel Rotary Uninterruptable Power System
SEG	Security and Estate Group
eDEOP101	Defence Explosive Ordnance Regulations
EDP	Electrical Development Plan
EE	Environment & Engineering Branch
EGIS	Estate Governance and Integrity System
ELV	Extra Low Voltage.
EMOS	Estate Maintenance and Operation Services
EMP	Electrical Master Plan
ENA	Australian Energy Network Association
ENST	Electrical Network Status Report
EO	Explosive Ordnance
ERIK	Estate Record and Information Kiosk
FAA	Federal Aviation Authority
FDB/FRB	Functional Design Brief / Functional Requirements Brief
FDR	Final Design Report – 100% design
FQCC	Fuel Quality Control Centre
GEMS	Garrison and Estate Management System
GCB	Generator Circuit Breaker
GCS	Generator Control System.
GTE	Ground Telecommunication Equipment
HAZAN	Hazard Analysis
HAZOP	Hazard Operability
HIE-A	Handbook of Infrastructure Engineering - Aerodromes
HMI	Human-Machine Interface.
HOTO	Hand Over Take Over
HV	High Voltage: Above 1000V AC or 1500V DC.
ID	Infrastructure Division – a Division of SEG
ICAO	International Civil Aviation Organization
IEC	International Electrotechnical Commission
ISM	Information Security Manual
ISS	Intake Switching Station or Intake Substation as appropriate.
LEG:	Local Emergency Generator
LV	Low Voltage

MEPS	Minimum Energy Performance Standard
MFPE	Manual of Fire Protection Engineering.
MIEE	Manual of Infrastructure Electrical Engineering (this Manual)
MGLB	Mobile Generator Link Box
NATA	National Association of Testing Authorities
NBPS	No Break Power Supply
NCC	National Construction Code
NZS	New Zealand Standard
NEC	Neutral earthing contactor
NEM	National Electricity Market
NER	National Electricity Rules
NSP	Network Service Provider
NVIS	Night Vision Imaging System
OLA	Ordinance Loading Apron or Area
PALC	Pilot Activated Lighting Control
PAPI	Precision Approach Slope Indicator
PCMS	Power Control and Monitoring System
PELV	Protected Extra Low Voltage in accordance with AS/NZS 3000
PLC	Programmable Logic Controller.
PSS	Primary Switching Station / Primary Substation as appropriate
PVC	Polyvinyl Chloride
RMU	Remote Terminal Unit
RCD	Residual Current Device
SCADA	Supervisory Control and Data Acquisition
SELV	Separated Extra Low Voltage in accordance with AS/NZS 3000
SDR	Schematic Design Report – 50% design
SEG	Security and Estate Group
SIT	Series Isolation Transformer
UFC	United Facilities Criteria
UPS	Uninterruptible Power Supply
VHF	Very High Frequency
WAE	Works As Executed

ANNEX 1C

Related documents

1. Estate Engineering Governance and Integrity System (EEGIS) referenced documents.
2. Electronic Defence Explosive Ordnance Publication 101 (eDEOP 101)
3. Manual of Fire Protection Engineering (MFPE)
4. Commonwealth Workplace Health and Safety (WHS) Act 2011 and regulations
5. Environment Protection and Biodiversity Conservation (EPBC) Act 1999
6. Environment and Heritage Manual (EHM)
7. Pollution Prevention Management Manual (PPMM)
8. Defence Training Area Management Manual (DTAMM)
9. Defence Assistance to the Civil Community Manual (DACC)
10. Defence Security Manual (eDSM)
11. State and Territory electrical safety legislation and regulations
12. AS/NZS 3000:2018 – Electrical Installations “Wiring Rules”
13. Fuel Service Branch - DFI Design Practices Manual
14. Defence Communications Cabling Standard
15. MIEE Guideline 001 – MIEE Technical Guidelines, including the guidelines it references
16. MIEE Guideline 002 – MIEE Definitions

CHAPTER 2
Application

Aim

2.1 The aim of this chapter is to detail out where, how and when this Manual will apply across the *Defence Estate*.

References

2.2 Reference is necessary to the following documents:

a. Documents adopted by reference in the State and Territory in which the work is being conducted;

b. Defence Policies and referenced standards and codes; and

c. Guidelines referenced in this policy.

Application

2.3 The requirements of this Manual apply across the *Defence Estate*:

a. Where new facilities or infrastructure are to be constructed;

b. Where existing facilities or infrastructure are to be refurbished, altered or additions made;

c. In the operation of existing installations and infrastructure; and

d. In the maintenance of existing installations and infrastructure.

Leased premises

2.4 Where leased premises are classified as having a contribution factor of CF1 or CF2, serious consideration to the application of this Manual shall be given. Any decision to not apply the requirements of this Manual in any such cases shall only be with the written consent of the appropriate *Capability Manager*.

2.5 Where Defence lease facilities to third parties, any modifications to those facilities by the third party shall be in accordance with this Manual.

Joint use facilities

2.6 Joint use facilities located on Defence establishments in the Australian Territory are required to comply fully with all applicable Australian Legislation and Regulations. This includes the applicable State and Territory electrical safety requirements for the jurisdiction in question. The requirements of this Manual *should* also be applied.

Foreign facilities at Defence establishments

2.7 Foreign facilities located on Defence establishments in the Australian Territory are required to comply fully with all applicable Australian Legislation and Regulations. This includes the applicable State and Territory electrical safety requirements for the jurisdiction in question.

Facilities designed outside Australia

2.8 It is *recommended* that where facilities are designed outside Australia, that the project engages Australian design assistance early in the project to ensure that the installation will meet applicable Australian Legislation and Regulations, including mandatory Australian Standards.

Overseas bases / facilities

2.9 Facilities located overseas shall comply fully with local statutory requirements, standards, and codes.

2.10 *Capability Managers* or *Project Sponsors* may elect to apply the requirements of this Manual, in part or in full, to overseas bases or facilities as they consider appropriate, subject to compliance with paragraph 2.9.

Temporary facilities or works

2.11 Where works of a temporary nature are to be undertaken, the specific requirements of this Manual may not necessarily be applicable. A lower standard can be applied to temporary works required during the period of construction of a project where:

a. This offers significant cost / time savings for these temporary works;

b. The temporary works meet the applicable statutory standards; and

c. Where this lower standard is accepted by the *Defence Electrical Operating Authority / Network Controller* for those works to the Defence electrical distribution networks and systems.

2.12 The temporary works are to be removed by the completion of the project.

2.13 Where the requirements of this Manual are not to be applied to any temporary facilities or works the Project Delivery Authority responsible for the delivery of the Temporary facility of work shall fully document the extent of the temporary works and justification for not applying any requirements of this Manual.

Retrospective application of this manual

2.14 This Manual is applicable to new works and installations and to the alteration, addition or augmentation of existing installations. There is no requirement to apply this Manual retrospectively to existing installations which are not otherwise being upgraded or have a change in operational requirements. In simple terms, if works are being undertaken on an installation they shall comply with this policy, however this policy alone does not warrant works to be undertaken.

CHAPTER 3
Fundamental principles

Aim

3.1 This Chapter sets out the Fundamental Principles applying to this Manual.

References

3.2 Reference is necessary to the following documents:

a. State and Territory Legislation and Regulations for electrical works;

b. ASNZ 3000 – Electrical installations “*Wiring Rules*”;

c. Defence Policies and referenced standards and codes;

d. Guideline 301 – Approval process for Alternative Performance Solutions; and

e. Guideline 302 – Approval process for Dispensations

Prime principle

3.3 The overall electrical engineering philosophy for Defence facilities and infrastructure is to enable and support the sustainment of capability via the provision, maintenance and renewal of electrical installations, systems and infrastructure that are regulatory compliant, safe, functional and fit for purpose, energy efficient and offering the optimum through life performance.

Hierarchy of application

3.4 This Manual fits in the hierarchy of application set out below in its application.

a. Commonwealth Legislation and subsequent regulations and their codes, standards and guidelines;

b. State and Territory applicable electrical legislation and their subsequent regulations and their codes, standards and guidelines and service installation and connection rules;

c. Australian Standards;

d. Defence & Military Standards, i.e. AAP, DEF(AUS), eDEOP;

e. This Manual;

f. ENA Guidelines, as and where applicable; and

g. International Standards, where applicable i.e. ISO, IEC.

3.5 Where there is a conflict between the above, the more stringent requirement shall apply.

Statutory requirements (legislation and regulations)

3.6 Defence electrical installations, systems and infrastructure shall first and foremost comply with all applicable *Statutory Requirements*;

a. Commonwealth Legislation and subsequent regulations and their codes, standards and guidelines; and

b. State and Territory electrical safety legislation and their subsequent regulations and their codes, standards and guidelines.

3.7 Advice from the Australian Government Solicitor is that the Commonwealth is bound to comply with the electrical safety laws of all States and Territories with the possible exception for Western Australia and the Australian Capital Territory. The Australian Government Solicitor considers that there are a number of sound practical reasons for the Commonwealth to also comply with the electrical safety laws of Western Australia and the Australian Capital Territory.

3.8 The Australian Government Solicitor *recommend*s that Defence comply with the electrical safety laws of all States and Territories.

AS/NZS 3000 - the wiring rules

3.9 Australian Standard AS/NZS 3000, known as the *Wiring Rules*, is the mandated Standard by all States and Territories for all electrical installation work within Australia. The most current edition of the *Wiring Rules* shall be applicable at all times, unless there is a *Statutory Requirement* otherwise.

3.10 Adherence to the *Wiring Rules* is mandatory for all Defence electrical works.

3.11 Any dispensations against the requirements of the Wiring Rules can only be provided by the State or Territory Electrical Regulator for the jurisdiction involved. Defence or the Commonwealth has no authority to provide any dispensation against the *Wiring Rules*.

Legislative conflicts with defence requirements

3.12 Where any difference is perceived between the requirements described within this Manual, and its Guidelines, and those defined in any Legislation and its subsequent regulations, codes, standards and guidelines, the requirements defined in the Legislation and its subsequent regulations, codes, standards and guidelines, shall take precedence. In any such instances the matter shall be bought to the attention of the Electrical Engineering Section

3.13 Where a *Statutory Requirement* conflicts with another Defence standard, the matter must be referred to the relevant Defence Technical Authority / Policy Owner for their resolution. Any such instances may also be bought to the attention of theElectrical Engineering Section.

3.14 Where *Statutory Requirements* or standards conflict, these must be referred to the appropriate regulatory authority for resolution. Where such conflict may involve the requirements of this Manual an information copy is be provided to the Electrical Engineering Section.

3.15 All such conflicting requirements shall be fully documented by *the Project Delivery Agen*t, the *Operations Agent* or the *Maintenance Agent* and shall contain a proposed course of action suitably argued with compensating factors clearly identified. Formal written Defence approval of any alternative performance solution proposal must be obtained at the earliest stage possible.

3.16 All regulatory advice and approvals including Defence approvals shall be included in the design reports, project files, asset and equipment inspection and maintenance activity documentation supplied and delivered to Defence. Where operations activities are affected, alternative and appropriate operating instructions shall be included in operations manuals and standard operating procedures supplied and delivered to Defence.

AS/NZS 3000 – wiring rules, compliance by specific design and installation

3.17 AS/NZS 3000 specifies at clause 1.9 the means for demonstrating compliance. Where electrical installations, due to their unusual requirements, cannot meet the relevant requirements of Part 2 of AS/NZS 3000, compliance by specific design and installation is permitted for Defence electrical installations.

3.18 The Assistant Secretary Environment and Engineering (ASEE) is the only authorised Defence authority to endorse formal letters of acknowledgement as required by the *Wiring Rules* for fixed electrical installations. Such letters of acknowledgement are to be supported by a fully justified Compliance by Specific Design and Installation Proposal. Guideline 1204 AGL Compliance by Specific Design provides guidance as to the preparation of a submission.

Dispensations against the requirements of the MIEE policy

3.19 This Manual sets out the fundamental principles for the provision of electrical services, installations and infrastructure for Defence. Where a non-compliance to the Defence specific policy requirements of the MIEE is sought, i.e. this Manual, a *Dispensation* is required.

3.20 The *Delivery Authority* or their delegated representative shall forward a formal request for *Dispensation* to ASEE through *DEEP*. Requests for Defence approval of *Dispensations* must use the approved template ‘Request for Dispensation’ available on DEQMS. A copy of any supported requests will be returned to the *Delivery Authority*. In the event of non-agreement, formal advice outlining the reasoning will be provided from the delegated representative to the *Delivery Authority*.

3.21 The development of *Dispensations* requires consultation with relevant stakeholders at the start of the *Dispensation* development process. The Electrical Engineering Section shall form part of the consultation process and sufficient time shall be made by the *Deliver Authority* to ensure the acknowledgment of the *Dispensation* before construction or installation begins.

3.22 The level of supporting information required for a *Dispensation* shall be agreed as part of the consultation process. As a minimum the request must clearly identify:

a. the *Delivery Authority* and their *Delivery Agent*;

b. the area of non-compliance (with specific reference to the appropriate section of the compliance document);

c. the reason for non-compliance;

d. the risk mitigation strategy including any compensating factors or alternatives proposed;

e. cost implications, where relevant, by comparison of the initial and whole of life costs of the MIEE provisions with those of the proposed design solutions;

f. operational implications, where relevant, by comparison of existing standard operating procedures with those of the proposed design solutions; and

g. copies of any technical opinions or reports sought shall be enclosed.

3.23 When required by the Electrical Engineering Section, the manager of the operational capability is to acknowledge and agree to the Dispensation request and the impact it may entail in writing.

3.24 Where this dispensation may increase or have the potential to increase the capability risk this shall be full documented for the *Capability Manager*. The responsible *Capability Manager* shall agree to and accept the increased capability risk in writing. This shall be submitted as part of the dispensation submission.

3.25 The *Delivery Authority* or their delegated representatives shall ensure that supported applications and supporting evidence are saved in *DEIS* prior to responsibility for the works being handed over to the relevant SEG region.

3.26 *Dispensations* shall not be issued retrospectively once construction or installation works has commenced or been completed.

Technical guidelines – Performance Solutions

3.27 The Technical Guidelines to this Manual provide solutions that are Deemed to Comply with the requirements of this Manual, and are Defence's preferred solution to meeting the requirements of this Manual. Where a project considers it is unable to meet the requirements of this Manual's Technical Guideline a *Performance Solution* may be proposed.

3.28 The *Delivery Authority* or their delegated representative shall forward a formal request for a *Performance Solution* to *DEEP*. Requests for Defence approval of an *Performance Solution* must use the approved template available on DEQMS. A copy of any supported requests will be returned to the *Delivery Authority*. In the event of non-agreement, formal advice outlining the reasoning will be provided from the delegated representative to the *Delivery Authority.*

3.29 The development of any *Performance Solution* will require consultation with relevant stakeholders at the start of its development process. The Electrical Engineering Sectionshall form part of the consultation process and sufficient time shall be made by the *Delivery Authority* to ensure the acknowledgment of the Alternative Performance Solution before construction or installation begins.

3.30 The level of supporting information required shall be agreed as part of the Electrical Engineering Section consultation process. As a minimum the request must clearly identify:

a. the Delivery Authority and their Delivery Agent;

b. the area of non-compliance (with specific reference to the appropriate section of the compliance document);

c. the reason for non-compliance;

d. the risk mitigation strategy including any compensating factors or alternatives proposed;

e. cost implications, where relevant, by comparison of the initial and whole of life costs of the MIEE provisions with those of the proposed design solutions;

f. operational implications, where relevant, by comparison of existing standard operating procedures with those of the proposed design solutions; and

g. copies of any technical opinions or reports sought shall be enclosed.

3.31 When required by the Electrical Engineering Section, the manager of the operational capability is to acknowledge and agree to the request and the impact it may entail in writing. Where this may increase or have the potential to increase the capability risk for normal and/or abnormal operating conditions this shall be fully documented for the responsible *Capability Manager*. The responsible *Capability Manager* shall agree to and accept the increased capability risk in writing. This shall be submitted as part of the submission.

3.32 The *Delivery Authority* or their delegated representatives shall ensure that supported applications and supporting evidence are saved in *DEIS* prior to responsibility for the works being handed over to the relevant SEG region.

3.33 Acknowledgements or agreements shall not be issued retrospectively once construction or installation works has commenced or been completed.

3.34 In all such instances where an acknowledgement or agreement has not been issued and the works or installation have been delivered contrary to this Manual's Technical Guideline requirements the *Delivery Authority* or their delegated representatives shall ensure that the non-conformances to this Manual's requirements are full documented and saved in *DEIS* prior to responsibility for the works being handed over to the relevant SEG region.

3.35 In all such instances the *Delivery Authority* or their delegated representatives shall ensure that the relevant SEG region and onsite management and EMOS operators have been full briefed and made aware of the non-conformances.

The estate governance and integrity system, EGIS

3.36 *EGIS* sets out the roles and responsibilities for ensuring the delivery of Defence works that are compliant with *Statutory Requirements* and in conformance with Defence Policies. In short this responsibility resides with the *Delivery Agent* as the lead *Industry Partner*.

The Electrical Engineering Section role for design and documentation reviews and approvals

3.37 For works associated with this Policy, unless otherwise set out in any Guideline to this Policy, the Electrical Engineering Sectionis not an agent to review or provide approvals or acceptance for Project designs or delivered works. The Electrical Engineering Section. will provide advice and guidance to the *Delivery Authority* and or the *Delivery Agent* as to these policy requirements.

Certification and verification of works

3.38 The certification and verification of all works, designs, construction, commissioning, operations, maintenance, and decommissioning shall be in accordance with all *Statutory Requirements* and Defence Policy requirements. The *Delivery Agent* shall be responsible at all times of ensuring this is complied with and in providing the necessary assurances and confirmation to Defence as and when requested.

Defence Estate Quality Management System / Estate Record and Information Kiosk

3.39 DEQMS / ERIK promulgates Infrastructure procedures, policy and procedures for the development and management of the Defence Estate, including facilities and infrastructure.

General technical requirements

3.40 The general technical requirements applicable for electrical installations across the *Defence Estate* are set out under the Guidelines to this Manual.

3.41 The general technical requirements applicable for AGL electrical installations across the *Defence Estate* are prescribed in the following Chapters:

a. Chapter 12 – Aeronautical Ground Lighting; and

b. Chapter 13 – AGL Maintenance.

3.42 The general technical requirements applicable for AGL electrical installations across the *Defence Estate* are detailed in the following Guides:

a. Guide 1201 – Design and Installation;

b. Guide 1202 – Airfield Lighting Equipment Room;

c. Guide 1203 – AGL Control System;

d. Guide 1204 – Aeronautical Ground Lighting Series Circuits Compliance by Specific Design and Installation; and

e. Guide 1301 – AGL Maintenance Practices.

Whole of life optimisation and design life

3.43 The design, construction, operation and maintenance of the *Defence electrical distribution system* and *electrical installations* shall optimise whole of life outcomes for Defence.

3.44 In determining suitable design, materials and methods the following shall be considered:

a. The Defence capability that is supported by the asset and the importance of the asset in supporting that capability;

b. The reliability requirements and the consequences of failure of the asset;

c. The expected lifetime of the asset in Defence ownership, considering that Defence often own assets for long periods from construction right through to decommissioning;

d. The expected time between upgrades or refurbishment;

e. The climatic, environment and service requirements of the area in which the equipment is installed;

f. Availability of maintenance and other support at the location in which the asset is located; and

g. The required survivability of the asset following events such as natural disaster.

3.45 For the majority of assets, the above generally requires the use of good quality commercial or industrial grade materials and practice.

Defence specialist systems

3.46 Generally, Defence utilises systems and equipment used through broader industry in a manner consistent with commercial and industrial applications. Given the nature of Defence objectives, Defence has some particular requirements in relation to the implementation of these systems which may not be consistent with uses in other industries. These are outlined in the Guidelines supporting this Manual. These Guidelines are listed in Annexure 1C.

3.47 Particular attention is drawn to Electronic Defence Explosive Ordnance Publication 101 (eDEOP 101) which provides guidance for designing systems Explosives Hazardous Areas and Restricted Electrical Areas.

3.48 Defence utilises a number of specialist systems across Defence establishments to support operational capability objectives. These systems are often not commonplace in broader industry and require specialist knowledge in order to safely and successfully design, construct and operate them. These may not have relevant Australian Standards or require application of principles-based engineering in order to achieve compliance by specific design with the principles of standards, rather than the deemed to satisfy conditions which may not be appropriate for these applications. Defence's requirements relating to such systems are outlined in the Guidelines listed in Annexure 1C. Particular attention is drawn to:

a. Constant Series Current devices in Aeronautical Ground Lighting;

b. Shore power to docked vessels, including both 50 Hz and 60 Hz systems;

c. Submarine battery changing and discharging facilities;

d. Aircraft power system, including both 400Hz and DC systems;

e. Hazardous area systems, including explosive ordinance areas; and

f. Apron floodlighting.

Competent personnel

3.49 Competent, experienced and appropriately licensed persons shall be utilised to undertake planning, design, construction, commissioning, operation, maintenance, and decommissioning of any works that are performed under this policy. Refer also paragraph 4.4.

3.50 Persons who have responsibility for any activity, or are directly engaged in the design, installation and modification works shall be competent to discharge those duties or perform those tasks. Accordingly, all persons involved in any activity, including management and maintenance activities, shall have the appropriate training, technical knowledge, experience and qualifications relevant to the specific duties they have to perform.

3.51 The following competence factors shall be considered to justify the competence of persons carrying out their duties

a. Engineering appropriate to the application area;

b. Engineering appropriate to the technology (e.g. mechanical, electrical/electronic/software engineering);

c. Safety engineering appropriate to the technology;

d. Knowledge of the legal and safety regulatory framework;

e. The consequences in the event of a failure;

f. The consequences of failure to adhere to safety procedures;

g. The novelty of the design, design procedures or application;

h. Previous experience relevant to the specific duties to be performed and the technology being employed; and

i. Relevance of qualifications to the specific duties performed.

3.52 Attention is drawn to Defence's use of Compliance by Specific Design in some areas across the estate, in particular Defence Specialist Systems as indicated in paragraph 3.48.

CHAPTER 4
Project delivery requirements

Aim

4.1 This chapter defines the principals and responsibilities applying to the design and construction of electrical installations across the Estate. It includes references to the operational phase of the installations, the planning for which begins during the planning and design functions.

References

4.2 Reference is necessary to the following documents:

a. State and Territory Legislation and Regulations for electrical works;

b. ASNZ 3000 – Wiring Rules; and

c. Defence Policies and referenced standards and codes.

Prime principle – the estate governance and integrity system, EGIS

4.3 EGIS sets out the roles and responsibilities for ensuring the delivery of Defence works that are compliant with Statutory Requirements and in conformance with Defence Policies. In short, for the electrical works under this policy, this responsibility resides with the *Delivery Agent*.

4.4 The *Delivery Agent* is responsible for ensuring that competent, experienced and appropriately licensed / registered persons shall be utilised to undertake planning, design, construction, commissioning, operation, maintenance and decommissioning of any works that are performed under this policy.

4.5 The *Delivery Agent* shall specify sufficient minimum controls to provide assurance that assets which are brought into service are in-scope and that the facilities and activities are:

a. Safe and fit for purpose;

b. In accordance with the approved engineering designs; and

c. Comply with all applicable legislation and standards.

Introduction

4.6 Design and construction of new or modified facilities and equipment is a complex activity with potential to introduce very significant health, safety, security, operations, environment and reliability risks if not executed correctly.

4.7 Continuous identification and management of these risks is needed throughout the process of design, construction and commissioning. The earlier these risks are identified in a project, the easier it is to eliminate or significantly reduce risks without incurring expensive rework or retrofits, or otherwise being forced to accept less effective risk controls.

4.8 Risks are properly managed during the design, construction and commissioning life-cycle phases by utilising structured engineering processes and best practice standards and systems.

Legislative requirements and industry standards

4.9 Legislative requirements relating to design and construction of plant, facilities and equipment exist in all Australian States and Territories for the Commonwealth, and across numerous legislative statutes and instruments. All relevant legislative instruments containing specific requirements in relation to facilities design, construction and operational integrity shall be complied with.

Major and minor projects

4.10 Projects delivering *electrical installations* and infrastructure for Defence typically fall into one of two categories:

a. Major Projects: Consisting of projects requiring:

(i) the provision of new, or modification of existing, *Defence electrical distribution systems*;

(ii) replacement of a large main switchboard; and

(iii) the provision of a new facility with an expected electrical demand in excess of 100kVA; or

b. Minor Projects: Consisting of projects other than Major Projects.

4.11 Major projects require a higher level of documentation be provided by the *Designer* and *Construction Agent* during the course of the project. Major Projects shall provide documentation as defined in Chapter 5 of the Manual.

4.12 Minor Projects may provide a lower level of documentation as considered appropriate by the *Delivery Authority.*

Project roles and responsibilities

4.13 Defence Projects may be delivered under a number of contract mechanisms e.g. PMCA, PDS, and Managing Contractor. Regardless of the contract mechanism the project roles and responsibilities exist. The *Delivery Authority,* in conjunction with the *Delivery Agent* where appropriate, shall identify the parties fulfilling the following roles and responsibilities:

a. The *Delivery Agent;*

b. The *Designer; and*

c. The *Construction Agent(s)*

4.14 The *Delivery Agent* shall:

a. ensure the requirements of this Manual are implemented including ensuring the *Designer* and the *Construction Agent* fulfil their responsibilities and provide evidence of compliance with the provisions of the Manual;

b. identify if an EMP is established for the site and is current and appropriate for use in the project. Refer also paragraph 6.11. Where no such EMP exists, the *Delivery Agent* shall arrange for the provision of one;

c. ensure project records are prepared and retained;

d. where more than one party fulfils the role of *Designer* or more than one party fulfils the role of *Construction Agent*, clearly define the separation of responsibilities between those parties;

e. unless the contract under which the *Delivery Agent* is engaged specifies otherwise, the *Delivery Agent* shall be responsible for ensuring relevant stakeholders are consulted during the project;

f. ensure persons who will operate and maintain the works are actively consulted in planning, design and construction of the works such that they are organisationally ready to receive, operate and maintain the assets constructed and installed under the works; and

g. ensure persons who will operate and maintain the works shall be actively engaged in the commissioning and HOTO of the works such that they are trained in their operations and maintenance functions as a part of the HOTO process. Successful HOTO will include formal verification that operations and maintenance persons have demonstrated appropriate competency in the activities they will undertake for the assets under the works.

4.15 The *Designer* shall:

a. produce the *Design* as required by the contract under which they are engaged;

b. complete *Design Verification*, noting the contract may require additional third-party verification or review;

c. prepare *Dispensations*, compliance by specific design and or *alternative performance solutions* that may be required; and

d. complete designer construction verification and certification including ensuring appropriate testing and commissioning is identified and completed.

4.16 The *Construction Agent* shall:

a. Construct the works defined in the *Design* as required by the contract under which they are engaged;

b. *Commission* the works;

c. Support HOTO activities; and

d. complete construction verification and certification.

4.17 The *Electrical Operating Authority* has a number of specific responsibilities and authorities in the operations, acceptance, maintenance and upkeep of *Defence electrical distribution systems* and documentation. These are set out in Chapter 9 of the Manual.

Design & design review

4.18 Persons responsible for *Design* and *Design Verification* shall be;

a. professional engineers qualified and experienced in the facilities, services or installations that is the subject of the design;

b. be a CPEng or have the qualifications and experience to meet those requirements;

c. where a State or Territory requires Professional Engineering registration, have the appropriate registration for the jurisdiction they would practice in; and

d. as and where required, have the post graduate training, experience and competencies for any specialist areas that they may be practicing in. For example undertaking designs in:

   (i) AGL;

   (ii) Hazardous Areas and or Explosive Ordnances Hazardous Areas;

   (iii) High voltage;

   (iv) Distribution networks Protection Systems.

e. This paragraph is not intended to exclude inexperienced personnel from contributing to *design* activities, rather it requires such people to be supervised and for an experienced person to be responsible for the design.

4.19 Persons undertaking the *design verification* shall, in addition to the requirements above, also:

a. have the qualifications, experience and competencies no less than that of the persons whose designs are been checked and verified; and

b. be appropriately experienced and competent in the field / area of the design been checked and verified.

4.20 The *Design* being produced shall be in line with best industry practices and be in full compliance with all applicable Legislative and Regulatory requirements and in full conformance with all applicable Defence policy or guideline requirements.

4.21 The *Design* being produced shall identify and document the operational performance requirements for the works, and how those requirements are being realised in the design. These requirements shall be separately identified such that they may be measured against during the commissioning and operations phases of the assets under the works.

4.22 Commensurate with the level of design work required the design shall;

a. Identify the significant legislation and or regulations required to be complied with;

b. Identify those major Australian Standards that the design will need to comply with;

c. Where an Australian Standard/s may not exist or be applicable identify any:

(i) Industry Standards or guideline, etc; or

(ii) Other International or National Standard or guideline, etc;

That will be applied in this instance.

d. Identify the Defence policies, guidelines, etc. applicable to which conformance will be required;

e. Identify any other compliance, conformance or performance requirements specific to the design in question not covered by the above.

4.23 Where the design will not comply or conform with any matter above this shall be clearly highlighted and bought to the attention of the Delivery Agent, Defence Project Manager and the Defence Project Sponsor. The Designer shall instigate any requirement for dispensation or alternative design or compliance by specific design to address the non-compliance or non-conformance.

4.24 Dispensations and or alternative performance solutions or compliance by specific designs approved shall be formally recorded in the design and retained as part of the design documentation, including with reference to paragraph 4.21.

4.25 Where a dispensation and or alternative design or compliance by specific design is not approved or no application is made this shall be bought to the attention of the Delivery Agent and Defence Project Manager and Defence Project Sponsor and direction sought as to how they wish to proceed. This shall be formally recorded in the design and retained as part of the design documentation.

Design verification / certification – including reports and drawings

4.26 All designs shall be subjected to structured design reviews. Design reviews shall always address the following key questions;

a. Will the design operate as intended, including for normal and abnormal operating conditions?

b. Does the design meet applicable regulatory requirements?

c. Does the design meet applicable Australian Standards and Codes?

d. Does the design comply with the standards selected for the project?

e. Does (or will) the design incorporate the required outcomes of the risk studies and reviews?

f. Will the design meet the capability managers' expectations?

g. Is the design constructable, operable and maintainable?

h. Is the design appropriately cost effective over the life of the assets under the works?

4.27 The person/s undertaking the design check and verification shall confirm and certify the above is correct and applicable.

4.28 Where person/s undertaking the design check and verification has issues with the design that are unable to be resolved with the designer, these shall be documented and brought to the attention of the *Delivery Agent* and the *Defence Project Manager* and the *Defence Project Sponsor* for direction.

Designer's involvement in project delivery

4.29 Where appropriate and critical to ensuring a fit for purpose outcome the Designer shall nominate critical hold points during the delivery phase of the project and the actions required. Where deemed appropriate towards ensuring that delivery will be in line with the design intent the *Designer* shall be present at those hold points to take any appropriate actions.

Designer construction verification and certification

4.30 The *Designer* for the Project shall provide formal written verification and certification that the completed construction works are in accordance with and meet fully the intent of their design.

4.31 The *Designer* for the Project shall provide formal written verification and certification that the completed commissioning activities are in accordance with and meet fully the intent of their design.

4.32 Where the *Designer* provides any qualifications to their certification, these shall be brought to the attention and action of the *Defence Project Manager* and *Project Sponsor*.

4.33 Where the *Designer* is unable to provide verification and certification of the works against their design, the *Designer's* reasons or report shall be provided to the attention and action of the *Defence Project Manager* and *Project Sponsor*.

4.34 It is noted that Defence may use project delivery models where the original Designer is not engaged through construction. Where the originating *Designer* is not engaged through the construction phase of a project and an alternative *Designer* is not engaged, the *Delivery Agent* shall provide the certification and verification as required by this Chapter.

Construction

4.35 Persons undertaking *Construction Phase* activities shall be;

a. Suitably qualified, competent and experienced for the works or services to be undertaken,

b. Where required and as necessary have the appropriate regulatory licence or registrations for the works or services required be undertaken or be under the direct supervisor at all times under a said person

4.36 As and where required, have the post trade training, experience and competencies for any specialist areas that they may be practicing in. For example undertaking works in particular Defence Specialist Systems as indicated in paragraph 3.48. The construction shall be in line with best industry practices and be in full compliance with all applicable Legislative and Regulatory requirements and in full conformance with all applicable Defence policy or guideline requirements.

4.37 Where the construction / delivery cannot be in in line with the approved design and or re-design or additional design work is required the design to be undertaken will be in line with this policy.

4.38 Where the *design* required to be delivered is considered to not comply with the required legislative and regulatory requirements or conform with the required Defence Policy requirements, this shall be clearly highlighted and bought to the attention of the *Delivery Agent*, *Defence Project Manager,* and the *Defence Project Sponsor*.

4.39 Where compliance or conformance cannot be achieved the *Project* shall instigate any requirement for dispensation, or performance solution or compliance by specific design to address the non compliance or non conformance.

4.40 *Dispensations* and/or *performance solutions* or compliance by specific designs approved shall be formally recorded in the design and retained as part of the project documentation.

4.41 Where a *dispensation* and or *performance solution* or compliance by specific design is not approved or no application is made this shall be bought to the attention of the *Delivery Agent* and *Defence Project Manager* and *Defence Project Sponsor* and direction sought as to how they wish to proceed. This shall be formally recorded and retained as part of the project documentation.

Construction verification and certification

4.42 The *Construction Agent* shall provide formal written confirmation that the completed works are fully compliant, in accordance with the intent of the design and in conformance with the applicable legislative and regulatory and Defence Policy requirements.

4.43 All Legislative and Regulatory required certificates, etc. of compliance shall be included with the HOTO documentation.

4.44 All Defence policy certificates, etc. of conformance shall be included with the HOTO documentation.

Site testing and commissioning

4.45 The *Designer* shall identify relevant testing and commissioning activities required to verify the correct and safe operation and maintenance of infrastructure, and confirm the design intent and performances expectations are achieved.

4.46 Under the direction of the *Delivery Agent*, the *Designer* shall engage with persons who will be operating and maintaining the infrastructure in the commissioning activities, such that those persons are appropriately ready to receive the assets under the works and perform their business functions. The *Delivery Agent* shall confirm this aspect of organisational readiness has been achieved.

4.47 The *Construction Agent* shall complete site testing and commissioning as required by relevant Australian and IEC equipment standards and the contract under which they are engaged. The *Construction Agent* shall work with the operations and maintenance persons in performing the commissioning activities, in accordance with the requirements prepared by the *Designer*. Evidence of satisfactory site testing and commissioning shall be provided as part of the handover and takeover documentation. Refer also to paragraph 4.31.

4.48 The *Construction Agent* shall ensure factory acceptance testing, consisting of routine and special tests as a minimum and additional testing as appropriate to verify correct and safe operation of infrastructure, is completed. Evidence of satisfactory factory acceptance testing shall be provided as part of the HOTO documentation.

4.49 Site testing and commissioning shall be witnessed by appropriate persons to be defined by the *Designer* in consultation with the *Defence Project Manager*, *Delivery Agent* and *Electrical Operating Authority*.

Handover/takeover

4.50 Handover/Takeover (HOTO) is the formal transfer of the new or modified facilities or equipment from the construction and commissioning project phases to the end-user.

4.51 Handover is the term utilised where the *Commonwealth Contract Representative* accepts that delivered works from a *Construction Agent* are completed and fit for purpose. Handover includes the transfer of data associated with the design, construction, and commissioning of the assets under the works for use in operating, maintaining, and renewing the assets. The handover is formalised by the

Contract Representative issuing a completion certificate to the *Construction Agent* in accordance with the appropriate contract clause.

4.52 Takeover is the term utilised where Defence accepts the delivered works from the Contract Representative into the *Defence Estate* or Materiel and enables its use by the resident units for its intended purpose. Takeover includes accepting the data associated with the design, construction, and commissioning of the assets under the works for use in operating, maintaining, and renewing the assets. This acceptance is confirmed by completion of the HOTO Checklist.

Record keeping

4.53 Project documentation must be retained throughout the Asset lifecycle, including critical engineering documents such as:

a. Functional Design Brief;

b. Design Plan;

c. Design reports;

d. Issued For Tender drawings;

e. Issued For Construction drawings;

f. Dispensations;

g. Management of Change review records;

h. Pre-Start Up Safety Reviews;

i. As-Built Drawings;

j. Baseline System and Asset Performance Data;

k. System and Asset Cost Data in both Work or Materials Breakdown Structure form and Asset Breakdown Structure form;

l. Manufacturer Data Sheets;

m. Operating Instructions;

n. Inspection and Maintenance Schedules and Instructions;

o. Inspection Test Reports; and

p. Post-Project Closeout Reports.

4.54 All records and documents covered by this Element remain the property of the Department of Defence, must be kept in electronic formats, and be readily available without the need for proprietary software. The records and documents must be provided in the formats and other characteristics specified in the design documentation to ensure the ready transfer of that data into Defence information

management solutions. The documents must be stored according to Defence records management policies. Documents must be stored in Objective via *DEIS* using the ERIM file structure protocol.

4.55 The *Delivery Agent* shall be responsible for ensuring all project records are provided to the *Defence Project Manager* for publication to Objective.

Post project engineering review

4.56 The *Delivery Agent* shall convene a meeting of appropriate personnel to conduct Post Project Engineering Reviews. Post Project Engineering Reviews shall be undertaken at the completion of the construction and commissioning of any major projects as defined in paragraph 4.10 and where otherwise considered appropriate by the *Defence Project Manager*.

4.57 This review should consider all aspects of the Design, Construction and Commissioning phases of the project, and should include key project personnel.

4.58 In particular, the Post Project Engineering Review must consider the following:

a. Clarity and relevance of prescribed standards, and whether to *recommend* changes to any Defence Standards;

b. Constructability of design, and suggestions for future projects on how designs may be improved;

c. Lessons learned throughout the project that may be relevant for future projects, including a review of any variations and dispensations;

d. Feedback from construction teams, operations personnel and maintenance personnel on opportunities to reduce cost, complexity or risk on future projects;

e. Comparison of actual operating performance obtained to intended operating performance; and

f. Comparison of actual costs to budget costs.

4.59 The Post-Project Engineering Review shall be formally documented to ensure learnings are captured, with follow-up actions to be communicated with agreed timelines. The *Delivery Agent* shall provide the review report to the following for their attention and action as may be required:

a. the *Defence Project Sponsor;*

b. the *Defence Delivery Authority; and*

c. the Electrical Engineering Section.

CHAPTER 5
Electrical documentation

Aim

5.1 This chapter defines the documentation requirements for the electrical infrastructure on Defence establishments at all stages of the life cycle of that infrastructure, including:

a. Planning;

b. Design;

c. Hand Over and Take Over (HOTO);

d. Operation;

e. Maintenance; and

f. Renewal.

References

5.2 Applicable Guidelines

a. Guideline 501 – Design and Design Compliance Documentation;

b. Guideline 502 – Construction Compliance Documentation;

c. Guideline 503 – Handover Takeover and WAE Documentation; and

d. Guideline 303 – Electrical Network Labelling.

Prime principle

5.3 Defence attaches considerable importance to the provision and maintenance of proper engineering documentation at all stages of the life cycle for buildings and infrastructure across the Estate to enable its safe and efficient operation. Due regard shall be paid to the detail and completeness of documentation to enable these objectives to be achieved.

5.4 All documentation shall be of the best standard in line with accepted engineering and electrical engineering practice and shall comply with the relevant Australian Standards, or if such do not exist, with the relevant IEC or International (ISO) Standards.

5.5 Documentation shall be clear, concise, precise and fit for purpose for all functions associated with managing, operating, maintaining and renewing the buildings and infrastructure. Documentation shall be complete and comprehensive, and be presented in a clear manner without undue clutter.

General requirements

5.6 All documentation shall include evidence of review and verification by appropriate personnel.

5.7 Specific details for documentation and reports required for different types of projects are also set out in the individual Guidelines to this Manual.

Planning phase documentation

5.8 The requirements for planning reports and associated documentation are contained in Chapter 6 – Power System Planning and Reporting.

Design documentation - general

5.9 Design documentation serves two primary purposes:

a. To inform stakeholders what infrastructure is being delivered, why that infrastructure is an appropriate solution, and how that infrastructure will be managed; and

b. To act as a contractual mechanism for the engagement of a *Construction Agent*

Designers must recognise this and provide an appropriate level of design documentation commensurate with the works being delivered and the manner in which they will be delivered.

5.10 Design documentation shall be comprehensive and to a level of detail consistent with the delivery methodology required by Defence.

5.11 Subject to the level of design required, design documentation shall consist of:

a. Design and compliance reports;

b. Drawings;

c. Specifications;

d. Performance metrics; and/or

e. Datasheets.

Design and compliance reports

5.12 Provide design reports in accordance with the respective project requirements. Further guidance on general inclusions of design reports for different project types are included in Guideline 501 – Design and Design Compliance documentation.

5.13 Commensurate with the level of design required, design reports shall be prepared to fully inform the *Delivery Agent*, the *Defence Project Manager*, the *Defence Project Sponsor* and/or other relevant stakeholders.

5.14 Design reports shall clearly identify the design intent, providing the logic behind design decisions and demonstrate how concurrence to these decisions were achieved. The commentary *should* fully describe the design intent and parameters that will be provided by the constructed infrastructure. Design reports shall clearly specify the performance outputs expected in operating the constructed infrastructure.

Drawings

5.15 Drawings shall be fully legible when printed on A3 size sheets.

5.16 Symbols shall comply with Australian Standards. Where the use of non-standard symbols is unavoidable, description of the relevant symbol(s) shall be provided in a legend on the drawing.

5.17 All design drawings shall be in full accordance with the applicable Australian Standards and be in accordance with best industry practices.

5.18 The guidelines to this policy set out drawing requirements for specific matters.

5.19 Drawings shall where appropriate outline critical hold points required during the delivery of the works and the issues required inspection, validation, witnessing etc. at those hold points.

Technical specifications

5.20 Technical specifications shall be provided to articulate the quality of workmanship the works shall be performed to and provide further detail regarding execution of the works.

5.21 Technical specifications may be stand alone documents or combined with commercial requirements depending on the project requirements. For minor works, the specification may be included on the drawings.

Handover/Takeover (HOTO)

5.22 HOTO documentation is governed by the Estate Project Handover/Takeover Policy. Attention is drawn to the responsibilities of all parities outlined in the policy.

5.23 The HOTO Plan and Checklist, which support the policy, and Guideline 503 – Handover Takeover and WAE documentation provide further details regarding typical HOTO documentation requirements for electrical infrastructure.

5.24 All deliverables shall be provided with copies of the native format files i.e. in addition to pdfs *.dwg, *.dxf, *.xlsx etc shall be provided. If required, the native files may have identifying features (company branding etc) removed.

Operations Manuals

5.25 Comprehensive operations manuals shall be provided in plain English including:

a. Description of the system, its functions, major assets, equipment and other components, including as installed drawings;

b. Operating instructions including:

(i) Description of normal system operation;

(ii) Procedures for normal operating activities, including safety hazard and risk controls;

(iii) If required, procedures for special operating activities, including safety hazard and risk controls;

(iv) Description of system response to reasonably expected abnormal operation modes;

(v) Procedures for abnormal operating activities, including safety hazard and risk controls.

c. Normal set point of any adjustable settings, including commissioning/acceptance test and baseline performance results;

d. Description of operational objectives with respect to safety, environmental and security management requirements; and

e. Description of safe and environmentally appropriate disposal activities for asset and equipment end of life

Maintenance Manuals

5.26 Comprehensive maintenance manuals shall be provided in plain English including:

a. Description of the system, its functions, major assets, equipment and other components, including as installed drawings;

b. System and asset key performance measures and reliability performance metrics;

c. Warranty information including certificates, terms and conditions, periods of cover and any other pertinent details;

d. Maintenance instructions including:

(i) Preventative maintenance activities including instruction on how to perform each activity and recommended frequency of each activity, including safety hazard and risk controls;

(ii) Unplanned or corrective maintenance activities including instruction on how to perform each inspection and maintenance activity, including instruction on other indicators to be used to trigger a maintenance activity, including safety hazard and risk controls;

(iii) Reactive maintenance instructions to rectify common faults, including replacement of failed parts, including safety hazard and risk controls.

e. Obsolescence management plan including spare parts management; and

f. Special instructions for major maintenance activities, including asset rehabilitation requirements.

CHAPTER 6
Power system planning and reporting

Aim

6.1 The aim of this policy is to provide a strategic framework for the reporting, recording and planning of *Defence electrical distribution systems* and networks at Defence establishments connected, or intended to be connected, at high voltage or supplied from a CPS.

References

6.2 Reference is necessary to the following documents:

a. State and Territory Legislation and Regulations for electrical works;

b. AS/NZS3000– Wiring Rules; and

c. Defence Policies and referenced standards and codes; and

d. Guideline 601 – Planning Reports.

Prime principle

6.3 The reporting, recording and planning of *Defence electrical infrastructure systems should* be undertaken via one or a combination of the following primary methods:

a. Electrical Master Plan – EMP;

b. Electrical Development Plan – EDP; or

c. Electrical Network Systems Report – ENSR.

6.4 In addition to the above primary reports the following ancillary reports might be required:

a. Electrical Load Projection Report;

b. Emergency / Standby Power Report; and

c. Power Supply Options Analysis

Performance objective

6.5 The objective of this policy is to:

a. Document the current electricity supply arrangements and the configuration and condition of the Defence owned distribution networks and support systems for a Base;

b. Identify deficiencies, risks, safety and operational issues with the electricity supply infrastructure to, and within, the Defence establishment;

c. Capture existing, and forecast potential changes, in demand;

d. Identify potential emergency / standby electricity requirements and considerations for addressing possible requirements;

e. Provide a strategic framework within which the future development of the electrical supply infrastructure at a Defence establishment can take place in a carefully considered way;

f. Ensure adequate infrastructure capacity is available for new and proposed developments to the end of the specified Planning Horizon. Where no Planning Horizon is specified 15 years shall be utilised; and

g. Minimise redundant or abortive works.

Report – approvals and acceptance

6.6 The responsible authority for the acceptance and approval of all planning reports under this policy resides with theElectrical Engineering Section.

6.7 TheElectrical Engineering Section.will promulgate all approved reports via DEQMS to enable access by stakeholders and service providers for their reference and use as required.

Electrical master plan

6.8 An Electrical Master Plan shall be a stand-alone document that provides a framework within which the future development of the electrical distribution and supply infrastructure at a Defence establishment can take place.

6.9 Estate Planning are responsible for ensuring every Defence establishment with a Defence owned, operated and maintained high voltage electricity distribution network has an EMP in place and is accessible via DEQMS.

6.10 Each EMP *should* be reviewed and updated at least every 10 years, if it has not already been done so under 6.11.

6.11 Any project or person that seeks to:

a. Develop, establish or take over the ownership and operation of a high voltage distribution network on a Defence establishment;

b. Undertake major upgrades or changes to the primary high voltage distribution network including changes or upgrades to the:

(i) Incoming supply and feeders from the Network Service Provider;

(ii) ISS or PSS;

(iii) CEPS, CPS or CEP;

c. Undertaken major upgrades or expansion of the high voltage electrical distribution network on the Base; or

d. Undertake an overall Master Planning exercise for the Base,

shall undertake a review of the EMP for adequacy with regard to the proposed works, and update it as required. Further, the need for an amendment to the EMP shall be reviewed at the earliest practicable time in the project lifecycle, preferably before Gate 1 approval.

6.12 In the event there is no EMP on DEQMS, the *Defence Project Manager* shall refer this to Estate Planning.

6.13 The structuring, format and issues to be addressed in EMP are set out in more detail in Guideline 601 –Planning Reports to the Manual.

Electrical development plan

6.14 An Electrical Development Plan shall be produced either as a precursor to, or as part of, the Design Reporting by any project seeking to modify the *Defence electrical distribution network* or its supporting infrastructure.

6.15 The principal objective of the EDP is to detail the extent of works to be executed by the project, including:

a. The works to be undertaken on the Defence electrical distribution network and or its support infrastructure and/or any changes proposed to the incoming supply arrangements from the Network Service Provider; and

b. How the proposed works:

(i) Are consistent with the EMP;

(ii) Meet the immediate electrical supply needs of each project while minimising capital expenditure both for the project and long term; and

(iii) Minimise redundant work in the context of the EMP.

6.16 Where the EDP significantly deviates from the EMP, the EDP shall specifically highlight these deviations. Any such deviation shall be reviewed and agreed to by the Electrical Engineering Section prior to implementation.

6.17 Where an Electrical Master Plan does not exist, the EDP shall indicate how the proposed works will fulfil the infrastructure needs of the current project and not limit future development of the electrical infrastructure needed for possible future developments. In doing so it shall be guided by similar master planning principles as used for EMPs above, though in a less stringent way.

6.18 The structuring, format and issues to be addressed in the EDP are set out in Guideline 601 –Planning Reports to this Manual.

6.19 The EDP *should* be commensurate with level of works to be undertaken. For example;

a. The installation of a substation or substations on a ring may need to address the impact on the ring in question, and could be concise; and

b. Whereas, more extensive works to the electrical distribution networks will require a more extensive report.

Electrical network system report

6.20 The Electrical Networks System Report is/can be a standalone report to capture the status, configuration and condition of the electricity supply arrangements to and within the Defence establishment and to identify issues.

6.21 Estate Service Delivery can require an Electrical Network System Report be prepared for Defence establishment with a Defence owned, operated and maintained high voltage electricity distribution network and this is accessible via DEQMS.

6.22 The Electrical Engineering Sectionis responsible for review and approval of Electrical Network System Reports.

6.23 The structuring, format and issues to be addressed in the Electrical Systems Network Report are set out in more detail in Guideline 601–Planning Reports to this Manual.

Electrical Load Projection Report

6.24 The Electrical Load Projection Report can be a standalone report or integrated as part of a larger report, such as an EMP. It shall capture the existing loads and maximum demands for the Defence Establishment and using available data on proposed future projects project these forward to the end of the designated Planning Horizon. The default Planning Horizon is 15 years unless otherwise specified.

Emergency / Standby Power Report

6.25 The Emergency / Standby Power Report can be a standalone report or integrated as part of a larger report, such as an EMP. It shall help facilitate and identify the possible current Emergency / Standby Power requirements for the Defence Establishment and using available data on proposed future projects project these forward to the end of the designated Planning Horizon. The default Planning Horizon is 15 years unless otherwise specified.

Power Supply Options Analysis

6.26 For new sites or where the existing power supply arrangement is identified as being deficient going forward, a Power Systems Options Analysis shall be undertaken. This can be a standalone report or integrated as part of a larger report, such as an EMP. It shall assess the possible viable means of providing power supply to the Base and provide possible recommendations for consideration.

CHAPTER 7
Electrical distribution systems

Aim

7.1 The aim of this policy is to provide the principles and objectives for the design Defence Electrical Distribution Systems.

References

7.2 The following references:

a. Guideline 701- HV and LV Distribution.

Prime principle

7.3 The principles that this policy seeks to ensure that:

a. Defence meets its statutory and safety obligations by protecting people, property and the environment in accordance with all applicable Statutory Requirements;

b. There is adequate availability and reliability of the electricity supply to meet Defence's capability requirements; and

c. Defence can effectively safely manage, operate and maintain its Defence electrical distribution systems within the skills and competency sets of its personnel in any times of need.

Performance objective

7.4 The objective of this policy is to provide an electrical power distribution system that:

a. Safe to operate and delivers electrical power in a manner that is safe to users and other stakeholders;

b. Achieves compliance with the respective statutory obligations, industry installation standards, codes and legislation;

c. Provides adequate capacity for Defence operations in normal and abnormal operating conditions;

d. Provides an adequate degree of flexibility and redundancy in order to provide fault tolerance and the ability to expediently recover from the failure of major elements;

e. Provides acceptable power quality for users and other stakeholders;

f. Is configured in a logical manner, and uses materials and equipment of a type that facilitates semi-skilled operation;

g. Is developed in a planned way to considering the longer-term planning of the Defence Establishment; and

h. Has effective power control and monitoring, consistent with the size of the system, to detect system status and faults, as well as whether system components are becoming overloaded.

Defence electrical distribution systems

7.5 The Defence electrical distribution system is defined as an electrical power distribution system that is owned, operated and/or maintained by Defence. As such, Defence is responsible for the system and liable for issues that arise as a result of the systems.

7.6 The Defence electrical distribution system is deemed to extend from the source/s of electrical supply through to the point of attachment / point of entry / point of supply at each facility on the Defence establishment.

7.7 The source of electrical supply can be one or more of the following:

a. The agreed point of supply/connection with the *Network Service Provider*, in the case of any incoming supply mains;

b. The output of a Defence owned power station, such as a CPS or CEPS: or

c. The output of a third party owned power station, such as renewables or a conventional power station: or

d. The output of specialist equipment, such as:

(i) Load levelling equipment, such as batteries or super capacitors: or

(ii) Inverter systems used to discharge the batteries of submarines.

7.8 Defence electrical distribution systems include:

a. Defence owned high voltage networks from the point of supply / connection with the *Network Service Provider* to the low voltage terminals of any distribution transformer, including:

(i) All protection, supervisory, monitoring and control systems associated with the high voltage networks above;

(ii) Any generation, energy storage and power conditioning systems connected and feeding into the high voltage networks including their protection, supervisory, monitoring, operating and control systems and associated step-up transformers. Typical examples on the Defence networks include CEPS, CPS, CEP, DRUPs, standby / emergency generators, renewable energy generation and storage systems, power factor correction, etc:

b. The low voltage supply from the Defence distribution transformer from the low voltage tails thorough to the point of supply or connection at the facility or building on the Defence site, including:

(i) All protection, supervisory, monitoring and control systems associated with the low voltage networks above;

(ii) Any generation, energy storage and power conditioning systems connected and feeding into the low voltage networks including their protection, supervisory, monitoring, operating and control systems. Typical examples on the Defence networks could be but not be limited to, LEGs, MGLB, renewable energy generation and storage systems, power factor correction, etc:

(iii) The low voltage cable / power line from the distribution substation low voltage board to the point of connection / point of supply or to the main switchboard of building or facility is considered part of the low voltage network.

c. Defence establishments where the incoming supply from the Network Service Provider is low voltage, from the point of connection or supply with the *Network Service Provider* thorough to the point of supply or connection at the facility or building on the Defence site, including:

(i) All protection, supervisory, monitoring and control systems associated with the low voltage networks;

(ii) Any embedded generation, energy storage and power conditioning systems connected and feeding into the low voltage networks including their protection, supervisory, monitoring, operating and control systems. Typical examples on the Defence networks include LEGs, MGLBs, renewable energy generation and storage systems, power factor correction, etc.

d. Where UPSs are provided for specific capabilities within the low voltage reticulation system of a facility, these do not form part of the *Defence electrical distribution systems.*

Safe and compliant installations

7.9 The design of *Defence electrical distribution systems* shall ensure that the system can be constructed, operated, maintained and de-commissioned in a way that is safe, and minimises risk or hazard to persons, property, external organisations, the community or the environment.

7.10 *Defence electrical distribution systems* shall be constructed, operated, maintained and de-commissioned in a way that is safe, and minimises risk or hazard to persons, property, external organisations, the community or the environment.

7.11 The design, construction, operation and maintenance of *Defence electrical distribution systems* shall at all times:

a. Be in full compliance with all applicable legislation, regulations and applicable standards; and

b. Adhere to the requirements and obligations set out within the applicable NSP's Service and Installation Rules and any connection agreement in effect.

Support defence's capability

7.12 The *Defence electrical distribution system* must provide electricity supply that will support and sustain Defence operations and capability. Operational facilities may require a higher level of redundancy and survivability than typically seen outside the Defence industry. In order to support and sustain Defence operations and capability, the *Defence electrical distribution system* must:

a. Provide adequate capacity for current loads. New assets shall provide spare physical and electrical capacity to accommodate anticipated future development and/or load growth:

   (i) Typically, new assets shall be no more than 80% utilised by known loads unless planning considerations require otherwise i.e. known loads shall be increased by 25% when selecting new equipment ratings;

   (ii) Projects utilising existing assets may use available spare capacity without providing additional infrastructure, though *should* they trigger the need for additional infrastructure, additional spare shall be provided.

b. High voltage networks shall generally be flexible and be provided with redundancy down to the distribution substation level. This shall enable the system to be quickly reconfigured to bypass faulty power system components;

c. HV secondary distribution shall generally be configured as ring mains to provide redundancy and flexibility. The exceptions are:

   (i) Where the importance of the load the substation supports is low and capability will not be compromised by not providing redundancy;

   (ii) The cost of providing a ring main is prohibitive for the benefit gained and adequate standby power facilities are provided as an alternative.

d. Standby power shall be provided in accordance with Chapter 8 – Power Generation Systems;

e. Maintain power quality within acceptable limits at all times, unless a fault event causes power quality to excursion outside limits. Notably:

(i) Voltage and frequency shall remain within the limits set by Australian Standards or the NSP, including from no-load to full-load;

(ii) Flicker caused by large intermittent loads or generating systems shall comply with Australian Standards and shall not have adverse impacts on other users and stakeholder;

(iii) Harmonic content of the electrical supply shall comply with Australian Standards and the requirements of the NSP. This includes the cumulative impact of existing harmonics and any new harmonic sources. Harmonics shall not have adverse impacts on other users and stakeholders.

f. Consider Radio Frequency Interference (RFI) or other emissions from power system elements and components where the installation will occur in proximity to RFI sensitive facilities. If necessary, choose locations at a distance from these facilities, and/or provide suitable shielding and/or filtration.

7.13 Where Defence capability must be maintained following extreme events, such as natural disasters, the role of the Defence Electrical Distribution System in supporting that capability shall be considered. This is particularly the case where there is a post disaster functionality requirement. Where the Defence Electrical Distribution System is essential to support the existing capability or possible future capability, the survivability of the relevant individual power system elements shall be considered. This might preclude more physically vulnerable forms of construction, such as using building type substations rather than kiosk substations.
This can apply not just to the power system elements that directly supply the capability, but also those that are upstream. For example, power might not be able to reach a facility if the other substations on the ring have been compromised, so all substations might need to be constructed to the higher standard to achieve the required survivability.

Planned and coordinated

7.14 The *Defence electrical distribution system* shall be developed in a planned way that considers the future development of the establishment. Where applicable the planning process *should* include an EMP and an EDP. See Chapter 6 – Power System Planning.

Operations

7.15 The system shall be operated in a manner that optimises overall reliability and energy efficiency, for instance:

a. Normal network open points shall be located so the impact of a fault to operations is minimised. In general, this requires the open points to be located toward the middle of rings; and

b. Main power transformers can be operated in parallel provided they have the necessary load-sharing controls, and the increased fault level does not exceed equipment limits. Special care is required to ensure that the increased earth fault level does not exceed the design limits of equipment or earthing systems, particularly older earthing systems.

Standardisation of equipment

7.16 High voltage switchgear and related ancillary equipment within that switchgear shall be standardised as far as practical to maximise safety and simplify operation and maintenance practices within each Defence establishment or, to a lesser extent, across the region.

7.17 Where there is a mixture of equipment within a Defence establishment or across a region, the choice of which will become the site standard shall be taken in consultation with the site *Electrical Operating Authority / Network Controller* regarding operational experience with the equipment. This shall consider:

a. Technical suitability for the intended application;

b. Compliance of the equipment with the requirements of this Manual;

c. Operational issues with the equipment and local technical support, and

d. Factors that affect future service life, such as spare parts issues or remaining time the equipment is likely to be manufactured.

7.18 Equipment other than the site standard can be considered, with the agreement of the EOA and the Electrical Engineering Section and:

a. Where a large quantity of new equipment is being introduced, and there is a clear financial benefit to Defence in considering alternatives: or

b. Where the site standard equipment does not offer necessary technical features for a particular application.

7.19 The existing site standard equipment can be considered no longer to be viable if:

a. The equipment does not comply in significant ways with the requirements of this Manual;

b. The equipment has issues that adversely affect safety, operability, or compromise Defence operations or capability, or

c. The equipment no longer available, spares are in short supply or there are plans to supersede the equipment.

7.20 Where equipment other than the site standard is used or the existing site standard is no longer viable, then a new site standard shall be established using a performance based specification. The final decision on any new standard equipment should be undertaken in consultation with the site *Electrical Operating Authority /*

Network Controller regarding the operational and maintenance aspects of the equipment.

Environmental obligations

7.21 The *Defence electrical distribution system* in its planning, design and operation shall comply with Defence's environmental obligations.

Status monitoring

7.22 The *Defence electrical distribution* system status shall be monitored by the *Electrical Operating Authority* to ensure system components to not become overloaded or operate outside of their rated conditions. This may be achieved using PCMS, as outlined in Chapter 11, or via other means.

Defence electrical operating authority / network controller responsibilities

7.23 Chapter 9 of this Policy sets out the role and responsibilities of the *Defence Electrical Operating Authority / Network Controller*.

7.24 Persons seeking to access, work upon, approach, design, or perform any other works associated with the *Defence Electrical Distribution System* shall refer to Chapter 9.

CHAPTER 8
Power generation systems

Aim

8.1 The aim of this policy is to provide the principals and objectives for power generation systems connected to the *Defence Distribution network* or providing power supply on the *Defence Estate*.

References

8.2 The following references:

a. Guideline 801 – Centralised Power Generation and Conversion;

b. Guideline 802 – Local Emergency Generators;

c. Guideline 803 – Mobile Generator Link Boxes;

d. Guideline 804 – Uninterruptible Power Supplies;

e. Guideline 805 – Standby Power Systems Selection; and

f. Guideline 806 – Power Conversion Systems

Prime principle

8.3 The principals that this policy seeks to ensure that:

a. Defence meets its statutory and safety obligations by protecting people, property and the environment in accordance with all applicable Statutory Requirements;

b. There is adequate availability and reliability of the generation systems to supply and meet Defence's capability requirements; and

c. There is the ability for Defence to effectively manage, operate and maintain the systems within the skills and competency sets of its personnel in any times of need.

Scope

8.4 This Chapter covers systems such as:

a. Large centralised power generation systems. Typically connected at High Voltage to the *Defence electrical distribution system*, such as:

(i) Central Power Station (CPS):
A power station whose principal purpose is to provide normal power to an establishment, or large portions of an establishment.
This can be as the sole source of power or in conjunction with other sources, such as the grid or another CPS.

The power generation technology can be quite varied, and possibly include:

(a) Liquid or gas fuelled generating units utilising reciprocating engines or gas turbines;

(b) Fuel cells;

(c) Renewables, such as solar or wind;

(d) Battery Energy Storage Systems (BESS); and

(e) Power generation combined with co-generation or waste heat utilisation for other services, such as air conditioning.

(iv) Central Emergency Power Station (CEPS):
A power station whose principal purpose is to provide standby power to an establishment, or large portions of an establishment, in the event of failure of the normal supply:

Like a CPS, the power generation technology adopted at CEPS can be quite varied and even incorporate hybrid solutions such as Diesel Rotary Uninterruptable Power System (DRUPS);

(v) Central Power Conversion Station (CPCS)
A power station whose principal purpose is to change the frequency of the incoming electrical supply to provide power for specialist applications, such as shore power, to an establishment or large portions of an establishment.

b. Small distributed standby power generation systems. Typically connected at Low Voltage to the *Defence electrical distribution system*, such as:

(i) Local Emergency Generators (LEG)
A generator or number of generators whose principal purpose is to provide power to facilities, or portions of a facility, in the event of a failure of the normal supply;

(ii) Uninterruptable Power Supplies (UPS)
An energy storage and supply system to maintain supply electrical energy to a facility on the event of a short term power outage. Typically connected in series with primary power supplies;

(iii) Hybrid solutions, such as Diesel Rotary Uninterruptable Power System (DRUPS) that combines the functions of a LEG and UPS in a single unit;

(iv) Mobile Generator Link Box (MGLB)
Facilities for connection of transportable generating sets.

c. Small embedded power generation systems. Typically connected at Low Voltage to the Defence electrical distribution system, such as:

(i) Small scale Photovoltaic (Solar) Systems
A small (<100kW) renewable energy system whose principal purpose is to provide power to a facility to offset energy consumption from the *Network Service Provider* or a CPS.

Performance objective

8.5 The objective of this policy is to provide electrical generation and storage systems that:

a. Provides the required generating capacity with flexibility, reliability and redundancy consistent with the importance of the capability being supported;

b. Is safe to operate and generates electrical power in a manner that is safe to users and other stakeholders;

c. Achieves compliance with the respective statutory obligations, industry installation standards, codes and legislation including requirements of the *Network Service Provider* and the National Electricity Rules;

d. Provide full automation of the main functions of the power generation system, albeit with occasional operator intervention *should* unusual circumstances arise, and to safeguard the system;

e. Provides acceptable power quality for users and other stakeholders;

f. Is configured in a logical manner, and uses materials and equipment of a type that facilitates semi-skilled operation;

g. Has effective power control and monitoring, consistent with the size of the system, to detect system status and faults, as well as whether system components are becoming overloaded;

h. Minimises the possibility of credible single points of failure compromising Defence capability; and

i. Facilitates energy security, energy sustainability and greenhouse gas emissions reductions in line with broader Defence objectives.

Power generation on Defence establishments

8.6 The connection of any power generation system onto a *Defence electrical distribution system* shall be in full accordance with this Manual.

8.7 Power generation systems may be located on a Defence Establishment for some of the following reasons:

a. As a source of normal supply, generally when the mains is unavailable at the site, or has insufficient capacity or quality;

b. To provide standby power in the event of loss of normal power supply. This is referred to as a standby power system or emergency generator;

c. To support the normal supply during periods of peak electrical demand. This is referred to as peak lopping;

d. To offset energy consumption from the normal power supply. This often involves the use of renewable energy sources;

e. To address power quality issues with the normal power supply, for instance voltage regulation and stability issues; and

f. Specialist systems require power at different frequencies to that available from the normal power supply. Such circumstances require power conversion systems;

Requirement for standby power

8.8 Standby power shall be provided where electrical power is required to maintain critical and essential capabilities upon failure of the normal supply, and where there are no practical alternative ways of maintaining that capability without serious degradation of the capability, e.g. manual operations rather than automatic. The need for standby power, and the requirements thereof, shall be determined in close consultation with the *Capability Manager* or *Project Sponsor* or their nominated delegate.

8.9 Critical and Essential capabilities are generally those classified as Contribution Factor CF1 and CF2.

8.10 In general, standby power systems *should* be located close to the facility in which the capability is located.

8.11 The requirements and justifications for any small distributed power generation systems connecting to the low voltage power system shall be provided by the relevant *Capability Manager* and or Project Sponsor for the facility in question. MIEE Guideline 805 – Standby Power System Selection can provide assistance for *Capability Managers* and Project Sponsors in determining where and when emergency / standby power systems may be warranted and the types to consider.

8.12 The type of standby power system that is provided is dependant upon the characteristics of the load, in particular the maximum permissible power supply interruption before capability is seriously degraded. It will generally consist of one or more of the following:

a. No permissible power interruption
Typically computer systems where data loss will compromise capability or for safe shutdown.
Requirement: Uninterruptable Power Supply (UPS);

b. 0 to 60 seconds permissible power interruption
Requirement: Local Emergency Generator (LEG);

c. More than one day permissible power interruption in locations where standby generators can be hired at short notice.
Requirement: Mobile Generator Link Box (MGLB); and

d. Hybrid solutions, such as Diesel Rotary Uninterruptable Power System (DRUPS) can be used that combine the functions of a LEG and UPS in a single unit.

8.13 The level of redundancy provided in the standby power system shall consider:

a. The importance of the capability; and

b. The reliability of the normal electrical supply.

8.14 Where required, redundancy within the standby power system can be provided by either:

a. Providing redundant generating units and ancillary systems; and

b. Provision of a Central Emergency Power Station (CEPS).

8.15 Establishment of a CEPS shall require that the justification is set out within an agreed and promulgated Electrical Master Plan. Typical justifications include:

a. The establishment has a post disaster functionality and requires that power be broadly available for the efficient delivery of this functionality;

b. The normal electrical supply is of poor reliability or quality, and this affects the overall operation of the establishment; and

c. Additional redundancy is required for individual standby power systems.

Power system stability and power quality

8.16 To the extent that it is affected by the power generation system, power system stability and power quality within the *Defence electrical distribution system* shall be maintained within acceptable limits at all times:

a. Voltage and frequency shall remain within the limits set by Australian Standards or the NSP, including from no-load to full-load;

b. Flicker caused by large intermittent loads or generating systems shall comply with Australian Standards and shall not have adverse impacts on other users and equipment; and

c. Harmonic content of the electrical supply shall comply with Australian Standards and the requirements of the NSP. This includes the cumulative impact of existing harmonics and any new harmonic sources.
Harmonics shall not have adverse impacts on other users and stakeholders.

8.17 As a minimum, for large centralised power generation systems and for distributed systems with a significant collective rating that run in parallel with the primary power supply, the following technical studies shall be prior to completion of the design to ensure that the system does not adversely impact Defence operations:

a. Load Flow study including power quality and thermal loading;

b. Fault level study, including the impact upon any existing equipment;

c. Protection study;

d. Earthing study; and

e. Additional studies as required by the local *Network Service Provider.*

Protection systems

8.18 All power generating units shall be provided with protection systems commensurate with their capacity, type and operational circumstances. In particular, the following protection shall be provided:

a. Protection to safely disconnect the equipment in the event of a fault event in such a way that minimises damage to the equipment;

b. Synchronism Check where supplies from different un-synchronised sources can be connected together;

c. Anti-islanding protection:

   (i) To the requirements of the *Network Service Provider* where generating units run in parallel with the mains;

   (ii) Where the generating unit is not designed to run islanded.

Microgrids

8.19 Depending upon the power system configuration large, centralised power generation systems can be controlled and integrated into the *Defence electrical distribution system* by establishing a microgrid.

8.20 The establishment of a microgrid that controls any Defence assets shall require the prior approval of the Electrical Engineering Section.

8.21 If the microgrid controls any Defence assets, then the microgrid controller shall be under the direct dedicated control of Defence.

Large centralised power generation systems – Defence owned

8.22 These requirements apply to large centralised power generation that is owned, operated and/or maintained by Defence. As such, Defence are responsible for and liable for the system.

8.23 Generation assets shall be provided in a manner that:

a. Allows the generation plant to operate at full capacity, safely and reliably under any reasonable weather condition at the location, subject to any higher requirement specified by the *Capability Manager*;

b. Is survivable under extreme weather conditions at the location, so that the plant can be quickly brought into service after such an event;

c. Considers passive defence and is consistent with the required design life. This normally requires that the plant be housed within a sturdy building;

d. Prevents excessive degradation of the assets due to environmental conditions at the location;

e. Allows maintenance activities to be undertaken under any reasonable weather condition at the location;

f. Considers the maintenance support, including timely supply of spare parts, that is available at the location;

g. Provides adequate maintenance access so that the plant can be safely accessed, even when running;

h. Meets all environmental requirements, including:

(i) Containment of spills, such as fuel, lubricants or electrolytes;

(ii) Noise limits;

(iii) Gaseous or exhaust emissions;

i. Considers future expansion of the installation;

j. Has suitable segregation between major components to minimise the potential for a single event to disable the entire station;

k. Be provided with the amenities to support the operation and maintenance of the facility;

l. Enable operators to be able to visually monitor the generators remotely i.e. without physically being in the generator hall;

m. Provides a consistent operational, control and monitoring system across the Estate and the Base; and

n. Be able to operate uninterrupted for an agreed minimum period without the need for refuelling, maintenance and servicing.

8.24 Emergency / stand by systems shall be capable of restoring supply automatically and autonomously on the loss of any incoming supply.

8.25 Defence owned Large Centralised Power Systems shall be fully integrated into the Base’s high voltage network and its monitoring, control and operational systems.

Large centralised power generation systems – third party owned

8.26 These requirements apply to large centralised power generation that is owned, operated and/or maintained by third parties, but which supply power into a *Defence electrical distribution system.*

8.27 The design, construction, operation, maintenance and management of such systems shall at all times be in full compliance with:

a. All applicable Legislative, Regulatory and NSP requirements; and

b. Contractual requirements between Defence and the third party

8.28 The connection and operation of any such system shall:

a. Not jeopardise or present a threat to the resilience, reliability, operation and/or security to the *electrical distribution system* or the NSP supply;

b. Meet Legislative, Regulatory and NSP requirements without placing future restrictions on development of Defence systems (e.g. Defence power generation systems) without the prior specific approval of Defence; and

c. Provide the supply availability defined in the contractual requirements between Defence and the third party.
Where generators are provided as the primary power supply for a Defence establishment the availability of the system *should* generally be no less than 99.99%.

8.29 Defence shall have the authority at all times to disconnect, physically or electrically, a system from the Defence network where it considers it:

a. Is adversely affecting power system reliability, stability or power quality to Defence or at the point of connection to the NSP, such that these fall outside acceptable limits;

b. Poses a threat or safety risk;

c. Is in breach or non-compliant with any applicable Legislative, Regulatory or NSP requirement; or

d. Is in breach of the contractual requirements between Defence and the third party or any other any Defence contractual obligations.

8.30 Point of Connection - The connection of any such systems shall be in full accordance with an agreed *Electrical Master Plan*:

a. Connections *should* be made at the Primary Nodes of the high voltage network. For example ISS, PSS, CEPS, etc;

b. The point of connection shall be via fully automated Circuit Breaker which shall be able to be:

   (i) Monitored, Opened and Closed by Defence; and

(ii) Monitored and Opened by the Third Party Operator. The Third Party Operator shall not be able to Close the breaker.

8.31 Defence shall at all times have full visibility and able to monitor and capture and retain at the connection point the following:

a. Frequency;

b. Volts – each phase;

c. Current – each phase;

d. Power Factor;

e. Real Power kW;

f. Apparent Power kVA;

g. Reactive Power kVars;

h. kWh at 5 minute incremental periods and cumulative for the 24 period.

8.32 At no times shall the Third Party owner, operator, maintainer or any other of their representative/s have access to, visibility of, or control of the Defence Electrical network or its systems unless otherwise set out in this policy.

8.33 Where a system or portions of the system is to revert to the ownership of Defence at any point in time, the relevant portions of that system shall be in full conformance with the requirements of this policy.

Small distributed standby power generation systems

8.34 These requirements apply to small distributed standby power generation systems. Typically connected at Low Voltage to the *Defence electrical distribution system*.

8.35 The type of standby generation system provided shall generally be in accordance with paragraph 8.12.

8.36 Uninterruptable Power Supply (UPS):

a. UPSs shall be arranged to enable maintenance without interruption to equipment/facilities the UPS supports. This may be achieved through:

(iii) Modular UPS systems;

(iv) External bypass systems.

b. UPSs shall be compatible and suitable for the load it is supporting, including where a LEG may also be providing further emergency / standby power support;

c. UPSs shall be housed in a manner that:

(i) Allows the UPS to operate at full capacity, safely and reliably under any reasonable weather condition at the location, subject to any higher

requirement specified by the *Capability Manager*, and including extended loss of normal power supply.

(ii) Is able to be monitored and operated by semi-skilled personnel;

(iii) Is survivable under extreme weather conditions at the location, so that the plant can be quickly brought into service after such an event;

(iv) Prevents excessive degradation of the assets due to environment conditions at the location;

(v) Allows maintenance activities to be undertaken under any reasonable weather condition at the location;

(vi) Considers the maintenance support, including timely supply of spare parts, that is available at the location;

(vii) Provides adequate maintenance access so that the energy storage system can be safely accessed, even when running;

(viii) Meets all environmental requirements, including containment of spills and gaseous emissions; and

(ix) Considers future expansion of the system.

8.37 Local Emergency Generators (LEG):

a. The LEG shall be capable of automatic and autonomous operation to:

(i) Provide standby power on the loss of the normal supply as soon as reasonably practical following the loss of that supply. The transfer to LEG supply shall be break before make;

(ii) The load applied to the LEG while it is operating shall remain above the manufacturers minimum load. Where the actual load falls below this minimum load additional resistive load shall automatically be added to keep the load above the minimum; and

(iii) On restoration of normal supply, following a suitable time delay to ensure the stability of the normal supply, the transfer to the incoming supply shall be on a break before make.

b. Manual controls shall be provided to allow the manual operation of the above functions;

c. Remote operation and monitoring shall be provided where the LEG needs to integrate with other Defence systems, such as CEPS and Air Traffic Control. Remote control overrides the automatic starting and stopping of the LEG. This typically includes:

(iv) Remote Start (and connect) and Stop (after disconnecting);

(v) LEG Run-on, where the LEG will operate as if the normal supply is not present; and

(vi) Status, including Run, Stop, Connected, fault etc

d. LEG fuel systems have adequate capacity to support the LEG operating at the prospective load until it can be appropriately refuelled. Further guidance on an appropriate period is provided in Guideline 802 - Local Emergency Generators (LEG);

e. Generation assets shall be housed in a manner that:

(i) Allows the generation plant to operate at full capacity, safely and reliably under any reasonable weather condition at the location, subject to any higher requirement specified by the capability manager;

(ii) Is able to be monitored and operated by semi-skilled personnel;

(iii) Is survivable under extreme weather conditions at the location, so that the plant can be quickly brought into service after such an event;

(iv) Prevents excessive degradation of the assets due to environment conditions at the location;

(v) Allows maintenance activities to be undertaken under any reasonable weather condition at the location;

(vi) Considers the maintenance support, including timely supply of spare parts, that is available at the location;

(vii) Provides adequate maintenance access so that the plant can be safely accessed, even when running;

(viii) Meets all environmental requirements, including containment of spills and gaseous emissions and noise limits;

(ix) Considers future expansion of the installation;

(x) Maintain a consistent operational, control and monitoring system across the Estate and the Base;

(xi) Be able to operate uninterrupted for an agreed minimum period without the need for refuelling, maintenance and servicing.

f. LEGs and DRUPS shall be suitably sized to support the load required, and when newly installed have spare capacity to cater for any potential future load growth.

8.38 Diesel Rotary UPS (DRUPS):

a. DRUPS shall comply with the relevant provisions for both UPS and LEGs.

8.39 Mobile Generator Link Box (MGLB)

a. The objective of a MGLB is to:

(i) facilitate the safe and convenient connection of mobile generators; and

(ii) provide a consistent mobile generator connection interface.

b. The provision, in design and construction, of a MGLB across the Estate shall be of a consistent and uniform configuration and standard.

Small embedded power generation systems

8.40 Small embedded power generations systems shall only be connected to the *Defence electrical distribution system* following:

a. Consultation with responsible *Electrical Operating Authority* regarding any power system limitations;

b. Performance of a power system study that determines the normal and worst-case effect(s) on power quality from the proposed embedded generation and any existing embedded generation at:

(i) The installation;

(ii) The source of supply, e.g. the distribution transformer; and

(iii) Any other loads connected to the same source of supply
The results of this study shall inform the capacity of the embedded generation that is installed.

8.41 Small embedded generation systems shall be provided with automatic protection to immediately disconnect from the *Defence electrical distribution system* in the event of a loss of normal supply, and shall remain disconnected until supply to the *Defence electrical distribution system* is restored and stable.

8.42 Where small embedded generators are used to supplement local standby power systems, any switchboard supplied by the embedded generator, either directly or otherwise, shall be clearly labelled as such.

CHAPTER 9
Electrical operating authority

Aim

9.1 The aim of this policy is to provide the principals and objectives for the management and operation of electrical systems on the *Defence Estate*.

References

9.2 Reference is necessary to the following documents:

a. State and Territory Legislation and Regulations for electrical works;

b. AS/NZ 3000 – Wiring Rules; and

c. Defence Policies and referenced standards and codes.

Scope

9.3 This Chapter sets out the roles, responsibilities and authorities in the management and operation of Defence electrical distribution and power generation systems.

Objective

9.4 The objectives of this policy are that electrical distribution systems and power generation systems:

a. Are safe to operate and deliver electrical power in a manner that is safe to users and other stakeholders;

b. Achieve compliance with respective statutory obligations, industry installation standards, codes and legislation;

c. Provide defined capacity for Defence operations in normal and abnormal operating conditions;

d. Provide defined power quality for users and other stakeholders;

e. Are configured in a logical manner that minimises power system losses; and

f. Have effective power control and monitoring, consistent with the size of the system, to detect system status and faults, including whether system components are becoming overloaded.

Responsibilities

9.5 The Department of Defence, as the owner and user of electrical distribution systems on its establishments, is responsible for their operation. Defence vests the responsibility for the technical control and operational safety for the Base *electrical distribution system* with the *Electrical Operating Authority.* Typically, the Estate Maintenance & Operations Services (EMOS) contractor is engaged to provide these

services as part of the Base Services Contract. In defined operating conditions, Defence personnel may provide part or all of these services.

9.6 The *Electrical Operating Authority* is responsible for the day to day operation, maintenance and management for the Defence *electrical distribution systems*. These responsibilities include;

a. Operating the network including:

(1) The continuity of supply from electrical distribution system to users;

(2) The configuration and operation of the electrical distribution systems at all times, including normal and abnormal operating circumstances;

(3) Implementing documented operating procedures for the operation of the *electrical distribution system*.

b. Regulating access to the electrical distribution systems;

(1) The appointment and authorisation of personnel required to access, operate or to work upon the electrical distribution systems;

(2) Ensuring the safety of all personnel required to access, work upon or work in close proximity to the *Defence electrical distribution system* including issuing access permits for any procedure requiring encroachment within safe working distances from *Defence electrical distribution systems*.

c. Managing the status and condition of the Defence electrical distribution system:

(1) Maintaining documentation of the configuration of the Defence electrical distribution system;

(2) Monitoring the condition, status and loads within Defence electrical distribution system;

(3) Accepting and connecting new electrical distribution system infrastructure; and

(4) Ensuring new works, upgrades or augmentations to the electrical distribution systems are in accordance with this policy;

d. Maintaining of the plant and equipment in accordance with Base Services contract requirements and all applicable legislation and regulations.

Authorisation to access or work upon or in close proximity defence networks

9.7 No person/s shall access, operate or work upon, or in close proximity to, the Defence electrical distribution systems without the expressed authorisation of the *Electrical Operating Authority*:

a. Close proximity relates to work within areas housing high voltage equipment or in proximity to earthing systems of high voltage systems where those earthing systems are likely to become exposed due to the works.

9.8 The *Electrical Operating Authority* shall be the sole body to accredit and authorise persons to access, operate and work upon, or in close proximity to, the *Defence electrical distribution systems*. Works must be under the direct supervision of an authorised person in accordance with the *Electrical Operating Authority's* documented operational procedures for the Site.

9.9 All such authorisations shall be in full accordance with all legislative and regulatory requirements for the applicable jurisdiction.

9.10 The *Electrical Operating Authority* shall have documented processes and procedures setting out the levels and categorisation of accreditations and authorisations for various activities, including but not limited to:

a. the levels of experience and competencies required;

b. means of assessing experience and competencies;

c. training requirements including ongoing and refresher training;

d. the time periods authorisations are valid for;

e. the means of renewing authorisations; and

f. the means for recording and updating authorisations.

9.11 The Electrical Operating Authority shall ensure that:

a. Persons who have been authorised have the competency and experience necessary for the tasks that they are performing;

b. The level and limitations of the authorisation is clearly set out and fully understood and accepted by the person;

c. Authorisations are for specific set time periods that are consistent with the work being performed;

d. Authorisations are cancelled immediately when they are no longer required, with the cancellation being acknowledged by the person who has been authorised;

e. The issue, acceptance and cancellation of authorisations shall be formally recorded;

9.12 Where persons or activities may come into close proximity to overhead power lines or may expose or be working close to underground power cables the *Electrical Operating Authority* or their designated delegate for the site shall be consulted before any works begin. The directions and advice provided by the *Electrical Operating Authority* or their designated delegate shall be fully abided by.

Acceptance and connection of works to the electrical distribution systems

9.13 The Defence *Electrical Operating Authority* or their designated delegate has the right to refuse any connection and/or energisation of works to the electrical distribution system where those works:

a. Compromise safety, or have not achieved full compliance with the appropriate legislation, regulations. This shall be supported by a formal safety and risk assessment that assesses the works in relation to:

   (i) Relevant codes, standards and guidelines;

   (ii) Legislative requirements;

b. Compromise operational integrity or are not in conformance with this Manual, the MIEE. This shall be supported by a formal review and risk assessment that assesses the works in relation to:

   (i) This Manual;

   (ii) Any brief or direction for the works from Defence, noting Defence can authorise works that are not in conformance with the above;

c. Have not provided the necessary updated documentation and records as required under this Manual and or provided updated network schematics, single line diagrams, network geographic and/or underground cable locations.

9.14 In refusing connection or energisation, the *Defence Electrical Operating Authority* shall provide a formal report on the above to the Project Sponsor, in consultation with the *Capability Manager*, for a decision regarding acceptance or otherwise of the installation. This shall be supported a formal review and risk assessment that assesses the works in relation to the relevant items of paragraph 9.13.

Documentation and records

9.15 The *Electrical Operating Authority* shall maintain the following documentation and records for the *electrical distributions systems*. Documentation shall be stored for easy access on the *DEIS* for each applicable Base. Where a project seeks to modify *Defence electrical distribution system*s, the production of updated documentation resides with the project, that is the project shall provide updated documents to the Electrical Operating Authority as part of the HOTO process;

a. Network schematic and single line diagram for the Base as a whole;

b. Schematics and single line diagrams for each substation and switching station;

c. A network geographic plan showing the general location of the electrical distribution network across the Base;

d. The electrical operating, access and permit procedures for the Base;

e. The operating / switching schematics used for the Base

f. Underground cable locations across the Base;

g. Power System Report for the entire system;

h. Protection Report for the entire system, and all protection relay settings files and protection settings for the Base;

i. Earthing Reports and the results of earth grid testing for each substation and switching station;

j. Load Flow Studies;

k. Contact details for the appointed Network Controller, and authorised operating personnel;

l. Installation Safety Management Plan;

m. Operating Protocol between Network Service Provider and Defence;

n. Defence electrical distribution system elements Inspection and Maintenance Plan(s);

o. Bushfire risk Management plan and associated risk assessments;

p. Operating Protocols for Abnormal Operating Conditions e.g. loss of primary power supply;

q. Any other management plans or information pertaining to the operation of the electrical distribution network;

r. Hazardous Area Dossiers;

s. Log Books;

t. Operation Manuals – refer also to paragraph 5.25; and

u. Maintenance Manuals – refer paragraph 5.26,

9.16 The above documentation and records shall be the most current and accurately reflect the current physical condition and performance status of the electrical distribution systems on the Base.

9.17 Where the Electrical Operating Authority makes changes to the network they shall update the documentation to reflect these changes.

9.18 The above documentation and records shall be kept on the DEIS in both raw data format to enable its editing and updating and in pdf format for the information Defence personnel, contractors, consultants, etc as required.

9.19 The Electrical Operating Authority shall make available the above documentation and records as required and or requested by any project seeking to undertake any works upon the electrical distribution systems.

Operational personnel

9.20 The Electrical Operating Authority shall ensure that they have sufficient authorised personnel to meet the daily operational requirements for the Base and to sustain abnormal operating conditions as agreed for each Base.

Support for projects

9.21 The Electrical Operating Authority shall provide reasonable support to projects undertaking works upon the electrical distribution systems. This shall include:

a. any required network switching and isolation; and

b. provision of system information including loads and spare capacity.

9.22 Where the requirements for this support may be beyond the resources readily available from Authorised Personnel for the Base, the Electrical Operating Authority may come to an agreed arrangement with a project. This could include and not be limited to:

a. Payment for required overtime;

b. Payment for temporary employment of additional Authorised Personnel; and

c. Authorisation of the Project’s personnel

High voltage system outages

9.23 The Electrical Operating Authority shall ensure that where the high voltage system is isolated in whole or part, that the duration of any power interruption or reduction in redundancy is as short as practical. This includes isolations that affect the ability to move the open points on rings.

9.24 If an isolation would reduce redundancy for greater than three days then the works require prior approval from the Base Commander and Regional Manager. This application shall be supported by a formal risk assessment including mitigation measures to be prepared by the person or project requesting the outage in consultation with the *Network Controller*.

CHAPTER 10

Safe access to electrical distribution networks

Aim

10.1 This Chapter sets out the responsibilities of persons and projects accessing to the Defence electrical distribution system.

References

10.2 Reference is necessary to the following documents:

a. State and Territory Legislation and Regulations for electrical works;

b. ASNZ 3000 – Wiring Rules; and

c. Defence Policies and referenced standards and codes.

Objectives

10.3 The objectives of this policy are to protect and ensure the safety of:

a. The Public and Property;

b. Defence's electrical generation and distribution systems; and

c. Persons working upon the electrical distribution;

Safe clearance from defence electrical distribution networks

10.4 All persons and equipment shall at all times maintain a minimum clearance of 3 metres from any uninsulated and exposed parts of the Defence electrical distribution system, unless authorised by the *Electrical Operating Authority* or their authorised delegate.

a. Examples of the uninsulated and exposed parts of the electrical distribution networks are:

   (i) The bare conductors and cabling on overhead power lines; and

   (ii) Exposed power cable terminations or joints within substations, switching stations, pillars or pits;

Authorisation to access or work upon or in close proximity to defence networks

10.5 Safe Work Australia provides guidance material for working in close proximity to electrical distribution networks. Reference https://www.safeworkaustralia.gov.au/resources-and-publications/guidance-materials/general-guide-working-vicinity-overhead-and-underground-electric-lines. Each State and Territory also have specific clearances required to be maintained by persons from electrical distribution networks.

10.6 All persons and equipment shall maintain clearances from Defence electrical distribution networks in accordance with the requirements set out by Safe work Australia and the applicable State or Territory requirements.

10.7 No person/s shall access, operate or work upon or in close proximity to the Defence electrical distribution systems without the express authorisation of the *Electrical Operating Authority*.

a. This includes areas:

(i) in proximity to underground electrical infrastructure;

(ii) housing high voltage equipment; or

(iii) considered as Work Zones B or C within the Work safe Australia Guidelines. Example Figure 9.1 below.

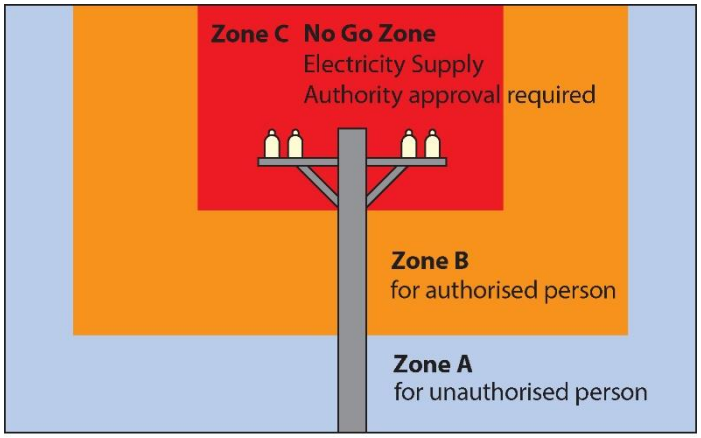

Figure 9.1 - Work zones in the vicinity of overhead electric line poles.

10.8 The *Electrical Operating Authority* shall be the sole body to accredit and authorise persons to access, operate and work upon or in close proximity to the *Defence electrical distribution system*. Works must be under the direct supervision of an authorised person in accordance with the *Electrical Operating Authority's* documented operational procedures for the Site.

10.9 Where persons or activities may come into close proximity to overhead power lines, or may expose or be working close to underground power cables, the *Electrical Operating Authority* or their designated delegate for the site shall be consulted before any works begin. The directions and advice provided by the *Electrical Operating Authority* or their designated delegate shall be fully abided by.

CHAPTER 11
Control and monitoring systems

Aim

11.1 The aim of this policy is to provide the principles and objectives for Defence Control and Monitoring Systems.

References

11.2 Reference is necessary to the following documents:

a. Defence Communications Cabling Standard;

b. Australian Government Information Security Manual (ISM);

c. Australian Communications and Media Authority Standards;

d. Defence Security Policy Framework;

e. Guideline 1101 - DESN Network Requirements;

f. Guideline 1102 – Power Control and Monitoring System (PCMS);

g. Guideline 1103 – Building Management System (BMS); and

h. Guideline 1103 – Substation Automation System (SAS)

Prime principle

11.3 The principles that this policy seeks to ensure that:

a. A consistent approach is to the provision of Defence control and monitoring systems, and the associated communications networks is applied; and

b. Engineering systems are protected from external parties seeking to disrupt Defence operations

Performance objective

11.4 The objective of this policy is to provide Control and Monitoring systems that:

a. Have effective control and monitoring, consistent with the size and function of the system, to detect system status and faults;

b. Detect whether system components are becoming overloaded;

c. Are developed in a systematic way without undue upgrade costs; and

d. Are managed from a whole-of-base perspective such that projects to expand, augment or leverage the network are not developed in isolation from other system components.

Communications Networks

11.5 Communications networks associated with Defence control and monitoring systems generally take two forms:

a. Process networks.
These are isolated communications networks that are dedicated to a particular purpose, such as an individual control system, and are generally confined to within a single facility; and

b. Wide area networks.
These are communications networks that extend over a large geographic area, although in a Defence context are generally restricted to a single establishment.

11.6 In order to maximise future supportability, communications protocols shall generally use open standards, such as Modbus or IEC 61850. Proprietary protocols are acceptable where the required functionality cannot be achieved otherwise.

Process Networks

11.7 Process networks are generally isolated networks not connected to other networks. However, where process networks are bridged onto other process networks or wide area networks this shall be done in such a way that it does not compromise the security of either network.

Defence engineering services network (DESN)

11.8 Rather than have a proliferation of wide area networks for different purposes across an establishment it is the objective of Defence to utilise common wide-area network infrastructure to support Engineering Services. This network infrastructure is termed the Defence Engineering Services Network (DESN).

11.9 The DESN is a communications backbone, generally consisting of multicore fibre optic cables and the associated active equipment. Depending upon the technical, security and other requirements of the individual system utilising the DESN communications might utilise the same or separate fibres on the DESN backbone.

11.10 The separate systems utilising the DESN may include:

a. Power Control and Monitoring System (PCMS), including Load Shedding;

b. Substation Automation System (SAS);

c. Generator Control System (GCS) for large centralised power generation systems;

d. Building Management System (BMS);

e. UPS Alarms;

f. Fire Services;

g. Crash Alarms;

h. Site Blackout Signals;

i. Emergency Shower Operation Alarm;

j. Security Access Control Systems;

k. CCTV;

l. Fuel Services SCADA systems;

m. Waste Water Treatment SCADA systems;

n. Lighting Controls; and

o. Computer Monitored Emergency Lighting.

11.11 The DESN network may provide the dedicated fibre link (separate cores to those provided above services) required for AGL control system (with nodesat ALERs and ATC Tower).

11.12 DESN infrastructure shall be consistent with the requirements of an Official Network as defined in the Defence Communications Cabling Standard and Australian Government Information Security Manual (ISM).

11.13 Any project seeking to create, or significantly augment or extend any systems that require the DESN, such as those listed in paragraph 11.10, shall:

a. where there is an established DESN at the base, interface the system with the DESN, including extending it if required; and

b. where there is not an established DESN at the base, provide enabling infrastructure within the physical boundaries of the project to be upgraded to connect to a future DESN

11.14 Where any system that will utilise the DESN are proposed for a facility, the requirements of the DESN infrastructure shall be considered in the design. This shall include racks, entry conduits, cable reticulation pathways and risers. Where it is foreseen that such systems could be installed in the future suitable provision for the future DESN infrastructure shall be provided.

11.15 Omission of DESN infrastructure by exception, with the consent and agreement of the Electrical Engineering Section.

Power control and monitoring system (PCMS)

11.16 The Power Control and Monitoring System (PCMS) is a supervisory system for the control and monitoring of various systems associated with *Defence electrical distribution system* at an establishment.

11.17 The functions of the PCMS vary between establishments depending upon the configuration of the *Defence electrical distribution system* can include, as appropriate:

a. LV load management in response to load shedding commands from other systems. Control of HV switchgear shall generally not be performed by the PCMS;

b. Control and monitoring of Local Emergency Generators across the establishment;

c. Monitoring of HV switchgear;

d. Monitoring of power flows in the HV network and distribution substations;

e. Monitoring of HV secondary equipment, such as battery chargers and protection equipment;

f. Monitoring of centralised power generation plant or other sources of electrical supply, e.g. CEPS or centralised frequency converters (such as 60 Hz);

g. Defence Operational Requirements, such as RAAF Base blackout systems; and

h. Other control and monitoring functions as required.

11.18 This policy does not prescribe the type of establishment that requires the implementation of a PCMS or the extent of the PCMS at an establishment. The determination as to whether a PCMS is required and its extent shall be by assessment of the relevant issues, including but not limited to the following:

a. Existence and capacity of any centralised power generation (either Prime or Standby) with a Generator Control System that requires the ability to shed remote load;

b. Master planning requirements and possible staged implementation;

c. The feasibility and desirability of extending the PCMS to existing facilities at the establishment;

d. Operational requirements, such as the extent of operator interfaces (full SCADA system implementation or a simplified HMI);

e. Maintenance requirements, such as data capture, monitoring and upkeep, to enable performance-based unplanned maintenance;

f. Consequences of power supply interruption, and the need to manage load to prevent these from occurring, in terms of:

(i) Loss of function;

(ii) Process disruption;

(iii) Recovery time;

(iv) Duration and frequency of power outages.

g. Ability of utility power supply or site emergency power supply to meet the site power requirements; and

h. The presence of embedded generation, within the Defence facility able to export electricity back into the NSP network.

11.19 Notwithstanding the above, in the design of new (or modifications to) centralised generator plant, high voltage networks or distribution substations the presumption is that, at a minimum, facilities in support of a future PCMS shall be provided.

11.20 Generally, PCMS shall be a distributed control system with three main components:

a. A distributed control system consisting of remote input/output devices (such as PLCs) or Remote Terminal Units (RTU). This is termed the PCMS Process Network (PN);

b. A Supervisory Control and Data Acquisition (SCADA) system that monitors and provides a user interface into the PCMS Process Network; and

c. Application servers for logging and retrieval of monitored information/data, events and alarms.

11.21 The PCMS shall be rugged and fault tolerant. For instance:

a. The PCMS shall utilise industrial grade equipment, and equipment used in substations shall be suitable for a noisy electrical environment;

b. The PCMS shall be resistant to cyber-attack. Radio or other wireless links shall only be used following a cybersecurity risk assessment and with Defence approval. Unless otherwise indicated the PCMS shall comply with at least IEC 62443 Security Level 2;

c. Process Network shall be capable of autonomous operation when communications to the PCMS SCADA are unavailable;

d. No automatic control shall be implemented in the PCMS SCADA; and

e. Fails in a way that minimises impact to operations.

11.22 The PCMS SCADA shall provide an operator interface consisting of an Operator Terminal/s or Human Machine Interface (HMI) to allow functions such as:

a. configuration of the PCMS PN control functions;

b. manual control of some PCMS PN control functions; and

c. monitoring, storing and trending data from the PCMS PN and other systems.

11.23 While the PCMS monitors a number of mission critical systems, such as the HV electrical system and any CEPS, with the exception of LV load management the PCMS shall not control or be able to influence these systems. Suitable security measures shall be incorporated that in the event of the PCMS being is subject to cyber-attack the attacker cannot gain access to mission critical systems that are monitored by the PCMS. Generally, interfaces between the PCMS and mission critical systems shall be at ‘low level’. Where ‘high level’ interfaces are used these shall be protected using suitable hardware firewalls.

Substation Automation System (SAS)

11.24 The Substation Automation System (SAS) is a control and monitoring system covering all or part of the *Defence electrical distribution system* at an establishment.

11.25 The primary purpose of the SAS is one way to fulfil the requirements for remote control of HV switchgear contained in Chapter 7, while also providing the operator with status information on the HV switchgear being controlled.

11.26 As the SAS is used to perform switching operations on the *Defence electrical distribution system,* and this has the potential to impact Defence capability cybersecurity shall be an important consideration. Unless otherwise indicated the SAS shall comply with at least IEC 62443 Security Level 3.

11.27 The SAS is generally restricted to the primary distribution nodes at an establishment, with the PCMS performing the monitoring and control functions at distribution substations.

11.28 The functions of the SAS vary between establishments depending upon the configuration of the *Defence electrical distribution system.* They can include, as appropriate:

a. Control of HV switchgear;

b. Monitoring of the status of HV switchgear;

c. Monitoring the power flows and other key parameters of the HV network;

d. Monitoring of the status of ancillary systems; and/or

e. Other control and monitoring functions as required.

11.29 The SAS shall utilise industrial grade equipment, and equipment used in substations shall be suitable for a noisy electrical environment.

11.30 The SAS might monitor status and data that is also required by the PCMS. In which case consideration should be given to avoiding duplication of infrastructure by having the SAS pass data to the PCMS. This shall be done in a manner that maintains the security and integrity of both systems.

Cybersecurity

11.31 The DESN shall be designed to withstand cyber security attack in accordance with Defence and Australian Government Policies in particular the *Information Security Manual* and the *Defence Security Principles Framework*.

Prevention of unauthorised access

11.32 The design and construction of the *Defence Engineering Services Network* and the systems running on the network shall prevent unauthorised access, including remote access, to the system that could result in interference, operation, monitoring and or tampering.

11.33 Access to any part of the *Defence electrical distribution system* shall be limited to persons authorised by the Base Electrical Operating Authority, and the extent of that access shall be strictly controlled.

CHAPTER 12
Aeronautical ground lighting

Aim

12.1 This Chapter sets out the electrical design compliance criteria applicable to aeronautical ground lighting installations for Defence aerodromes.

Prime principle

12.2 The overall philosophy for Defence AGL infrastructure is to enable and support air capability via the provision of appropriate visual aids and associated infrastructure that are regulatory compliant, safe, functional and fit for purpose, energy efficient and offering optimal through life performance.

12.3 AGL infrastructure is a unique and complex electrical installation that requires particular consideration of each installation, or each adjustment to an installation, to achieve compliance with electrical regulations. Typically, compliance is achieved through application of specific design that aligns with the recognised safety principles prescribed in electrical regulations.

Visual and photometric requirements

12.4 Criteria pertaining to the visual and photometric requirements of the AGL installations are detailed in ADRM and the associated Handbook of Infrastructure Engineering – Aerodromes.

AS/NZS 3000 – wiring rules; compliance by specific design and installation

12.5 AGL installations are unique and complex installations, with elements not complying with AS/NZS 3000 Part 2. Accordingly, the Compliance by Specific Design and Installation process shall be applied in a manner to provide compliance with AS/NZS 3000.

12.6 Defence ASEE has promulgated standing acknowledgement of Compliance by Specific Design and Installation for AGL electrical installations, comprising both the field installation and associate circuiting, CCRs, etc, with prescribed reasoning for such compliance. This reasoning and the prescribed specific design and installation includes mandated compliance criteria and must be applied in developing any design solution. MIEE Guideline 1204 – AGL Compliance by Specific Design and Installation details the basis of ASEE agreement and provides guidance as to the application of the Compliance by Specific Design and Installation process for AGL installations.

Technical guidelines - international standards

12.7 Whilst AS/NZS 3000 is the mandated Electrical Regulations with criteria for WHS requirements and safety of personnel and assets, AGL installations are typically unique and AS/NZS 3000 does not detail requirements for series circuits constant current installations for AGL. Accordingly, reference shall be made to

applicable international standards and guides with installations being compliant with such AGL specific requirements.

a. A number of IEC standards pertaining to Electrical Installations for Lighting and Beaconing of Aerodromes shall be referenced for technical guidance:

   (i) IEC 61820 – Electrical Installations for Aeronautical Ground Lighting at Aerodromes;

   (ii) IEC 61821 – Maintenance of Aeronautical Ground Lighting Constant Current Series Circuits;

   (iii) IEC 61822 – Constant Current Regulators;

   (iv) IEC 61823 – Series Isolation Transformers;

   (v) IEC 62870 – Safety Secondary Circuits in Series Circuits.

b. ICAO produces several Aerodrome Design Manuals pertaining to AGL that shall be referenced for technical guidance:

   (i) Doc 9157 Aerodrome Design Manual – Part 4: Visual Aids;

   (ii) Doc 9157 Aerodrome Design Manual – Part 5: Electrical Systems;

   (iii) Doc 9157 Aerodrome Design Manual – Part 6: Frangibility.

c. Other technical documents providing guidance include:

   (i) United Facilities Code 3-535-01 – Visual Air Navigation Facilities;

   (ii) Federal Aviation Authority AC 150-5345-30 – Design and Installation Details for Airport Visual Aids.

12.8 In the event of conflicting requirements between the standards listed in 12.7, the hierarchy for requirements shall be:

a. AS/NZS 3000; prioritised over;

b. IEC; prioritised over;

c. ICAO.

Criticality of system

12.9 AGL systems shall be treated as a critical safety system and be implemented with a high level of redundancy including:

a. Dual ALERs where practical;

b. Segregation of discrete interleaved circuits; and

c. High availability power supplies (>99.999%), typically including LEG and UPS.

12.10 ALERs are Contribution Factor 2 providing a direct and high level contribution towards the capability of Defence aviation operations.

AGL FIELD INSTALLATION

Circuit configuration

12.11 Each separate visual aid system shall be arranged on a discrete circuit.

Note: Runway lighting is a system. Threshold and end lights are sub-systems that may be supplied on a common (interleaved) circuit.

12.12 Every approach and runway lighting system shall be connected as constant current series circuits with the lights distributed over a minimum of two interleaved circuits.

12.13 For redundancy, where both Port and Starboard approach slope indicator systems (PAPI) are provided on a runway approach each system shall be connected on a discrete circuit.

12.14 Where “zone” control is established for taxiway lighting, as distinct from “segment” control, interleaved circuits shall be established to supply taxiway lighting.

12.15 For redundancy of critical AGL sub-systems, where more than one ALER is provided at an aerodrome, runway and PAPI circuits for the main or primary runway shall be routed so that each circuits can be energised from either of the two ALERs.

12.16 Primary circuits shall remain isolated from earth reference.

Pit and duct system

12.17 All AGL circuits shall be installed in a pit and duct system. Cables shall not be direct buried.

12.18 Lights shall be installed with secondary cables to remote SIT pits off the edge of the aircraft pavement. Deep base cans shall only be installed in circumstances as an exception to support installation of (inset) lights where installation of a remote SIT pit is not viable and SITs must be collocated with the light.

12.19 Pit and duct infrastructure shall conform to the requirements of the Compliance by Specific Design and Installation prepared for the project; providing the required minimum depth of cover.

12.20 Physical segregation shall be provided in the pit and duct system for installation of interleaved circuits.

12.21 An engraved metallic plate shall be provided at each pit identifying the primary circuits that are accessible within the pit.

12.22 A risk assessment shall be undertaken in accordance with Defence’s established Aviation Risk Management (AVRM) process to determine what treatment is required to manage the risk of underground obstacles associated with provision of the pit and duct system.

Primary cable

12.23 Primary cable shall be 6 mm² copper single core 5 kV grade insulated cable.

12.24 Primary cables shall not be screened.

12.25 Primary cables shall incorporate measures to prevent damage by termites.

12.26 Indelible drum and metre markings shall be provided on the outer sheath of primary cables.

12.27 All primary cables shall be labelled for identification where accessible in a pit.

12.28 A length of primary cable shall be provided as a “loop” of cable in pits where (1) a change in direction occurs, and (2) a cable joint (plug/socket) is located.

12.29 A cable management plan shall be produced so that a logical arrangement of primary cables is installed and a record of their installation including their drum and sequential metre marking may be recorded for inclusion in the “As Constructed” documentation.

12.30 Primary cable shall be batch tested by a NATA registered testing authority or approved equivalent to prove compliance with specified criteria.

Secondary cable

12.31 Secondary cable shall be flat twin 2.5 mm^2 (minimum) copper multi-strand (50/0.25) flexible PVC 0.6 kV grade insulation, nylon sheathed, cable.

Cable joints, plugs and sockets

12.32 Plugs/sockets shall be provided on primary cables to enable connection, or bypass, of SITs.

12.33 The primary cable joint shall maintain the insulation and dielectric properties of the primary cable when installed in any location within the AGL system.

12.34 A length of primary cable shall be provided for each connection to a SIT to facilitate future re-termination.

12.35 A length of primary cable shall be provided for each in line joint to facilitate future re-termination.

12.36 Plugs/sockets shall be provided on secondary cables to enable connection to SITs and lights. Provision shall be provided to retain the secondary cable plug at locations of the frangible coupling for elevated lights.

Series isolation transformers

12.37 Series isolation transformers (SITs) shall be 5 kV insulated 6.6:6.6 A manufactured generally in accordance with the requirements detailed in the current revision of IEC 61823 AGL Series transformers and the current revision of FAA AC 150/5345-47– Isolating Transformers for Airport Lighting Systems.

12.38 Secondary circuits from SIT to light shall be configured as a SELV (Separated Extra Low Voltage) circuit with no reference to earth; the secondary circuits *should* remain a floating system, not earthed at each SIT.

Luminaire and sign installation

12.39 The photometric, location and orientation criteria of AGL visual aids including luminaires and signs shall be as detailed in the ADRM and the Handbook of Infrastructure Engineering - Aerodromes.

12.40 The structural integrity of the lights shall conform with FAA criteria and frangibility shall conform with ICAO Aerodrome Manual Vol 6.

12.41 Inset light bases shall be compatible with inset light fittings. Bases shall be as *recommended* by the manufacturer of the light fitting.

Hazardous areas

12.42 Hazardous Areas and/or Explosive Hazardous Areas generally exist in defined locations on airfields, notably:

a. Aircraft refuelling operations on parking aprons and OLAs; and

b. Restricted electrical areas established on aprons licenced for explosive ordnance operations.

Where AGL systems are located within these defined hazardous areas, these shall comply with hazardous area requirements.

AIRFIELD LIGHTING EQUIPMENT ROOM (ALER)

ALER location

12.43 A risk based assessment shall be undertaken to determine the location, configuration, and number of ALERs to be provided on the airfield.

Fire detection

12.44 An early warning fire/smoke detection system shall be installed within the ALER.

LV distribution

12.45 All loads within the ALER are to be considered essential and the whole system needs to be switched from “Mains” to “Generator” supply in the event of a mains failure.

12.46 The supply to CCRs shall be distributed over 2 separate Distribution Boards in a manner that mitigates a single point failure extinguishing an AGL visual aid.

Backup power

12.47 A local emergency generator shall be installed to supply the CCRs.

12.48 For Precision Approach Cat 1 capability the backup power system shall restore AGL within 15 seconds in accordance with recognised standards. At other Defence airfields the backup power system shall also be configured to restore AGL within 15 seconds.

12.49 Appropriate fuel reserves shall be provided to enable the generator to supply connected load. Fuel storage shall comply with Defence Fuel Installation – Design Practices Manual, Defence Pollution Prevention Management Manual and environmental policies.

12.50 A UPS shall supply the AGL Control System to mitigate outages in the event of a power failure. 30 minutes minimum battery autonomy shall be provided.

VHF transceiver

12.51 A ground radio with VHF frequency selection for Air Band Frequency selected to comply with Ground Telecommunication Equipment (GTE) approval requirements shall be provided within the ALER.

Primary circuit surge protection

12.52 Suitably rated surge protection shall be installed on primary field cabling crossing the perimeter of the Airfield Lighting Equipment Room. The surge protectors shall be installed on the external perimeter of the ALER building.

AGL CONTROL SYSTEM

Provision of AGL control system

12.53 A control system shall be provided to enable control of the AGL by operators at the ATC facility (where provided) or maintainers at the ALER.

12.54 Consideration shall be given to an appropriate solution that provides the necessary control functionality whilst enabling corrective maintenance and repair activity at the installed location.

12.55 The control system shall provide revertive feedback to the control locations.

12.56 An AGL control system terminal shall be integrated within the ATC management system (where provided).

12.57 An AGL control system terminal shall be provided within each ALER on the Aerodrome. These terminals shall be configured to provide equipment status and maintenance information.

12.58 A portable AGL control system terminal shall be provided to facilitate maintenance activity, and provide control for mobile ATC tower, where required.

12.59 The AGL control system shall control the Aerodrome Beacon (where provided)

12.60 The AGL control system shall not control floodlighting or obstacle lights.

Pilot activated lighting control (PALC)

12.61 The provision of PALC shall be based on the documented operating intent of the Aerodrome.

12.62 PALC shall respond to VHF signal associated with the CTAF for the Aerodrome and shall not be configured to respond to mobile telephony signal and networks.

12.63 A method of monitoring use of AGL under PALC operation shall be applied.

Constant current regulators

12.64 Constant Current Regulators (CCRs) shall be utilised to energise AGL field circuits (specifically, Mains Isolation Transformers (MITs) shall not be used).

12.65 CCR Control Boards shall be provided to enable connection and isolation of CCRs supplying field circuits. The control board shall provide capability to isolate and earth the primary field cables associated with the board.

Standardisation of CCR

12.66 CCRs shall be standardised as far as practical to maximise safety and simplify operation and maintenance practices within each Defence establishment or, to a lesser extent, across the region.

12.67 Where there is a mixture of equipment within a Defence establishment or across a region, the choice of which will become the site standard shall be taken in consultation with the site *Electrical Operating Authority* / *Network Controller* regarding operational experience with the equipment. This shall consider:

a. Technical suitability for the intended application;

b. Compliance of the equipment with the requirements of this Manual;

c. Operational issues with the equipment and local technical support, and

d. Factors that affect future service life, such as spare parts issues or remaining time the equipment is likely to be manufactured.

12.68 Equipment other than the site standard can be considered, with the agreement of the Electrical Engineering Section and:

a. Where a large quantity of new equipment is being introduced, and there is a clear financial benefit to Defence in considering alternatives, OR

b. Where the site standard equipment does not offer necessary technical features for a particular application.

12.69 The existing site standard equipment can be considered no longer to be viable if:

a. The equipment does not comply in significant ways with the requirements of this Manual;

b. The equipment has issues that adversely affect safety, operability, or compromise Defence operations or capability, or

c. The equipment no longer available, spares are in short supply or there are plans to supersede the equipment;

12.70 Where equipment other than the site standard is used or the existing site standard is no longer viable, then a new site standard shall be established using a performance based specification. The final decision on any new standard equipment should be undertaken in consultation with the site *Electrical Operating Authority / Network Controller* regarding the operational and maintenance aspects of the equipment.

Blackout Control

12.71 Where Blackout control system is established on a Base to enable the Base operators to extinguish all external lighting from the Base Command Post, a signal shall be extended to the airfield lighting control system.

12.72 In the event of a Blackout signal being initiated, with Air Traffic Controllers available to manage the airspace, then any extinguishing of aeronautical ground lighting shall be subject to a confirmatory action by the ATC staff.

12.73 In the event of a Blackout signal being initiated, with no Air Traffic Controllers available to manage the airspace, then extinguishing of aeronautical ground lighting shall be subject to a permissive signal from the PALC system. If AGL is operational in response to a PALC request then the AGL shall remain illuminated pending end of cycle.

Intensity control

12.74 Intensity control of the respective visual aids provided on the airfield shall be based on the documented operating intent of the Aerodrome.

Cyber worthiness

12.75 The AGLCS shall incorporate failsafe arrangements to retain the last selected state in the event of a control system failure.

12.76 Remote access for dial in maintenance and update of the AGLCS must comply with all requirements of the Defence Security Principles Framework (DSPF).

12.77 There shall be a dedicated fibre link between the ALER(s) and ATC facility (tower), that is isolated from other networks.

12.78 PALC presence and configuration provided for aviation safety during times when ATC is not staffed. The risk associated with PALC system turning on lights unnecessarily is considered acceptable, however nuisance operation must be addressed if detected.

Night vision imaging systems

12.79 The Handbook of Infrastructure Engineering – Aerodromes defines operational requirements of lighting aids compatibility with NVIS.

12.80 Infrared signals may be provided as an intensity selection where the AGL technology allows (that is, “black current” in incandescent fittings).

12.81 Alternatively, the solution may be implemented as a discrete system configuration rather than intensity selection.

CHAPTER 13
Aeronautical ground lighting – maintenance

Aim

13.1 This Chapter sets out the electrical compliance criteria applicable to maintenance of aeronautical ground lighting installations for Defence aerodromes.

Prime principle

13.2 The overall philosophy for Defence AGL infrastructure is to enable and support air capability via the provision of appropriate visual aids and associated infrastructure that are regulatory compliant, safe, functional and fit for purpose, energy efficient and offering the best through life performance.

13.3 AGL infrastructure is a unique and complex electrical installation that requires particular consideration of each installation, or each adjustment to an installation, to achieve compliance with electrical regulations. Typically, compliance is achieved through application of specific design that aligns with the recognised safety principles prescribed in electrical regulations.

Visual and photometric requirements

13.4 Criteria pertaining to the visual and photometric requirements of the AGL installations are detailed in ADRM and the associated Handbook of Infrastructure Engineering – Aerodromes.

AS/NZS 3000 – Wiring rules, compliance by specific design and installation

13.5 AGL installations are unique and complex installations, with elements not complying with AS/NZS 3000 Part 2. Accordingly, the Compliance by Specific Design and Installation process shall be applied in a manner to provide compliance with AS/NZS 3000.

13.6 Defence ASEE has promulgated standing acknowledgement of Compliance by Specific Design and Installation for AGL electrical installations, comprising both the field installation and associate circuiting, CCRs, etc, with prescribed reasoning for such compliance. This reasoning and the prescribed specific design and installation includes mandated compliance criteria and must be applied in developing any design solution. MIEE Guideline 1204 – AGL Compliance by Specific Design and Installation details the basis of ASEE agreement and provides guidance as to the application of the Compliance by Specific Design and Installation process for AGL installations.

Technical guidelines - international standards

13.7 Whilst AS/NZS 3000 is the mandated Electrical Regulations with criteria for WHS requirements and safety of personnel and assets, AGL installations are typically unique and AS/NZS 3000 does not detail requirements for series circuits constant current installations for AGL. Accordingly reference shall be made to

applicable international standards and guides with maintenance activity being compliant with such AGL specific requirements. These are listed in paragraph 12.7.

13.8 The following competence factors shall be considered to justify the competence of persons carrying out their duties:

a. Safety engineering appropriate to the technology;

b. Knowledge of the applicable legal and safety regulatory framework for the installation;

c. The consequences in the event of a failure of a (constant current) series circuit;

d. The consequences of failure to adhere to safety procedures when working on (constant current) series circuits;

e. The novelty of the design, design procedures or application;

f. Previous experience relevant to the specific duties to be performed and the technology being employed; and

g. Relevance of qualifications to the specific duties performed.

Operation

Operation of AGL field installation and ALER equipment/fitout

13.9 Operators of the AGL system shall have the necessary background experience and understanding of:

a. High voltage nature of constant current regulated series circuits; and

b. Primary circuit insulation resistance of series circuits

13.10 Air Traffic Controllers selecting circuits and adjusting light intensities shall be considered “users” of the system rather than “operators”.

Maintenance

Maintenance of AGL field installation and ALER equipment/fitout

13.11 Maintainers of the AGL system shall have the necessary background experience and understanding of:

a. Maintenance of primary circuit insulation resistance;

b. Knowledge of CCR configuration and operation; and

c. Situational awareness of airfield operations (airside qualified).

Maintenance of AGL control systems

13.12 Maintainers of the AGL control system shall have the necessary background experience and understanding of:

a. Maintenance of PLC based control and SCADA system; and

b. Network topology and communications/control equipment

Safe operations

13.13 No live work shall be undertaken on an AGL series circuit infrastructure:

a. Live work is defined as activity involving access to live terminals, or requiring movement or adjustment of live cables. Opening SIT pits to remove cabling and SITs requires all circuits to be isolated. Opening lights to replace lamps requires circuit to be isolated. Where a tong tester is used to measure current, this may be undertaken provided that the cable being tested does not need to be physically moved and repositioned.

AGL Maintenance

AGL maintenance agent

13.14 The contractor responsible for the AGL maintenance contract shall undertake the responsibilities of Aeronautical Ground Lighting Maintenance Agent (AGLMA) for the AGL system at the respective Defence facility.

13.15 The AGLMA has primary responsibility to make the AGL system available for operation to the airfield stakeholders. In this role they are the primary operators of the airfield's AGL infrastructure, not withstanding that ATC staff will routinely use the system with selection and intensity management of the AGL installed.

13.16 The AGLMA responsibilities encompass:

a. Ensuring the availability, safety and condition of the AGL system;

b. Managing and undertaking the inspections, maintenance, servicing, overhaul and repairs of the AGL system;

c. Managing configuration integrity;

d. Complying with Aerodrome Works Safety requirements; and

e. Complying with the reporting and documentation requirements.

Extent of maintenance requirement

13.17 The AGLMA shall manage all maintenance activities and appoint appropriate personnel to manage, supervise and undertake the specific maintenance tasks.

13.18 Maintenance of the AGL system includes, but is not limited to:

a. Preventative maintenance of the AGL system in accordance with practices *recommended* in Guideline 1301 – AGL Maintenance Practices;

b. Breakdown maintenance of the AGL system in accordance with the AGL maintenance contract;

c. Holding the defined schedule of spare parts in good condition and keeping an inventory of available spares;

d. Maintaining available, appropriately qualified and experienced personnel to undertake the maintenance activities;

e. Manually operate the AGL system when required;

f. Operate and configure the Base AGL system in the event of an equipment failure in order to restore AGL;

g. Management of an applicable permit to work system;

h. Switch, isolate and earth the AGL system to allow safe access for all persons requiring access, such as maintenance personnel, Defence personnel and contractors;

i. Setting out deployable temporary lighting systems and markings (configured as series current circuits);

j. Accept, take into service and maintain newly commissioned AGL equipment;

k. Monitor and record system performance information, capturing, storing and upkeeping data for future maintenance and renewal decision making; and

l. Documentation and reporting in accordance with this manual.

Routine preventative maintenance

13.19 The AGLMA shall develop and maintain suitable maintenance procedures that instruct on the correct and safe method of maintenance for each activity that is to be undertaken on the AGL system. The maintenance procedures shall be contained in a suitable document (e.g. AGL Maintenance Plan) and shall be provided and used at all times. A copy of the procedures shall be made available to Defence. Refer to Guideline 1301 – AGL Maintenance Practices regarding typical routine preventative maintenance activity and schedules.

13.20 The AGLMA shall develop a maintenance plan with specific and measurable outcomes that are required to be realised by implementation of the plan and undertaking the prescribed maintenance activities and procedures.

13.21 The AGLMA shall implement routine preventative maintenance. The AGLMA shall monitor the condition of the AGL system and make suitable recommendations to the Electrical Engineering Section. through the normal Estate Appraisal and/or

Estate Upkeep processes (via applicable Product Directorate) for any necessary improvements to assure the condition of the AGL and also when required to optimise maintenance.

13.22 The AGLMA shall maintain an applicable permit to work system, determine which activities require authorisation, who is able to give such authorisation and how the authorisation, including written permission, is to be obtained. Refer to Guideline 901 – HV and LV Operations regarding issue of permits/sanctions.

13.23 The AGLMA must perform suitable risk/hazard assessments for all work to be performed on AGL constant current series circuits. The completed risk/hazard assessments shall be used to form the maintenance procedures and must be retained by the AGLMA and be made available on request.

Materials and workmanship

13.24 All materials and workmanship shall be of the best standard and shall comply with relevant legislation and Australian Standards. In addition, electrical installations and equipment shall comply with all appropriate and relevant Australian standards, for the type of installation or equipment to be used, irrespective of their status. Where Australian standards are not available, recognised international or overseas national standards shall be used where they are relevant to the type of installation or equipment and to the installation conditions in Australia.