Government of Western Australia
Department of Health

WESTERN AUSTRALIA HEALTH FACILITY GUIDELINES FOR ENGINEERING SERVICES

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1 PREAMBLE

1.1 Endorsement

The Western Australia Health Facility Guidelines for Engineering Services (The Guidelines) are the engineering design, operation and maintenance guidelines for public and private health facilities in Western Australia.

The Guidelines are presented in the form of minimum acceptable requirements for major metropolitan tertiary/acute care hospitals. While based on standards for major hospitals, the Guidelines allow for a risk-based approach to design for all facilities.

The application of the Guidelines for each specific healthcare facility covered by the Regulatory Framework must consider facility type, model of care, patient acuity, project scope, location, and strategic importance. All projects submitted to LARU for review will be assessed from a perspective of patient safety, quality of care, and readiness for normal and emergency operations.

The LARU commissioned an independent review of the 2021 Guidelines that took account of current healthcare design guidelines from other States and Territories, as well as emerging post-pandemic publications and advice on emerging clinical technologies. The purpose of this review was to carry out a gap analysis and comparison of the similarities within these reference guides. Further consideration was then given to adoption and alignment of appropriate national design guidance in an updated WA version that would better align with healthcare design standards across Australia, where several elements are already either identical or similar in nature.

Subsequent to this, more recently updated healthcare design guidelines were published around Australia and further considered for inclusion and alignment in this update, or cross referenced where appropriate. LARU also commissioned a detailed industry consultation process where a draft version of the Guidelines was reviewed, commentary provided and taken into account where appropriate.

The Director General of Health has endorsed the Western Australia Health Facility Guidelines for Engineering Services 2025, as a contemporary document to be used as the relevant healthcare design guidelines for all public and private hospitals and healthcare facilities throughout Western Australia.

1.2 Version History

VERSION HISTORY	YEAR OF RELEASE
First endorsed and published	1992
Revised	1994
Revised	1996
Revised	1998
Updated	1999
Updated	2006
Updated	2017
Immediate past version	2021
This version	2025

1.3 Disclaimer

All information and content in this material is provided in good faith by the Government of Western Australia Department of Health (HDWA) and is based on sources believed to be reliable and accurate at the time of writing. The State of Western Australia, HDWA and their respective officers, employees and agents, do not accept legal liability or responsibility for the material, or any consequences from its use. This guidance document is published as a print only electronic file; it is not a controlled document when printed.

1.4 Acknowledgements

LARU acknowledges the input of Western Australian healthcare design engineers and consultants, private and public health facilities, services and individuals who have contributed to the ongoing development and refinement of the Western Australia Health Facility Guidelines for Engineering Services (WAHFG ES).

The respective health departments in the other States and Territories of Australia are also acknowledged. As part of an inter-state design guidance alignment initiative, some of the content included in this updated design guidance document has been adapted or incorporated directly from the relevant healthcare guidelines currently in use in other states, including:

NSW - Engineering Services Guidelines GL2016_020 and GL 2023_009

VIC - VHBA Engineering Guidelines for Healthcare Facilities (Vol 1-6)

QLD – QH Capital Infrastructure Requirements: Vol 4 Engineering and Infrastructure Minimum Requirements

1.5 Application

The WAHFG ES has been the main healthcare design guidance document for engineering services in use in Western Australia since the retiral of the AusHFG Part E – Building Services and Environmental Design (Rev 5.0 last published in 2016). Both Rev 5.0 and Rev 4.0 relied heavily on the separate NSW, VIC and WA Design guidelines that were in use at that time, with no differentiation between Public and Private Healthcare design.

The WAHFG ES has previously been endorsed as a contemporary document to direct public and private health facility design in WA. It is the primary design guide and compliance document use in relation to private healthcare licensing and accreditation, and all references herein relate to licensee obligations, as governed by the Private Hospitals and Health Services Act 1927.

Use of the Guidelines for public health facility design is recommended, however non-mandatory unless directly referenced in project specific briefs and/or contracts prepared specifically for the delivery of new or refurbished public healthcare facilities.

If the premises is under a Public-Private Partnership Model and is subject to the PHHS Act, or where the WA State Government is the lessor and a private licence holder is the lessee, these guidelines become mandatory. In these cases, governance and dispensation processes regarding the application of the WAHFG ES will be defined and applied by the Health Service Provider/Project Sponsor operating the public health facilities.

Acknowledgement of Country and People

WA Health acknowledges the Aboriginal people of the many traditional lands and language groups of Western Australia. It acknowledges the wisdom of Aboriginal Elders both past and present and pays respect to Aboriginal communities of today.

2 BACKGROUND

2.1 Definitions

2.1.1 Terms used throughout The Guidelines have the following meaning:

TERM	DEFINITION
Approval of Premises	In accordance with the Private Hospitals Act S26C, the Chief Executive Officer (CEO), Director General, Government of Western Australia Department of Health has a duty to approve the premises and the arrangements for management, staffing and equipment when assessing a building application.
Australasian Health Facility Guidelines (AusHFG)	Guidelines provided as an initiative of the Australasian Health Infrastructure Alliance (AHIA). Website: https://www.healthfacilityguidelines.com.au/
Australian Standards (AS & AS/NZS)	Standards Australia Level 10, The Exchange Centre 20 Bridge Street, Sydney, NSW Tel: 02 9237 6000 Website: https://www.standards.org.au/
Building Approval Process	The Licencing and Accreditation Regulatory Unit (LARU) assess the suitability of the premises using the LARU building approval process. This is a gated approval process which requires all high priority matters to be satisfactorily addressed at each approval phase prior to progressing to the next approval phase. The facility and documentation is assessed for compliance with the relevant Building Guidelines: Concept meeting (CM) – preliminary presentation of the project concept to gauge viability. Approval in Principle (AIP) – desk top audit of the preliminary design documentation, functional brief, traffic flows and patient management. Approval to Construct (ATC) – desk top audit of the detailed construction drawings and documentation. Approval to Occupy (ATO) – a site inspection is required prior to approval to occupy being recommended which includes review of the 'As Constructed' drawings, commissioning data and reports, together with consultant and contractor letters of certification.
Building Code of Australia (BCA)	Volumes One and Two of the NCC
Certification	Certification of the design and installation by the Engineer and certification of the installation by the installation contractor or specialist sub-contractor.
Concept Approval	The proposed conceptual framework, building approval process and possible staging as discussed with LARU

TERM	DEFINITION
	prior to proceeding with an Approval in Principle submission for the works.
Credible contingency	Fault or failure of a single element or linked group of elements that could reasonably occur in a single event, but with unpredictable timing, whether or not well defined or understood.
Date of Occupation	The date nominated by the 'Licence Holder/Applicant' that the facility/area has been fully commissioned (both building commissioning and clinical commissioning) and is the day the service will commence.
Day Hospital Facility	Any facility within the compass of the Health Services (Day Hospital Facility) Determination 2016 where either surgery or an interventional treatment is practiced and patients do not stay overnight.
DoH/HDWA/ Health WA	Government of Western Australia Department of Health.
enHealth	Environmental Health Standing Committee
Facility/Facilities	A site and its infrastructure, buildings, building services, fittings, furnishings and equipment of any of the categories defined to be covered by these Guidelines.
Guidelines	In accordance with The Act Section 26J, Guidelines for the construction, establishment and maintenance of private hospitals and healthcare facilities are issued by the CEO. There are three Guideline documents used to assess compliance, these are the Western Australia Health Facility Building Guidelines for: o Architectural Requirements o Engineering Services o Psychiatric Hostels All building applications are assessed for compliance with the relevant Guidelines.
Healthcare facility	In the context of licensing a Private Facility, any building or setting in which clinical care is delivered to patients or the public. Refer to further guidance in Appendix "*LARU Decision Tree*".
Hospital	Any hospital as defined in the Act in which patients stay overnight.
HRT practice	All activities as defined in the Human Reproductive Technology Act 1991
HRT storage	Store or storage as defined in the Human Reproductive Technology Act 1991
ISO	The International Organization for Standardization Website: https://www.iso.org/

TERM	DEFINITION
Licence Holder/Applicant	The updated reference for the current licence holder responsible for the private health facility/private health service provided, or in the case of a new applicant, a reference to the "intended Licence Holder/Applicant" – previously referred to as "Proprietor".
Licensing and Accreditation Regulatory Unit (LARU)	Part of Government of Western Australia Department of Health responsible for the licensing and monitoring of private hospitals in Western Australia.
Maintenance (when applied with reference to facilities)	Any work required for a facility to reliably, safely and efficiently support its intended function throughout its used life.
Minor Works	Works, to the licenced premises, that are minor in nature and that are required to enhance assets and facilities to standards suitable for their intended function or change of individual room function. Minor works include refurbishment, individual room change of function, removal/replacement of redundant out of date equipment, minor door and opening changes to improve flow efficiency and minor external and landscape works. Further guidance in determination of minor works is provided in Appendix "*Minor Works Decision Matrix*".
National Construction Code (NCC)	National Construction Code with WA Amendments Australian Building Codes Board Website: http://www.abcb.gov.au
National Health and Medical Research Council (NHMRC)	National Health and Medical Research Council Level 1 16 Marcus Clarke Street Canberra ACT 2601 Tel: 13 000 NHMRC (13 000 64672) Email: nhmrc@nhmrc.gov.au Website: https://www.nhmrc.gov.au
Nursing Unit (NU)	The module by which a hospital is developed to ensure cost efficient nurse coverage for patient safety and service e.g. One (1) nursing unit = 30 to 35 acute patient bedrooms = One (1) ward.
Operating Polices	A formal statement of the policies governing the delivery of each function contributing to the services the facility will provide. They define inputs, outputs, organisation, authorities, service providers, service takers, normal and emergency operating conditions, performance requirements, performance reporting requirements, and the like, to fully describe input resources and workload, functional management arrangements and expectations, and output capacity and quality requirements.

TERM	DEFINITION
Operation (when applied with reference to facilities)	Any action required to reliably, safely and efficiently operate sites, buildings, building services, and equipment to deliver each function carried out at a facility throughout its used life.
Patient	A person who has been, is being, or will or may be provided with health treatment or care. Use of the term in this document is not a recommendation that "patient" be used in practice in preference to other terms such as "consumer", "clients" or similar, where applicable.
Practical Completion	The date when all works are complete, except for any defects or omissions that do not prevent the building from being used for its intended purpose. The building/works are handed over to the owner at practical completion.
Proprietor	Refer to Licence Holder/Applicant
Plumbing Code of Australia (PCA)	Volume Three of the NCC
Private Hospitals Act	The Western Australian Private Hospitals and Health Services Act 1927.
Project	Any project to build or alter a facility.
Radiological Council	An independent statutory authority appointed under the Radiation Safety Act in Western Australia.
Replacement (when applied with reference to Facilities)	Any replacement of a facility, facility component or equipment item required for a facility as a whole to reach its planned life reliably, safely and efficiently.
Risk	Anything associated with the Project or operation and maintenance of a facility that requires a duty of care decision.
Risk Management Plan	Operating policies will define the risks to be mitigated related to each function contributing to the services the Facility will provide. In addition, for private healthcare facilities, and to form part of a comprehensive Risk Management Plan, there shall be a Facility Risk Management Plan that addresses any functional risks requiring facility solutions for appropriate mitigation and identifies and mitigates facilities planning, cost control, environmental, contracting, construction, commissioning, operation, and maintenance risks associated with the Facility.
Shall	The word **shall** means the requirement described is mandatory for private healthcare Licence Holder/Applicants, or for both public and private facilities where governed by Legislation, Statutory Authorities or Regulatory requirements. Shall, in the context of public healthcare projects only applies where the WAHFG ES

TERM	DEFINITION
	have been mandated as part of the project specific brief/contract.
Shall consider (and sentence derivations thereof)	The words **shall consider** applies to a strong preference for a specific element, but not mandatory unless determined as such by Legislation, Statutory Authority or other relevant Regulatory requirements.
Should	The word **should** means the requirement described is recommended as guidance and expected to be considered as part of the design process, but not mandatory unless determined as such by Legislation, Statutory Authority or other relevant Regulatory requirements.
Should consider (and sentence derivations thereof)	The words **should consider** means the requirement described is provided as guidance as one of multiple design considerations as part of the normal design development process.
Submitted design(s)	In the context of application for ATO, the documentation (including reports, plans, schedules and specifications) submitted to LARU at Approval to Construct and modified to incorporate all agreed Approval to Construct Mandatory Items. Submitted design(s) shall include any approved variations submitted after ATC was granted.
The Guidelines/ WAHFG/ WAHFG ES	The Western Australia Health Facility Guidelines for Engineering Services (this document).
WAHFG AR	The Western Australia Health Facility Guidelines for Architectural Requirements.
WorkSafe WA	A part of Department of Local Government, Industry Regulation and Safety (LGIRS), the regulator for work health and safety in Western Australia.

2.1.2 Personnel definitions used in The Guidelines have the following meaning:

ROLE	DEFINITION
Acoustic Engineer	A professional acoustic engineer experienced in healthcare facility design and construction and registered with the Australian Acoustical Society and holds a valid membership with grade of Member (MAAS).
Architect	An individual registered architect or licenced architectural corporation that are currently registered with the Architects Board of Western Australia.
Building Surveyor	A building surveying “contractor” experienced in healthcare facility design and construction and registered under the Building Services (Registration) Act 2011 and included on the LGIRS Register of Building Surveying Contractors and Practitioners.

ROLE	DEFINITION
Civil Engineer	A professional civil engineer experienced in healthcare facility design and construction and registered on The Institution of Engineers Australia National Engineering Register (NER).
Electrical Engineer	A professional electrical engineer experienced in healthcare facility design and construction and registered on The Institution of Engineers Australia National Engineering Register (NER) or have demonstrated competence and compliance performance to this level as assessed by the HDWA LARU on previous WA licenced healthcare projects.
Facility Manager	A competent hospital engineer experienced in healthcare operation and maintenance, eligible for full membership of the Institute of Healthcare Engineering, Australia (IHEA), appointed by the Licence Holder/Applicant to manage the Facility.
Fire Safety Engineer	A professional fire engineer experienced in healthcare facility design and construction and registered on The Institution of Engineers Australia National Engineering Register (NER) or have demonstrated competence and compliance performance to this level as assessed by the HDWA LARU on previous WA licenced healthcare projects.
Fire Protection Designer (Engineer)	A professional fire services designer (wet and/or dry fire) experienced in healthcare facility design and construction and registered on The Institution of Engineers Australia National Engineering Register (NER) or have demonstrated competence and compliance performance to this level as assessed by the HDWA LARU on previous WA licenced healthcare projects.
Hydraulic Engineer	A hydraulic engineer experienced in healthcare facility design and construction and registered with the Association of Hydraulic Services Consultants Australia (AHSCA) with a full membership. Alternatively, a professional hydraulic engineer experienced in healthcare facility design and construction and registered on The Institution of Engineers Australia National Engineering Register (NER) or have demonstrated competence and compliance performance to the level of AHSCA full membership or IEAust NER as assessed by the HDWA LARU on previous WA licenced healthcare projects.
Independent Commissioning Agent (ICA)	A registered professional engineer or qualified technician experienced in healthcare facility design and construction that reports directly to the project owner and is independent from any consultant, contractor or sub-contractor involved in the design or installation of the engineering systems.

ROLE	DEFINITION
Mechanical Engineer	A professional mechanical engineer experienced in healthcare facility design and construction and registered on The Institution of Engineering Australia National Engineering Register (NER) or have demonstrated competence and compliance performance to this level as assessed by the HDWA LARU on previous WA licenced healthcare projects.
Security Consultant	A professional security consultant experienced in healthcare facility design and holding a current Security Consultant Licence from WA Police. (Note: security consultants require a *security consultant licence*, and installers require a *security installers licence* from WA Police).
Structural Engineer	A professional structural engineer experienced in healthcare facility design and construction and registered on The Institution of Engineers Australia National Engineers Register (NER).
Vertical Transportation Engineer	A professional vertical transportation services designer having demonstrated experience in lift and vertical transportation services applicable in healthcare facility design and construction. This role is not to be confused with “traffic” engineering.

2.1.3 Definitions for electrical power supplies as relevant to healthcare facilities referenced within The Guidelines are identified below.

Note these definitions clarify terms included in AS 3009 and others used in general practice with various intentions and meanings from site to site. These terms apply to all electrical services including those associated with other disciplines such as mechanical services and the like.

TERM	DEFINITION
100% Capacity	maximum demand of the load plus agreed load growth (spare capacity) as briefed, with a minimum as outlined within The Guidelines.
Spare capacity	proportion (or %) of the total capacity for each element in the power supply and distribution system that is allocated for future use and load growth.
“Emergency” circuit	lighting, power and other circuits which, in the event of failure of the normal supply, is required to operate to permit necessary patient care to be continued. An emergency circuit may contain a critical load. (Note: “safety” service is defined separately below.
“Critical” load	100% capacity of the load of equipment and services that are critical to the level of care and functional operation required of each portion of the Facility as determined in the FOP.
“Essential” load	100% capacity of the load of all the electrical services required to operate in situations where normal supply

TERM	DEFINITION
	is no longer available or no longer viable. This shall include critical and emergency services and all other loads as determined in the FOP.
“Non-essential” load	the load of all electrical services that does not include “Essential” loads, “Critical” loads and “Emergency” services and are not required to operate in situations where normal supply is no longer available or no longer viable.
“Normal” load	the load of all electrical services connected to the “Normal” supply.
“UPS” load	100% capacity of the load to be connected to each UPS power supply system. This can be a portion of “Critical” and “Emergency” loads and circuits as determined in the FOP.
“Normal” supply	the supply, sufficient to support the total of all “Non-essential” loads, “Essential” loads, “Critical” loads and “Emergency” services. This supply is that provided by the Supply Authority/Utility and as distributed through the supply distribution network. This definition also applies with the same intent to private standalone power systems in lieu of Utility supply.
“Vital” supply	the supply to an emergency circuit that has power restoration within 30 sec from loss of power. Note: the restoration time is discussed in greater detail in clause “*Vital (30sec) [Essential] Electricity Supplies*”.
“Instantaneous” supply	the supply to an emergency circuit that has power restoration within 1 sec from loss of power.
“Uninterruptible” supply	has the same definition as “instantaneous” with the additional requirement of being no-break.
“Essential” supply	where an electrical supply is denoted as an “Essential Supply” then this shall be arranged as “Vital supply”.
“Emergency” supply to “Emergency” service	Supply to Safety Services in accordance with AS/NZS 3000 or as required by applicable regulatory authority.
“Safety” service	Service as defined in AS/NZS 3000 as a system or component that operates to identify an emergency, or is intended to operate during an emergency, and is primarily associated with the safety of persons evacuating a building, fire-fighting operations or fire suppression.

2.1.4 Definitions for hydraulic services as relevant to healthcare facilities referenced within The Guidelines are identified below.

Note these definitions clarify terms used in general practice with various intentions and meanings from site to site. These terms apply to all hydraulic services including those associated with other disciplines such as mechanical services and the like.

TERM	DEFINITION
“Dead” leg	A section of pipework leading to an outlet (e.g., basin or shower) where water flows infrequently, only during draw-off from the main system. This includes pipework downstream of temperature control devices such as thermostatic mixing valves (TMV’s). Dead legs shall be limited by volume, with a maximum allowable capacity of 2 litres. However, wherever possible dead legs should also be as short as possible.
“Dead” end	A section of pipe that is capped or closed off at one end, with no outlet and no flow through it.
Delivery wait time	The time taken for heated water to reach its required outlet temperature after the outlet is opened. Measured from the moment of activation to the point when water reaches target temperature at the outlet.
Drinking water	Previously known as “potable” water.
Flushing point	An outlet or valve installed expressly to allow water to be flushed and drained from a pipe section for maintenance or water quality analysis purposes. Flushing and sampling points may be the same, such as when flushing occurs at an outlet. However, this method delivers low velocity and may not be suitable for all applications.
Non-drinking water	Previously known as “non-potable” water.
Sampling point	A designated location (e.g., tap outlet, valve, hose tap) where water samples can be drawn for testing and monitoring of water quality.
End of line	The furthest point from the water supply source within a distribution system, such as the last outlet, fixture, or terminal fitting on a pipe run or branch

2.1.5 Abbreviations used in The Guidelines have the following meaning:

ABBREVIATION	DEFINITION
AC	Air conditioning system
AGV	Automated guided vehicle
AHSCA	Association of Hydraulic Services Consultants Australia
AIP	Approval in Principle
AMR	Autonomous mobile robot
ANZCA	Australian and New Zealand College of Anaesthetists
ATC	Approval to Construct
ATM	Automated teller machine/cash dispenser
ATO	Approval to Occupy

ABBREVIATION	DEFINITION
AusHFG	Australasian Health Facility Guidelines
AS	Australian Standards
AS/NZS	Australian/New Zealand Standards
AV	Audio visual systems
BCA	Building Code of Australia
BCP	Business continuity plan
BESS	Battery energy storage system
BaMS	Battery management system
BIM	Building information management
BMCS/BMS	Building management and control system
BSN	Building services network
CBRN	Chemical, biological, radiological or nuclear incident
CCR	Core communications room
CCTV	Closed circuit television
CFU/ml	Colony forming units per millilitre
CPEng	IEAust Chartered professional engineer
CSA	Canadian Standards Association.
CSSD/CSD/CSU	Central sterilising department or unit
DBA	Direct brigade alarm
dB(A)	A-weighted decibel
DFES	Department of Fire and Emergency Services
DoH	Government of Western Australia Department of Health.
DOP	Dispersed oil particulate (tests)
DMIRS	Department of Energy, Mines, Industry Regulation and Safety (now known as LGIRS)
DnTw	Normalised weighted level difference
DTS	Deemed to satisfy
EOC	Emergency operations centre
EPA	Environmental Protection Authority
ESS	Energy storage system
EV	Electric vehicle

ABBREVIATION	DEFINITION
EWIS	Emergency warning and intercommunication system
FAMP	Facility asset management plan
FAT	Factory acceptance testing.
FCR	Floor communications room
FF&E	Furniture, fixtures and equipment
FMP	Facility maintenance plan
FOP	Facility operating plan
FRMP/RMP	Facility risk management plan or Risk management plan
GGMK	Great grand master key
GMK	Grand master key
HACCP	Hazard analysis critical control point
HCR	Hub communications room
HDWA	Government of Western Australia Department of Health.
HFR	Health Facility Representative
HSP	Health Service Provider
ICT	Information and communication technology
ICU	Intensive care unit
IEAust	The Institution of Engineers Australia
IHEA	Institute of Healthcare Engineering, Australia
ILI	Infectious like illness
IP&C	Infection prevention and control
LGIRS	Department of Local Government, Industry Regulation and Safety (previously known as DMIRS)
LIOM	Line isolation and overload monitor
LMS	Load management system
MGPS	Medical gas pipeline systems
MME	Major medical equipment
MRL	Machine room-less (lifts)
NCC	National Construction Code
NER	IEAust National Engineers Register
NHMRC	National Health and Medical Research Council

ABBREVIATION	DEFINITION
NOHSC	National Occupational Health and Safety Commission
OCP	Office of the Chief Psychiatrist
OGTR	Office of the Gene Technology Regulator
OR	Operating room
PBX	System for managing voice services
PC	Practical completion (of contract of works)
PCA	Plumbing Code of Australia
PV	(Solar) photovoltaic system
RCBO	Residual current circuit breaker with overcurrent protection
RCD	Residual current device
RO	Reverse osmosis
Rw	Weighted Sound Reduction Index
SAT	Site acceptance testing
SHICC	State health incident coordination centre
TGA	Therapeutic Goods Administration
UV	Ultraviolet
VOC	Volatile organic compound
WACHS	WA Country Health Service

2.2 Key Design Objectives

Designers of healthcare facilities should focus on delivering facilities that improve the safety, health and well-being of occupants and the quality of clinical care service delivery. The key objectives for design, delivery and maintenance of public and private healthcare facilities in WA are the provision of facilities that:

- prioritise patient, staff and visitors' safety, care and well-being
- support high quality, contemporary models of healthcare delivery
- are safe, pleasant and comfortable places to visit and work in
- promote contemporary and innovative approaches to design
- are flexible in use, resilient, reliable, and capable of adapting to advances in clinical technologies and changes in models of care
- are fit for purpose, practical, easy to use and efficient to operate and maintain
- are sustainable, low carbon designs and consider whole of life cycle costs in use
- are assessed for resilience to climate change and extreme weather events
- where required, are capable of supporting Western Australia's post-disaster and emergency response needs

2.3 Engineering Design Principles

2.3.1 Fundamental principles

The following engineering design principles are adapted from the NSW HI Engineering Services Guide GL2023-009 and should be considered during the initial concept stage of the design.

Each project should be considered and designed in a way that is appropriate to factors such as extent, clinical function and location of facility, and whether the project includes new, refurbished or expanded/extended facilities with potential historical limitations and constraints. Other factors such as operational resilience, sustainability and practicality will also influence design decisions.

Considerations include:

- size, clinical acuity and type of facility – will influence the choice and configuration of engineering systems
- location – the availability of support skills for ongoing maintenance will influence the level of complexity and technology in engineering systems
- new, refurbished and extended facilities – the age, condition and relative proportions of new and old will influence design solutions on electronic and sitewide infrastructure systems such as building management and control system (BMCS), ICT, electronic fire protection systems, nurse call, medical gases, water, drainage, chilled water and heating water systems. Whether systems should be replaced, or extended, or stand-alone from each other (with high level communications interfaces), should be considered with practicality in mind and with the full understanding of patient and occupant safety, and users requirements regarding operational continuity and disruption management

2.3.2 Hospital management documentation

In the context of engineering management of an operational healthcare facility there are a number of key documents referenced in the Guidelines, including:

- **Facility Risk Management Plan (FRMP)** addresses potential risks to the facility and outlines strategies to mitigate them, safeguarding patients, staff and visitors. This includes identifying, assessing, and managing risks across the entire facility, enabling proactive measures to protect not only patient safety but also organisational integrity.
- **Facility Operating Plan (FOP)** sets out the procedures and protocols for the functioning of the facility, including staffing and service delivery mechanisms, to provide safety for patients, staff and visitors and efficient management of all clinical procedures undertaken at the facility.
- **Business Continuity Plan (BCP)** outlines strategies to maintain facility operations during any credible form of disruption to engineering services, both planned and unplanned.
- **Facility Asset Management Plan (FAMP)** identifies a full audit of all assets, physical and philosophical and sets out parameters for the optimal use of facility assets, including guidelines for tracking physical resources.
- **Facility Maintenance Plan (FMP)** details the processes necessary for the upkeep, maintenance and management of facility infrastructure and equipment, ensuring the facility is safe, functional and compliant with regulations.

Further details are provided in later chapters and sections of the Guidelines.

2.3.3 Engineering design principles

The following principles should be addressed, including:

- hospital functionality, clinical services delivery, internal environmental conditions (impacting staff, patient and visitor safety and well-being), and departmental operational efficiency should be at the forefront of design
- overall site masterplans should be reviewed and used for the guidance and integration of engineering elements, major energy centres and site infrastructure nodes and incoming utilities
- sustainability should be integrated into the built environment, including appropriate low carbon designs for energy, efficient use of water, selection of appropriate materials
- building layout and design detailing should encourage effective service delivery, logistical efficiency, and reduction/elimination of maintenance. The 'indoor environment' should consider air quality, ventilation, daylight, and other factors that influence thermal, visual, acoustic and psychological comfort (e.g. biophilic design)
- adaptation for future use should be considered, including system configuration and equipment capacity and selection, system design integration, space allowances, all within the master planning framework.
- design should be appropriate for the location in terms of climatic conditions, sophistication of services, local availability of skills and support
- design should be reasonably able to adapt and respond to changes in infrastructure planning and clinical healthcare models, and likely changes in use
- systems and equipment including information and communication technology (ICT), major medical equipment (MME) and furniture, fixtures and equipment (FF&E) should be considered in terms of sustainability, availability, reliability and life-cycle costs
- design should be robust and resilient, and consider the services delivered during normal operations, as well as disaster and emergency planning scenarios, as defined for each hospital/healthcare facility
- method of construction including consideration of alternatives such as prefabrication to minimise on-site works

2.3.4 Functional integration

Designers should use open technologies, systems and architectures to promote interoperability and functional integration of all electronic systems.

The design team should liaise with the Licence Holder/Applicant of the healthcare facility to ascertain that design features are appropriate, understood, and that the systems are commissioned correctly, tuned over building "settling in" period (usually first 12-months of full operation) and can be operated efficiently after verification and handover.

2.3.5 Security, vandalism and robustness

Designers should identify and incorporate security, vandalism and infrastructure robustness and resilience features within the design.

Robustness and resilience - consider issues associated with an 'All Hazards Approach' and in particular examine the alignment of failure modes, 'mean time between failures' and 'mean time for repairs' of components to avoid critical failure modes. This is also appropriate for uninterruptible power supplies (UPS) and the like.

Infrastructure robustness and resilience - avoid single points of failures and co-location of critical services or design elements.

Designers should examine issues associated with security performance and vandalism, particularly in areas of defined risks, and ensure systemic issues do not

increase the vulnerability of the infrastructure (for example, excessive number of external doors) and overall staff, patient and occupant safety.

2.3.6 Infection prevention and control (IP&C)

Optimum ventilation rates should be maintained to improve the indoor environmental quality. The design of ventilation systems shall as a minimum comply with ventilation rates specified in Appendix "*Mechanical Design Parameters*", and to AS 1668.2 *The use of ventilation and air conditioning in buildings Mechanical ventilation in buildings*. These standards set minimum requirements for outdoor air supply, overall air change rates, ventilation effectiveness and filtration requirements to prevent excess accumulation of airborne contaminants. They also cover other associated factors such as temperature, humidity, air movement and noise.

Eliminating the sources of pollutants and contaminants is important during the design process. The location and detailing of air intakes, airflow direction, relative pressures, filtration levels, door seals, expansion and construction joints, flat surface detailing (e.g. shelving unit top surfaces etc) and equipment selection can influence infection control and cleaning protocols.

The use of non-porous materials, fixtures and fittings which are easily accessible and can be thoroughly cleaned should be considered. Materials should also be robust and able to withstand frequent cleaning and disinfection.

Non-contact activation of systems should also be promoted to avoid potential exposure and transmission of infections via surface contact means.

Procedural separation of visitors, patients and staff can minimise infection transmission, as well as standardisation of patient treatment areas for ease of cleaning and quality control.

Quarantine and isolation requirements should also be understood, and addressed in accordance with the AusHFG, relevant Australian and international standards, and Government of Western Australia Department of Health policies to inform the planning, design and commissioning related to isolation rooms and associated receiving and holding facilities where patients with Infectious Like Illnesses (ILIs) may be present. Refer also to the AusHFG: Pandemic Preparedness – Health Infrastructure Planning & Design Guidance 2023 for further details.

2.3.7 Disaster and emergency management

Metropolitan tertiary/acute care hospitals and major regional centres are generally regarded by the community as locations of safe haven, and designers should consider the operational consequences of design through the emergency cycle from business as usual through to critical infrastructure emergency management and through to recovery and reinstatement of service post-event.

Designers are encouraged to consider an 'All Hazards Approach' to disaster and emergency management and provide designs that address continuity of services, single points of failure, energy supply security, capacity and resiliency studies.

Licence Holder/Applicants and their design teams shall consult with the Government of Western Australia Department of Health and LARU to establish the level and extent of disaster and emergency management requirements for a particular facility. These requirements will vary depending upon hospital classification, geographical locations, state emergency management plans, legislation and critical infrastructure risk assessments. Refer to the WA Health Clinical Services Framework 2025-2035, Clinical Services Framework 2020 Addendum or any subsequent updated version for more details. This document sets out on a department by department and hospital by hospital basis the different levels (Level 1-6) of redundancy and emergency response required.

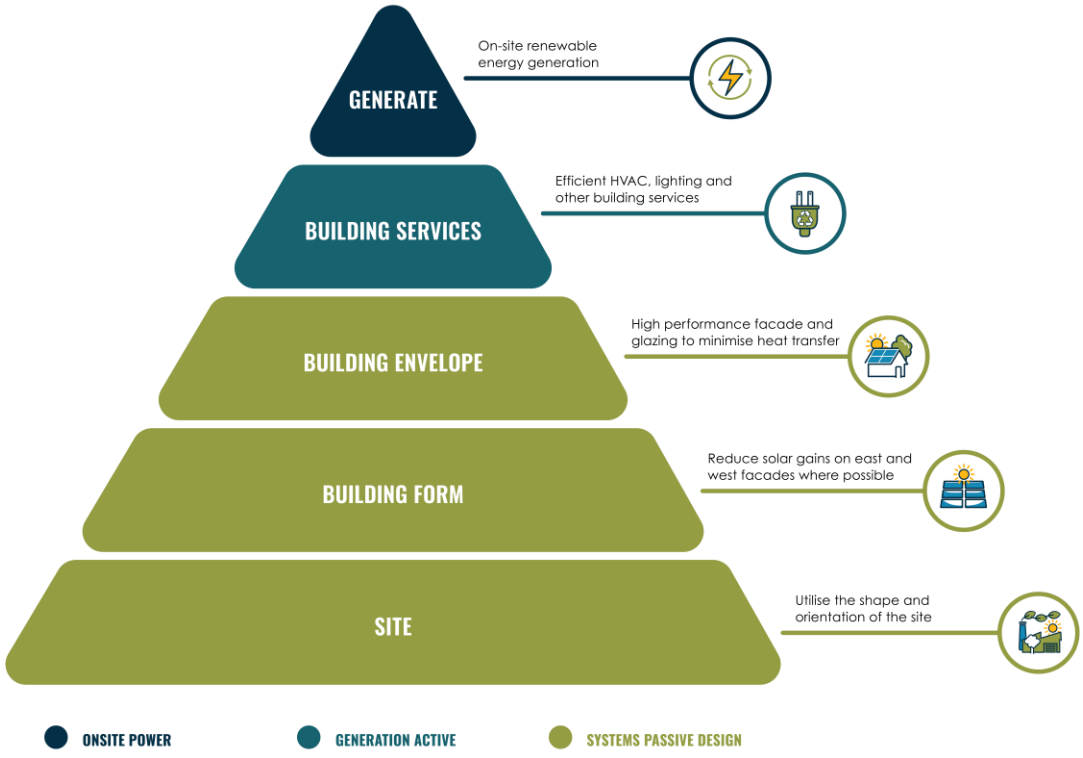
2.3.8 Sustainability, resilience, lifecycle and waste management

Healthcare facilities, by their nature, are complex, with a wide range of functional and services requirements that place a high demand on energy, water and materials.

The WA Government may from time to time upgrade and develop new strategies to respond to changes and challenges on environmental management and operational energy efficiency matters. Licence Holder/Applicants and healthcare designers should keep themselves up to date with new developments and strategies.

Proposed designs should include passive sustainable design strategies such as daylighting, demand management, gravity systems, energy and water efficiency and conservation techniques, use of non-toxic and environmentally sound materials and finishes and consider life-cycle sustainability and maintenance implications.

Designers should pay close attention to operational energy and carbon issues. The design team should integrate an approach such as an operational energy efficiency hierarchy to inform a responsible decision-making process. A suggested hierarchy is shown in the Figure below.



Operational energy efficiency hierarchy

Engineering design should be applied to reduce energy wastage and carbon dioxide emissions arising from the operation of the hospital, while maintaining clinical and functional standards.

2.3.9 Maintenance and logistics support

Designers should consider location, skills, spare parts supply, tools and techniques required for on-going maintenance and logistical support of elements they design and demonstrate how the design minimises maintenance of systems.

Designers are discouraged from incorporating customised and proprietary solutions, with restrictive maintenance agreements and vulnerable logistical supply chains.

2.3.10 Emerging technology

In general, technological research, systems developments, and advancements in equipment electronics and materials science, create opportunities for emerging technologies.

While healthcare projects are usually not appropriate environments for these technologies to be applied prematurely, it is incumbent upon designers to be aware of such developments and provide advice on these matters and consider adoption where safe and reliable systems can be delivered.

Examples where emerging technology will directly impact healthcare design include ICT systems, nurse call and other electronic systems infrastructure, medical equipment technologies, FF&E, wireless technologies, electrification and de-gasification of central energy plant.

2.3.11 Commissioning

Comprehensive commissioning coordinated across all aspects of the operation of the facility, including building, services, FF&E and MME, is required prior to practical completion for building associated works and ATO for equipment. Planning and implementation of commissioning is to be undertaken in accordance with AS TS 5342 *Technical specification for building commissioning*.

2.3.12 Certification and compliance

It is required that:

- designs are appropriately certified and verified as compliant to relevant codes and standards
- certifications are provided by appropriately qualified and credentialed engineering professionals (NER/CPEng, for example)
- appropriate industry established design practice is adopted.

In the context of private health design innovation, LARU may consider and accept standards other than those commonly accepted standards, if the Licence Holder/Applicant can demonstrate to LARU's satisfaction that the alternative approach:

- is superior and can comply with certification requirements, and
- does not compromise on patient/occupant safety, and the quality and reliability of clinical care.

An example of such an item would be the alternative approach to airflow in patient rooms to mitigate against ILI contagion spread in the early days of the Covid-19 pandemic.

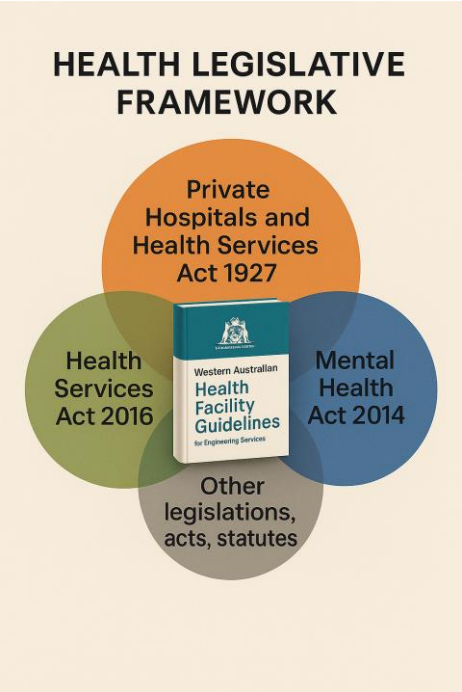
It should be noted that the requirement of this clause relates to the quality of design and compliance with design guidelines, rather than any statutory compliance that is required for occupation of a building, which follows the separate and established pathway via NCC compliance and building certification.

3 REGULATORY FRAMEWORK

3.1 Relevant Legislation

3.1.1 The provision of public and private hospitals and public and private healthcare facilities and services are governed by various relevant legislation, including the following:

- Health Services Act 2016
- Health Services (Day Hospital Facility) Determination 2016
- Mental Health Act 2014
- Health Legislation Administration Act 1984



3.1.2 For private healthcare facilities and in the context of Licence Holder/Applicant submissions to LARU, this also includes:

- Private Hospitals and Health Services Act 1927
- Human Reproductive Technology Act 1991

3.2 NCC and Statutory Authorities

3.2.1 All building services shall meet the relevant requirements of the National Construction Code (NCC) current at the time of design, and all relevant Australian Standards cited therein. WA Health approval at any of the Concept, AIP, ATC, or ATO stages does not negate the need to comply with the NCC/BCA requirements or any other statutory authorities, e.g., Water Corporation, Western Power, ATCO, Local Municipal Authorities, Economic Regulation Authority (ERA), Environmental Protection Authority (EPA), Radiological Council of Western Australia, Dangerous Goods, Department of Local Government, Industry Regulation and Safety (LGIRS) and the Department of Fire and Emergency Services (DFES).

Building Classification for all hospitals and healthcare facilities shall be as per the building classifications described within the latest version of the NCC/BCA appropriate to the type of healthcare facility being provided. Where the healthcare facility is located within or as an extension of a building type of a different classification, the relevant healthcare classification shall apply to that part of the building where healthcare is being provided. Where necessary the project Building Surveyor shall determine the relevant building classification, however in relation to private health licensing LARU reserves the right to query or contest any building classification determination made by the Licence Holder/Applicant where it is considered to result in an increased risk to patient and occupant safety and quality of care provided.

3.2.2 The National Construction Code (NCC) sets out the minimum technical requirements for new buildings (and new building work in existing buildings) in Australia.

Class 9a buildings are generally hospitals which are referred to in the NCC/BCA as healthcare buildings. They are buildings in which occupants or patients are undergoing medical treatment and may need physical assistance for emergency evacuation. This includes any clinic (or day surgery) where the effects of the treatment administered would involve patients becoming unconscious or unable/less

able to move. This in turn requires supervised medical care (on the premises) for some time after the treatment has been administered and may impact staff/patient ratios and the ability to safely and efficiently escape or move to a place of relative safety in the event of a fire emergency.

3.3 Australasian Health Facilities Guidelines

3.3.1 The Australasian Health Facilities Guidelines (AusHFG) are a nationally and internationally recognised source of hospital and healthcare facility design guidance. Much clinical and architectural design guidance emanates from this resource. The AusHFG suite of documents are reviewed by the AusHFG Project Team on behalf of the Australasian Health Infrastructure Alliance (AHIA). The AHIA is an Australian and New Zealand public sector collaboration, formerly the Health Capital Asset Manager's Consortium (HCAMC). The AHIA reports to the Health Chief Executive's Forum and the AusHFG Project Team are predominantly based in Sydney, within Health Infrastructure NSW. More details on the AusHFG, the AHIA and its structure can be found at the following website link: AusHFG | (healthfacilityguidelines.com.au)

3.3.2 AusHFG reviews of their healthcare design and planning resources take place on a regular and ongoing basis to ensure the available information remains contemporary and reflects changes in clinical practice, service models of care and technology. The guidelines are reviewed using a policy community approach and an annual work plan is used to track the update of the AusHFG resources.

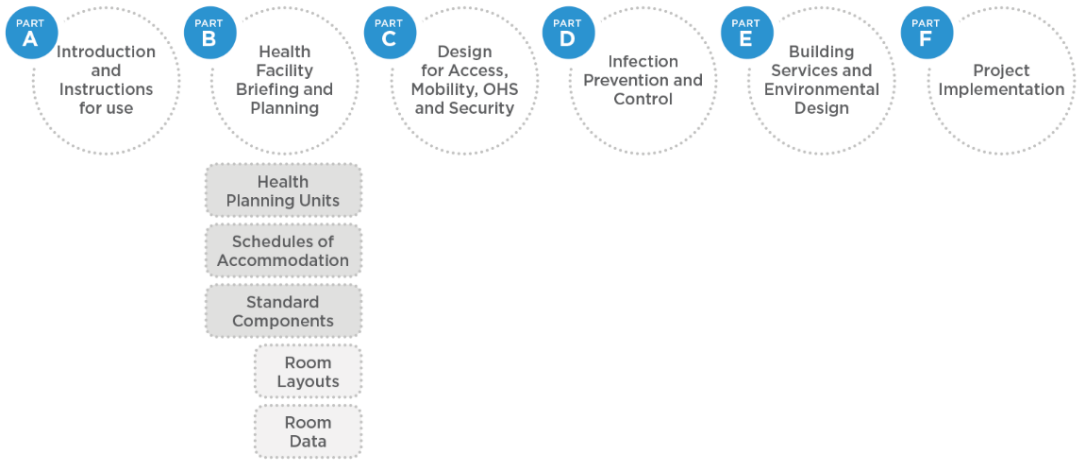
3.3.3 AusHFG Parts A, B, C, D and F are regularly maintained on behalf of the AHIA. In particular, Part B is updated frequently with new information on Health Planning Units, Room Data Sheet briefing and design parameters and typical room layout drawings. These include 3D Revit Model images of the different clinical room uses and loaded with all relevant FF&E information. Available spreadsheet data supports this function and is available for use in developing bespoke design and briefing solutions for healthcare projects.

The "Part E" element was retired in preference of the individual state and territory administered design guidelines, and therefore the WAHFG for Engineering Services (this document) serves this function for all public and private health facility projects in Western Australia. It should be noted however that Aus HFG Parts A, B, C, D and F also provide design guidance in WA, and where relevant engineering guidance exists within these documents then these shall also be complied with.

3.3.4 The structure of the AusHFG suite of guidance documents is shown below:

AusHFG Parts

The Guidelines are made up to six Parts. Part B contains the Health Planning Unit documents, Schedules of Accommodation and all Standard Component Room Layouts and Room Data Sheets as depicted below.



3.3.5 Western Australia is preparing to undergo a transition to AusHFG from the current Western Australia Health Facility Building Guidelines for Architectural Requirements (WAHFG AR). Until such time as the transition is completed WAHFG AR are applicable and take precedence.

3.3.6 All intended Licence Holder/Applicants shall assess the provisions of relevant standards and guidelines (including the AusHFG where necessary information is absent from WAHFG AR) and determine an appropriate application of these to their project. In new, major hospital developments, it is envisaged the requirements of AusHFG and these WAHFG for Engineering Services will be closely adhered to, except where deviations are associated with new models of care, operational policies or procedures, or innovative approaches to the delivery of health services. In such cases, dispensations shall be requested for private hospital licensing purposes by the Licence Holder/Applicant as part of their LARU submissions.

3.3.7 On smaller private hospital projects, regional projects and projects where substantial refurbishment is envisaged, designers shall critically evaluate the WAHFG AR and current AusHFG suite of guides (where necessary information is absent from WAHFG AR) to determine their applicability and suitability to the project during planning.

3.3.8 Any proposed deviations shall be clearly documented as non-conformances in the Licence Holder/Applicant submissions to LARU. These submissions shall be signed off by the relevant designers and stakeholders (including the project building surveyor, clinical lead and IP&C team).

3.4 WA Health Facilities Guidelines

3.4.1 Compliance with The Guidelines is mandatory when designing and operating private health facilities in Western Australia. As noted above, the Engineering Services element (this document) replaces any historic reference to Part E of the Australasian Health Facilities Guidelines. For the design of public health facilities, compliance with The Guidelines is usually a contractual requirement when referenced in the

project specific design brief or used as design guidance when no other project specific briefing guidance exists.

3.4.2 Mandatory requirements in The Guidelines are identified with the word “shall” and are applicable to all WA based private healthcare facilities, irrespective of healthcare facility status or any other type of care, acuity, size and location criteria that may apply.

3.4.3 A Declaration of Conformance shall be prepared by the Licence Holder/Applicant and endorsed by the relevant clinical team when submitting at each stage for approval. This provision is designed to ensure that the Licence Holder/Applicant declares any planned dispensations and understands the potential impact on clinical operations. This is especially relevant where any planned reduction in design provision from the prescribed standard of design – tertiary/acute care healthcare facilities, is considered appropriate based on reduced size, level of acuity, extent of new build vs existing, or a regional setting. Refer to Appendix “*Declaration of Conformance*” for the template to be submitted as part of LARU applications.

3.4.4 Compliance with The Guidelines shall be achieved when the following circumstances occur:

- a new facility is built
- within the area of an existing facility that is altered, extended or refurbished
- a new licensable healthcare service or procedure is introduced to an existing facility
- facility maintenance is carried out – comply with the requirements of chapter ”*Facility Maintenance*”
- equipment replacement within the facility is carried out – comply with the requirements of chapter “*Equipment*”
- required by LARU policy (such as facility changes of ownership, new tenancy/operator of an existing licensable health service or changes in legislation)

Further guidance can be found in the Appendix “*Minor Works Decision Matrix”*.

3.4.5 When alterations are to be undertaken to facilities supporting a particular medical/health service, all the facilities used in the delivery of that service shall be included in the alterations. For example, a procedure room upgrade shall not be carried out in isolation from its support facilities.

3.4.6 Site services standards, quality and reliability shall be appropriate for the function being served.

3.4.7 Any alterations or works provided to increase life safety should always be extended to cover the whole facility in the shortest time period that practical facility operating considerations will permit. For example, installation may have to be staged for reasons of disruption to services but should not be otherwise delayed.

3.4.8 In situations where the Licence Holder/Applicant occupies premises that are owned or controlled by another party, e.g. they are a tenant or lessee, there may be a requirement for modifications or additions to the base building (or otherwise outside of the tenant scope area) to achieve compliance with the Guidelines. In such an instance, the Licence Holder/Applicant is responsible for arranging all necessary works with other parties, such as their landlord, to achieve compliance with The Guidelines.

3.5 Other Referenced Standards and Guidelines

3.5.1 The following referenced Standards and Guidelines shall be considered when designing healthcare facilities in Western Australia and complied with where

relevant. For private healthcare facilities licensing applications, engineering services with any major deviations from relevant sections of these shall be documented together with associated background reasoning and clinical endorsement as part of the Approval in Principle (AIP) application:

- WA Health Clinical Services Framework 2025-2035, Clinical Services Framework 2020 Addendum (or any subsequent updated version) – this document, among other things, sets out on a department by department and hospital by hospital basis the different levels (Level 1-6) of redundancy and emergency response required
- Australasian Health Facilities Guidelines, all specific AusHFG Parts A, B, C, D, and F, including Health Planning Units relevant to the functional areas included in the licence application/facility schedule of accommodation
- HDWA State Health Emergency Response Plan (SHERP) (Vers 2.0 April 2024, or any subsequent updated version)
- WACHS Emergency (Disaster) Management Arrangements Policy – March 2021 (or any subsequent updated version)
- AusHFG: Pandemic Preparedness – Health Infrastructure Planning & Design Guidance September 2023
- AusHFG: Isolation Rooms – Engineering and Design Requirements, Feb 2017
- HB 260 – *Hospital acquired infections – Engineering down the risk**

  *note: although formally withdrawn by Standards Australia, this Handbook is still cited in AS 1668.2 *The use of ventilation and air conditioning in buildings Mechanical ventilation in buildings* and is considered a useful historical design guidance reference document in relation to infection prevention and control. Also comply with the AusHFG Pandemic Preparedness and Isolation Rooms design guidance referenced above.

- AusHFG: HPU_B.0350 – Small Rural Hospitals/Multipurpose Services
- all referenced Australian Standards cited within this document (Normative elements are mandatory provisions, and Informative elements should be considered as part of the design)
- AS/NZS 5369 – *Reprocessing of reusable medical devices and other devices in health and non-health related facilities* (replaced AS 4187 in Dec 2023)
- AS 3811 – *Patient alarm systems* – withdrawn, due for update and currently under consideration by Standards Australia

3.5.2 As noted in the Acknowledgements to this document, this update was designed to align the WAHFG for Engineering Services with other relevant healthcare design guidelines within Australia. The following series have been referenced and where relevant, common sections adopted within The Guidelines for the purposes of national alignment:

- NSW - Engineering Services Guidelines GL2016_020 and GL 2023_009
- Victoria - VHBA Engineering Guidelines for Healthcare Facilities
- Queensland – QH Capital Infrastructure Requirements: Vol 4 Engineering and Infrastructure Minimum Requirements

3.6 Applicable Document Revision

3.6.1 Cross-reference is made in this document to various codes, standards and reference documents. In some instances, these document citations also mention edition, revision, date or year of issue.

In all cases the most current version of such documents shall be applied at the AIP and ATC stages of project development, except where regulatory requirements dictate compliance with a specific alternative document (e.g. date of NCC applicable to the project). Where alternative documents are applied to a specific project, the relevant background for this decision is to be provided at AIP and ATC.

3.7 Clarification

3.7.1 Where additional clarification, policy and/or direction is required on a specific subject matter, LARU may issue appendices to The Guidelines or addenda notification via selected means of communication, from time to time.

3.8 Dispensation

3.8.1 Conformance with the Guidelines is required unless a dispensation is granted.

3.8.2 Dispensations will generally not be considered on new build private health facilities projects, unless under exceptional circumstances. The onus is on the Licence Holder/Applicant to demonstrate the exceptional circumstances that may apply.

Dispensation on mandatory items related to public hospitals and public healthcare facilities design should be discussed and agreed with the project sponsor and/or relevant health authority for the facility in the early stages of design development.

3.8.3 Dispensation on mandatory items may be granted to private health providers/Licence Holder/Applicants seeking licensing approvals in circumstances where additional time is required in order to achieve compliance with The Guidelines, where compliance is not practically achievable, or where non-conformance does not affect the safety of patients, staff and occupants and is deemed clinically unnecessary due to the specific circumstances and nature of the facility. On such occasions, the Licence Holder/Applicant shall provide full clinical endorsement of the proposed dispensation as part of the Approval in Principle application.

3.8.4 Dispensations will not be granted for convenience or as part of any value management/cost saving measures, or where they are considered by LARU to reduce the level of patient care and occupant safety within the hospital or healthcare facility.

3.8.5 Dispensations allow for the identification of a risk based approach and risk mitigation strategy to be developed by the Licence Holder/Applicant and presented as part of their licence application in order that it may be monitored throughout the licence period by LARU where relevant. Further, the dispensation process enables a performance-based solution to be developed and presented by the Licence Holder/Applicant where a deemed to comply/deemed to satisfy solution cannot be provided in relation to NCC/BCA provisions. These shall be accompanied by written endorsement/certification by the Building Certifier, where relevant.

3.8.6 To request a dispensation, a written proposal shall be submitted by the Licence Holder/Applicant to LARU as part of the Approval In Principle application. The proposal shall include the following as a minimum:

- identification of the area where a dispensation is sought
- identification of whether a temporary or permanent dispensation is sought
- a detailed rationale for the dispensation
- demonstration of a performance-based solution where a permanent dispensation is necessary
- the proposed process to minimise, mitigate and manage risk
- written clinical endorsement of the dispensation being sought

- the proposed process for monitoring compliance and rectification
- an expected timeframe for the duration of the dispensation
- any additional documentation that supports the request
- the expected date by which compliance is to be obtained (where relevant)

3.8.7 LARU will assess the evidence provided and may seek additional information as required. This may or may not include a site inspection. Following a LARU review, mandatory requirements and timelines will be put forward to the Licence Holder/Applicant for consideration and subsequent response as applicable, back to LARU.

3.8.8 It is the responsibility of the Licence Holder/Applicant to ensure that the facility is in conformance with the Guidelines and to advise LARU of any proposed non-conformance items. LARU has the authority to determine whether a dispensation is granted to a Licence Holder/Applicant and retains the right to reject proposed non-conformances.

4 COMPLIANCE

4.1 The Health Services Act 2016

4.1.1 The Health Services Act 2016 is applicable to all hospitals and healthcare facilities within WA. Each of the following premises is considered a hospital for the purposes of this Act –

1) Premises where medical, surgical or dental treatment, or nursing care, is provided for ill or injured persons and at which overnight accommodation may or will be provided; or
2) A day hospital facility i.e. premises that are not attached to, or are set apart from a hospital and at which persons are, or will be, provided with a health service (see definition below), and at which overnight accommodation is not provided.
3) A nursing post, i.e. a place at which a nurse is, or will be, stationed and at which facilities exist, or will exist, for medical attention, and which is not normally used for overnight accommodation of patients.

4.1.2 Note: Based on the above definitions from the Act, a 23 hour recovery or short stay facility shall be classed as Hospital where overnight accommodation is inevitably provided for some part of the 23 hour maximum stay period. This does not necessarily impact on engineering services provision but may impact staffing levels in the provision of 23 hour short stay services.

4.1.3 Further relevant definitions within the Health Services Act 2016 include:

s7. (1) A **health service** is a service for maintaining, improving, restoring or managing people's physical and mental health and wellbeing

(2) A health service includes:

a) a service that is provided to a person at a hospital or any other place
b) a service dealing with public health, including a program or activity for:
    i. the prevention and control of disease or sickness
    ii. the prevention of injury
    iii. the protection and promotion of health
c) a support service
d) the provision of goods for a health service

(3) A public health service is a health service provided by:

a) a health service provider
b) the Department CEO
c) a contracted health entity under a contract or other agreement entered into with —
    i. a health service provider
    ii. the Department CEO, the Minister or the Premier on behalf of the State

(4) A public health service

a) includes a health service declared under a regulation to be a public health service
b) does not include a health service declared under a regulation not to be a public health service

s8. (6) A **public hospital**

a) is a hospital controlled or managed by a health service provider, or
b) a hospital declared to be a public hospital by the Minister by order published in the Gazette for the purposes of this Act

4.2 The Private Hospitals and Health Services Act 1927

4.2.1 The Private Hospitals and Health Services Act 1927 is an Act to provide for the control and regulation of private hospitals and private psychiatric hostels and for related purposes.

4.2.2 The terms used for health service, hospital and public hospital are as defined in the Health Services Act 2016.

4.2.3 A Private Hospital is a hospital that is not a public hospital under the above defined terms, and a Private Hospital Service Provider is a holder of a licence granted under this Act to conduct a private hospital or a private psychiatric hostel.

4.2.4 Any person authorised for the purposes of visiting and inspecting private hospitals in the context of licensing approvals may inspect every part of any private hospital, including any outbuildings or premises attached to the private hospital.

4.2.5 Section 26C of the Act requires that the proposed premises are suitable to be approved as a private hospital.

4.2.6 Section 26J of the Act empowers the Director General of Health to issue guidelines covering construction, establishment and maintenance of private hospitals.

4.3 Human Reproductive Technology Act 1991

4.3.1 The Human Reproductive Technology Act 1991 is an Act relating to the practice of, the procedures used in, and the ethics governing, assisted human reproductive technology.

4.3.2 A procedure in accordance with the HRT Act may be undertaken in a public or private healthcare facility. Regardless, premises where a licensed service is provided in accordance with the Act is subject to the LARU Building Approval Process for all applicable engineering services in The Guidelines.

4.4 The Mental Health Act 2014

4.4.1 The requirements of the Chief Psychiatrist's Standards for Authorisation of Hospitals under the Mental Health Act 2014 (https://www.chiefpsychiatrist.wa.gov.au/standards-guidelines/chief-psychiatrists-authorised-hospital-standards/) apply to all locations registered as a facility for an Authorised patient and any other locations within general clinical space where risk to patients, carers and staff are considered to be of sufficient magnitude to require enhanced protection means.

4.4.2 Further specific services requirements are noted in subsequent sections of The Guidelines.

4.4.3 It should be noted that the term 'patients' is used in various documents associated with requirements for mental health. In these instances, it means people who are, or appear to be, experiencing a mental illness. This use of the term is not a recommendation that the term 'patient' should be used in practice in preference to other terms such as 'consumer', 'clients' or similar. It is simply a reflection of the terminology used in the Mental Health Act 2014.

4.5 WA Health Facilities Guidelines

4.5.1 The Guidelines apply to:

- Western Australian Private Hospitals and for related purposes as defined in the Private Hospitals and Health Services Act 1927, and

- Public Hospitals, private hospitals declared to be public hospitals by the Minister, health service providers and non-government entities contracted to provide health services, as defined in The Health Services Act 2016

4.6 Boundaries of Influence

4.6.1 In the context of private health providers, LARU's boundaries of influence are covered by the 1927 Act and the Health Services (Day Hospital Facility) Determination 2016.

The interpretation of Licensable and Unlicensable Premises, Licensable and Unlicensable Services, other commonly defined healthcare facilities are described below and illustrated in the Decision Tree chart included in the "*LARU Decision Tree*" appendix.

4.7 Licenced and Un-Licenced Premises

4.7.1 For the purposes of private health service licencing, it is important to differentiate between licenced and unlicenced premises. Licenced premises are considered all private healthcare and related premises that provide private health facilities and/or services that are covered by the regulatory framework included in the above referenced Acts. Unlicenced premises are those premises that fall outside of the above definitions, and include but are not limited to, GP Surgeries, off-site support facilities such as remote CSSDs, laundries, food preparation facilities, Hospital in the Home (HITH), and Retail Cosmetic Clinics – see also below for further definition on licenced and unlicensed services.

All acute care private hospitals, private day hospitals, 23-hour stay facilities, assisted reproductive technologies facilities and medi-hotels are considered licensed premises and required to comply with the WAHFG for Engineering Services.

4.7.2 The Health Services (Day Hospital Facility) Determination 2016 defines a day hospital facility as*:*

(a) a procedure that involves the administration of a general, spinal or epidural anaesthetic;

(b) a procedure performed under sedation, plexus blockade or Biers Block;

(c) a procedure that involves the invasion of a sterile body cavity;

(d) peritoneal dialysis and haemodialysis for the treatment of end stage renal failure;

(e) a psychiatric treatment programme that —

(i) is for a patient who has a mental illness; and

(ii) is provided by a multi-disciplinary team under the direction and supervision of a psychiatrist; and

(iii) is a half or full day programme that consists of more than one type of mainstream therapeutic activity.

4.7.3 A graphical representation of the decision tree of LARU requirement is provided in Appendix "*LARU Decision Tree*".

4.8 Licenced and Un-Licenced Service

4.8.1 It is also important to differentiate between licenced and unlicenced services. Licenced services are all private healthcare and related services covered by the Health Services (Day Hospital Facility) Determination 2016. Unlicenced services are those services that fall outside of the above definitions.

4.8.2 Health Facilities, beyond those listed in the Licensed Premises noted above, may include licensable services and therefore will require to comply with the WAHFG for Engineering Services.

These may include health services provided within the following facilities – private day hospitals, radiology services, urgent care clinics, day treatment (e.g. Renal, Chemotherapy etc.), transitional care, private disability nursing homes and dental surgeries.

4.8.3 A graphical representation of these is provided in Appendix "*LARU Decision Tree*".

4.9 Un-licenced services within Licensed Premises

4.9.1 Unlicenced services may exist within licensed premises, and although the requirement for clinical or architectural review by LARU will be assessed on a case-by-case basis, they may still require a separate engineering overview where they rely upon engineering services infrastructure from the licensed premises, or where emergency egress/emergency response systems may be impacted.

4.9.2 Examples of unlicenced premises or services may be individual tenancies, separate healthcare provider entities, or retail outlets within or associated with a private health facility such as a café, florist, 3rd party health service provider (who do not trigger any of the day hospital determination criteria), non-healthcare related office facilities or similar.

4.9.3 LARU, in reviewing private healthcare facilities' suitability for licencing approvals, may need to consider the impact of related unlicenced premises or services where they may impact on the safety, quality, capacity or reliability of engineering design, plant or utilities infrastructure where they serve both licenced and unlicenced premises on the same site.

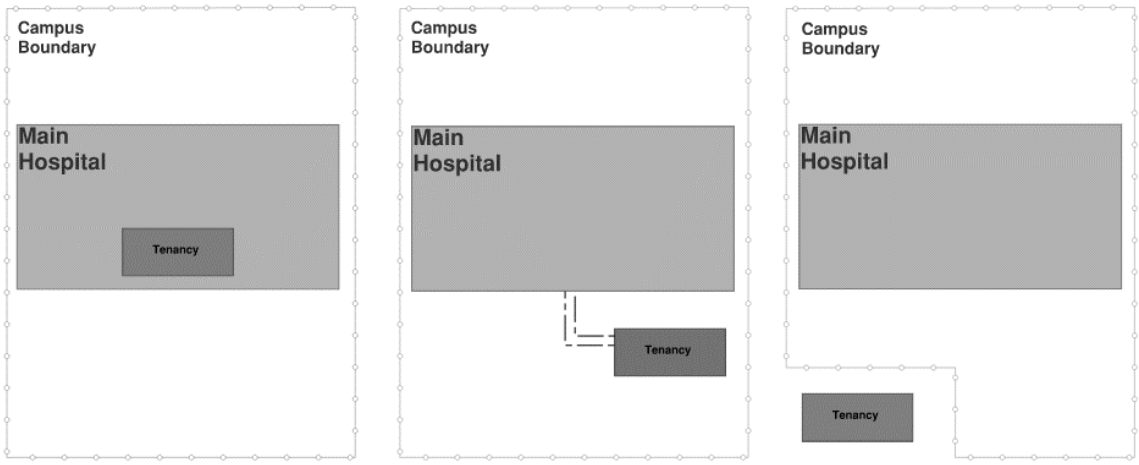
4.9.4 Where private health facilities are co-located with either public health facilities, other tenanted and licensable private health facilities, or non-health related premises such as multi-storey commercial offices or within retail centres, LARU require the Licence Holder/Applicant to review and consider the proposed Facility.

All implications of any shared engineering services infrastructure, common egress pathways, emergency life safety services, managed or unmanaged/immediate or phased evacuation procedures shall be reviewed and considered in the development of the Facility design including compliance with the relevant codes and standards.

4.9.5 Depending on whether separate licences exist for a main private hospital and a licensable service provided by a tenant, the application submission may require to be led by the main private hospital licence holder or the sub-licence holder.

4.9.6 If a site has a Hospital or Day Procedure Facility and other classes of facility accommodation, and there is any sharing of accommodation or building services then, depending on the class of building required, these Guidelines shall apply to all of the facilities involved.

For example, if there is a radiology unit in a medical consulting facility on the same site as a hospital and it is shared with the hospital then the radiology facility, its building services and the access ways to the radiology facility shall comply with The Guidelines. This type of example shall be discussed and clarified with LARU by the Licence Holder/Applicant as early as possible in the design development process, i.e. at concept stage.



Tenancy within hospital - requires application for approval

Tenancy within campus, external to hospital - may require application for approval depending on degree of interconnection

Tenancy off site from the hospital - does not require application for approval

5 FACILITY RISK MANAGEMENT PLAN

5.1.1 For the purposes of applying for a private healthcare licence, the Licence Holder/Applicant shall develop a Facility Risk Management Plan (FRMP). The purpose of the FRMP is to manage the risk, likelihood and consequence with planning, designing, construction, operation and maintenance of engineering services, including any design non-conformance declared as part to the submission. The FRMP shall be part of an overall health service risk management plan and shall be developed progressively and reach the following status at each Project stage:

1) Commencement of design
   a) Define the Facility healthcare risks the services will be required to mitigate
   b) Define the Facility performance risks the design will be required to mitigate
   c) Define the Facility construction, operation and maintenance risks the design will be required to mitigate
   d) Define responsibility for delivery of mitigation
2) Completion of engineering services design
   a) Full documentation of mitigation strategy
   b) Assignment of mitigation tasks for the construction stage
   c) Establishment of mitigation quality control for the construction stage
3) Commissioning
   a) Assignment of mitigation for normal and emergency operation
   b) Training of persons assigned operational mitigation tasks
   c) Establishment of mitigation quality control for operating and maintaining the services
   d) Rehearsal of emergency operation mitigation. Define and implement healthcare and facilities risk management performance assessment
4) Operation
   a) Systematic performance review and improvement
   b) Ongoing update and review of the risk management plan

5.1.2 Identification of risks shall meet the requirements of statutory regulations and the Licence Holder/Applicant's duty of care. The guidelines of AS ISO 31000 *Risk management – Guidelines* should be applied.

5.1.3 The FRMP should include but not be limited to provide mitigation for:

- healthcare risks related to quality and performance of Facilities
- reliability and maintainability risks associated with the supply of building services under each of the conditions of operation required
- services risks associated with maintaining the quality of facilities services outputs
- services risks associated with the failure of utilities or consumables supplies
- safety risks associated with demolition, construction, use, operation, and maintenance of the facilities
- safety risks associated with continuing to operate facilities during additions to or alterations of existing facilities
- security risks associated with unauthorised access to facilities and facilities services
- operating and maintenance risks related to non-availability of design parameter details or operating or maintenance instructions

- pandemic response measures and infection prevention methodologies in the event of major airborne (droplets) or touch (physical contact) based infectious outbreak
- fire life safety and managed/unmanaged emergency egress of patients, staff and visitors from all building classifications, with special attention to be taken where mixed use, multi-storey locations in non-healthcare commercial buildings are used
- safety risks associated with vertical transportation of materials through the facility e.g. vertical transportation of dewars

5.1.4 Particular attention should be given to fire safety and to having a consistent level of safety across the whole Facility. For example, during additions to, or alterations of existing facilities, when upgrading fire safety provisions, they should be extended to the whole site as quickly as practicable, including allowance for business continuity considerations.

6 RELIABILITY AND REDUNDANCY CRITERIA

6.1.1 All hospitals and healthcare facilities shall have reliability, resiliency, redundancy and maintainability provisions incorporated in the design and delivery of engineering services. Engineering services shall comply with all relevant statutory provisions, The Guidelines, and in the case of private health facilities, the duty of care requirements as defined by the Licence Holder/Applicant and as detailed within their Facility Operating Plan (FOP) and Business Continuity Plan (BCP).

The FOP & BCP shall define the measures necessary if/when normal operations at the facility are disrupted or threatened with disruption and identify actions and resources necessary to ensure continuity of service appropriate to the conditions and functioning of the facility.

Necessary engineering functions shall be determined in accordance with the defined role of the facility, including where specifically identified as part of the State's Emergency Response requirements.

6.1.2 Disaster or emergency role

Healthcare facilities required to *withstand natural disasters, or with a strategic post disaster and emergency role* (i.e. the facility is expected to operate through any local disaster) shall:

- be built to withstand any risk assessed hazard
- have redundancy plans to maintain safe healthcare services during a disaster, through all contingencies

6.1.3 Continue surgical and/or emergency services during failure

Healthcare Facilities that will *continue to offer invasive surgery or emergency medical services through failure of normal utility services* shall have redundancy, sterile and non-sterile consumables storage, operator, engineering and maintenance skills and training to maintain safe and resilient healthcare services, of the extent required to support the surgery and emergency stabilisation and post-surgery or post stabilisation medical care, through all credible contingencies.

6.1.4 Safely close down surgical and emergency critical services during failure

Healthcare Facilities that will safely *close down surgery and emergency stabilisation, or maintain occupancy of the building under a healthcare function on failure of normal utility services* shall have redundancy, sterile and non-sterile consumables storage, operator, engineering and maintenance skills and training to maintain safe and resilient healthcare services, of the extent required to safely close down current surgery and emergency medical care and then maintain non interventional patient medical care, through all credible contingencies.

6.1.5 Facilities in remote locations or with other critical functions

Healthcare Facilities with limited access or critical functions *that have no viable alternative to provide substitute treatment in the event of failure of normal utility services* shall have redundancy, sterile and non-sterile consumables storage, staff skills and training to maintain safe and resilient healthcare services, of the extent required to continue medical care until the completion of the procedure, through all credible contingencies.

Examples of such facilities include those in a remote/isolated location/areas with other medically critical or non-clinically critical issues, such as, renal dialysis, mental health treatment, communities with potential exposure to unusual medical risks.

6.1.6 Non-critical services

During contingencies non-critical medical and medical support services that can be safely closed down may be so closed down if this is necessary to temporarily divert available capacity or reliability to required critical services.

Such diversions of services shall be part of the Facility Risk Management Plan which shall define:

- circumstances in which the diversion is permitted
- conditions and precautions associated with the diversion and reinstating normal operation
- who is authorised to make the diversion
- training of operators

6.1.7 Contingency conditions

Contingencies to be covered shall be determined as part of the risk management process and shall include but not be limited to:

- normal utilities source failure, e.g. electricity, fuel source, water, drainage, essential fire services, information and communications technology (ICT), battery energy storage
- normal consumables supply failure, e.g. filters, HEPA filters, luminaires, etc
- equipment and plant module failure
- complete failure of service delivery from plant and equipment
- breach of security: physical and cybersecurity
- concurrent failure (as noted above) during periods of routine maintenance/outage

7 ENGINEERING SERVICES OPERATING POLICIES

7.1.1 Operating Policies for engineering services shall be established by the Licence Holder/Applicant and should reach the following status in relation to the LARU project approval stages.

7.1.2 Commencement of design (Approval in Principle - AIP stage for licensing submissions):

- identify input and output parameters and qualities to be achieved
- identify times and conditions under which the services are to be delivered
- identify the planned life expected from the Facility

7.1.3 Completion of engineering services design (Approval to Construct - ATC stage for licensing submissions):

- define operating parameter tolerances on which operating cost analysis has been based and which shall be achieved to deliver the project business plan
- definition of the availability expected from the service

7.1.4 Commissioning (Approval to Occupy - ATO stage for licensing submissions):

- define operating and maintenance authorities and any conditions related to access for operation and maintenance
- define any interdependence of services or components of services
- define any licences and/or technical qualifications required to operate or maintain services

7.1.5 On operation:

- record the as-commissioned (baseline) performance parameters of each service as tested in normal and emergency operating modes

7.1.6 Services Operating Policies are a subset of the policies covering every function the Facility will deliver or require for delivery of its healthcare functions.

8 GENERAL & ENVIRONMENTAL REQUIREMENTS

8.1 Construction Standards

8.1.1 Engineering services shall as a minimum comply with the requirements of the National Construction Code except where these Guidelines require a higher standard.

8.1.2 Access

Services shall have safe access for maintenance. When components have a service life less than the planned life of the principal asset (e.g. the building they serve) they shall be installed with provision for replacement. Access points should:

- be positioned to avoid interference with healthcare delivery
- be provided with appropriate access control for safety and security
- provide for safe handling of any goods requiring access
- minimise need for portable equipment to be provided for access

8.1.3 Flood risk mitigation

All engineering services and equipment necessary to support the ongoing operation of the most critical aspects of the facility shall be located in secure position above highest “worst credible” flood level, taking into account all available climate change adaptation requirements for the specific location.

Typically, this includes electrical services such as power supply and distribution plant, mechanical services plant, hydraulics non-submersible pumps, fire protection pumpsets, communications incoming services and security equipment racks.

8.2 Acoustic Services Brief

8.2.1 The Licence Holder/Applicant shall define the extent of acoustic services to be provided, along with a description of service and the acoustic performance required.

8.2.2 Extent of Service

Acoustic Services shall be provided to comply with requirements of the relevant Australian Standards, environmental regulations and the Licence Holder/Applicant’s Risk Management Plan. As a minimum the acoustic services shall address the following:

- WA Environmental Protection (Noise) Regulations 1997 (WA EPNR)
- internal noise levels
- internal sound insulation
- reverberation time
- vibration and structure borne noise

8.2.3 Environmental Noise Emissions

Environmental noise resulting from operations of the facilities shall comply with the assigned noise levels at the nearest noise sensitive premises. The noise emissions from operational activities of a new or redeveloped hospital /healthcare facility are addressed through the Environmental Protection Act 1986 with the prescribed standards detailed in the WA EPNR.

Various activities that are typically expected at a hospital and that require assessment include, but are not limited to, the following:

- Central Energy Plant containing mechanical and electrical plant (including emergency or standby generators)

- any outdoor mechanical plant
- loading docks
- Back of House areas which have the potential to generate noise

The WA EPNR regulations also require that the noise character shall be “free” of annoying characteristics, namely, tonality, modulation and impulse generation. If these characteristics cannot be reasonable and practicably removed, a series of adjustment to the measured levels are required as per the regulations.

8.2.4 The internal noise levels and reverberation time shall comply with the design levels presented in standard AS/NZS 2107 *Acoustics - Recommended design sound levels and reverberation times for building interiors*. The noise ingress levels and noise from building services shall be designed 5dB below the maximum levels in order to allow for the cumulative noise not to exceed the maximum design sound levels.

8.2.5 Aircraft and Helicopter Noise

Where the facility is in close proximity to or within an aircraft or helicopter flight path, noise ingress from these intermittent sources shall be addressed. Internal noise levels should generally be designed in accordance with Table 3.3 of the Australian Standard AS 2021 *Acoustics – Aircraft noise intrusion – Building siting and construction*.

In addition where the noise levels listed in AS 2021 are not feasible, noting that helicopter operations are essential in emergency medical operations, the noise level criteria should be investigated and assessed on a case-by-case basis to eliminate or mitigate risks wherever possible, in consultation with (and if necessary, direction from) the WA Department of Health.

8.2.6 Internal sound insulation

Air-borne sound insulation requirements for each room should be adequately designed so the noisy activities from one room do not interfere with the need for quiet in adjacent rooms. Air-borne sound insulation requirements for partitions and floors are provided based on the activity noise in one room to the noise tolerance in the adjacent room.

The following tables (table 1 – “*sound insulation parameters of rooms”* and table 2 – “*sound insulation performance to be achieved on site”*) provide the minimum sound insulation requirements for various areas. The sound insulation requirement to be applied should be established by assessing the privacy between a pair of rooms in each direction and the higher sound insulation requirement should be selected for the partition separating the two rooms.

The airborne sound insulation performance of various partitions and floors is generally available in terms of weighted sound reduction (Rw). The acoustic performance on site (DnT,w) will be assessed as 5-8 dB below the Rw rating depending on construction quality and room acoustic parameters. The difference between Rw and DnT,w can be significant if noise flanking paths are not controlled.

8.2.7 Table 1: Sound insulation parameters of rooms

ROOM	NOISE GENERATION OF SOURCE ROOM	NOISE TOLERANCE OF RECEIVING ROOM
CLINICAL AREAS		
Patient Room/Single bed ward	Average	Low
Multi Bed Ward	Average	Medium

ROOM	NOISE GENERATION OF SOURCE ROOM	NOISE TOLERANCE OF RECEIVING ROOM
Toilet/Ensuite	Average	High
Counselling/Interview Room	Average	Low
Consultation Room	Average	Low
Mental Health Consulting Rooms	Average	Low
Mental Health Bedroom	Average	Very Low
Child Health Room	Average	Low
Distressed Relatives Room	Very High	Low
Medical Imaging Rooms	Average	Very Low
Treatment/Medication/Examination Room	Average	Low
Speech and Language Therapy	High	Low
Operating Theatre	Average	Very Low
Birthing Room or Delivery Suite	Very High	Low
Newborn Nursery Suite	Very High	Low
Intensive Care	Average	Very Low
Utility Rooms (Dirty/Clean)	High	High
STAFF AREAS		
Meeting Rooms – Small	Average	Low
Meeting Rooms – Large	High	Low
Board/Conference Rooms	High	Low
Private Offices	Average	Low
Open Plan Office	Average	Medium
Lecture Theatre	High	Low
Library	Average	Low
Classrooms, Training Rooms	Average	Low
Laboratories	High	Medium
Staff Dining	High	Medium
Quiet Room	Average	Low
Focus Room	Average	Low
PUBLIC AREAS		

ROOM	NOISE GENERATION OF SOURCE ROOM	NOISE TOLERANCE OF RECEIVING ROOM
Reception and Waiting Areas	High	High
Toilets	Average	High
Corridors/Lobby Spaces	Average	High
Multi Faith Room/Chapel	Average	Low
INFRASTRUCTURE		
Engineering workshops*	Very High	High
Plantrooms*	Very High	High

*Discontinuous wall construction shall be provided for these rooms due to constant high noise source.

8.2.8 Table 2: Sound insulation performance to be achieved on site (DnT,w,dB)

MINIMUM DnT,w	NOISE TOLERANCE IN RECEIVING ROOM	NOISE GENERATION OF SOURCE ROOM			
		Low	**Average**	**High**	**Very High**
	High	25	30	35	40
	Medium	30	35	40	50
	Low	35	40	45	50
	Very Low	40	45	50	*

*Adjacencies should be avoided by planning of layouts, wherever possible. Where this is not possible DnT,w 55 should be achieved as a minimum.

Attention should be given to the situations where electrical services are located back-to-back in acoustically rated partitions. Socket outlets, switches, medical-gas outlets, integrated plumbing system (IPS) panels and the like should not be back-to-back in partitions intended to provide sound insulation DnT,w above 35.

A discontinuous partition is required where impact noises are expected and in areas where a sensitive space (such as in-patient bedrooms, consulting rooms and the like) separates a non-sensitive space likely to be a source of impact noise (such as kitchen and cleaner's rooms). A discontinuous construction is satisfied when two separate leaves of a partition are separated by a minimum of 20 mm.

Service risers separating a sensitive space (inpatient rooms, consulting rooms, Operating Theatres) shall be designed to airborne sound insulation ratings of $R_w + C_{tr}$ 40 and $R_w + C_{tr}$ 25 where it separates service riser from a non-sensitive space.

8.2.9 Doors

It is important to note that where a door or window is included in a sound rated partition the overall performance of that partition will be significantly reduced and be limited by the acoustic performance of the door or glazing.

Typical solid core doors with perimeter and drop-down acoustic seals are expected to achieve a maximum sound insulation rating of Rw 30-35, unless high performance acoustic rated doors or two doors with an air lock arrangement are used.

If no acoustic seals are provided, (e.g. because of infection control), it should be recognised that sound insulation performance will be reduced. Careful space planning should be undertaken to locate noise sensitive spaces away from areas where it is likely people can overhear.

8.2.10 Doors to the following areas shall achieve a minimum sound transmission rating of Rw30:

- for plant areas, higher ratings for doors may be required depending upon the equipment within the plant room and also the noise sensitivity of adjacent rooms
- counselling/interview room
- consultation room
- treatment/medication/examination room
- meeting rooms
- board/conference rooms
- private offices
- multi faith room/chapel
- quiet or focus rooms
- child health rooms
- distressed relatives rooms
- dirty utility

8.2.11 Impact Isolation

Impact noises due to various sources such as footfall and trolleys shall be controlled at the floor surface where possible.

Impact sound insulation requirements for each room should be adequately designed so the noisy activities from one room do not interfere with the need for quiet in adjacent space below. Impaction sound isolation requirements for floors or slabs are provided based on the activity noise in one room to the noise tolerance in the adjacent room.

8.2.12 The following table (table 3 – "*Impact Isolation Performance Requirements of Floors/Slabs from Above"*) provides the minimum sound insulation requirements for various areas. The sound insulation requirement to be applied shall be established by assessing the privacy between a pair of rooms in each direction and the higher sound insulation requirement shall be selected for the partition separating the two rooms.

The airborne sound insulation performance of various partitions and floors is generally available in terms of weighted standardised impact sound pressure level (L_{nTw}). The degree of performance is typically indicated by lower L_{nTw} values (e.g. lower values indicate higher performance and represents a reduced impact noise level impacting on the floor below).

8.2.13 Table 3: Impact Isolation Performance Requirements of Floors/Slabs from Above (L_{nTw})

ROOM	MINIMUM L_{nTw}
Wards	55
In-Patient Areas	
Intensive Care	
Consulting Rooms	
Interview Rooms	
Operating Rooms	
Procedure Rooms	
Executive Offices	
Boardrooms	
Medical Examination	60
Treatment Rooms	
General Offices	
Open Plan Office Areas	
Lobby or Waiting Areas	
Laboratories	

8.2.14 Vibration

Vibration in occupied spaces shall not exceed the just perceptible level defined by AS 2670.1: *Evaluation of human exposure to whole-body vibration - General requirements*.

Vibration precautions should include:

- dynamic balancing of machines
- isolation of sources of vibration from vibration transmission paths (e.g. machines from pipes, ducts, support structures, lifts, and the like)
- piping being designed to avoid pressure pulse noise or being fitted with effective pulse dampers
- structures being isolated from ground transmitted vibrations
- equipment being selected and supported to avoid operation at resonant frequencies

8.2.15 Commissioning and Testing: Facilities shall be commissioned and tested as described in following sections of The Guidelines. The Licence Holder/Applicant may also be directed to provide further specific testing if needed to establish Approval to Occupy status.

8.2.16 Testing required shall be formally reported and held in the Licence Holder/Applicant's record system. Reports should:

- describe methodology
- identify and provide the credentials of the commissioning and testing personnel
- identify test instruments and their calibration status
- report design and measured parameters
- report service outcomes and their stability

8.3 Layout and Capacity

8.3.1 Services layout and capacity should provide for:

- access for firefighting to all buildings and for truck and crane access to install and remove any items of equipment requiring truck transportation or crane placement
- efficient safe access and egress for all service providers and maintenance activities
- flexibility for development in healthcare practice and technology over the planned life of the facility
- safe, non-disruptive maintenance and replacements of facility components over the planned life of the facility
- non-disruptive impact on the neighbourhood
- compliance with the performance and risk management requirements of these Guidelines
- optimise ESG considerations including commitments to meeting local, state, national and global sustainability targets
- minimising waste from the Facility and enable recycling and reuse of products used at the Facility

8.4 Optimising Performance

8.4.1 New engineering services can only be commissioned to suit the season applying to the commissioning period. This rarely provides the opportunity to fully test services that are appropriately set up to deal with the whole range of conditions they will be required to cope with in service.

Optimising resources should therefore be provided to:

- monitor performance during at least the first year of operation (commencing from when healthcare functions are fully commissioned) and demonstrate it meets agreed design objectives (monitoring should continue until required performance is achieved)
- establish the operating and maintenance regimes for the works
- establish performance audit reporting regimes for the works
- update operating and maintenance instructions for the works to reflect any optimising adjustments made
- update as constructed documentation of the works to reflect any optimising adjustment made
- establish the ongoing maintenance of the as constructed record
- audit services risk mitigation and propose any changes to the works or works operating and maintenance procedures that proper duty of care risk management may require

8.4.2 Resources should also be provided to:

- optimise performance to the limits of the services capability

- identify and report any scope for alterations to provide further worthwhile enhancements of performance
- establish performance audit reporting regimes for the works

8.5 Project Documentation

8.5.1 Project documentation shall be adequate for the assessment of compliance with The Guidelines and at least define:

- context and philosophy of design
- design codes used in the design
- extent and layout of the services
- capacity of the services
- performance and quality of the services
- requirements of The Guidelines that are not achievable

8.6 Protection and Security

8.6.1 Engineering services should be appropriately protected from interference, damage and poor functionality. There should be:

- out of tolerance alarms on all engineering services parameters critical to healthcare delivery or equipment and personnel safety
- mitigation for all foreseeable malfunctions, e.g. over and under parameter limit shut down; over pressure venting; leakage drainage; and the like
- protection from vandalism
- access control on access ways to service controls and the fill points of tanks
- markers identifying the routes of underground services
- identifying markers on all equipment and controls
- warnings of all hazards

8.6.2 It should be considered that dimensioned position of all in ground services are recorded on drawings and, in areas of complexity photographically, as they are being built. Positions should be measured from a fixed datum position including depth of burial.

8.7 Utilities

8.7.1 Utilities include electricity, gas, water, drainage, communications, medical gases, fuel supplies, ventilation, air conditioning and any similar services required by the facility functions.

Utilities shall be configured to deliver reliability, maintainability and risk mitigation measures defined in the Operating Policies provided by the Licence Holder/Applicant, The Guidelines and the following minimum requirements:

- compliance with Supply Authority requirements
- back up or division into service modules to provide reliability and enable maintenance of critical functions during maintenance activities (minimum requirements are covered in the sections of The Guidelines dealing with particular services)
- arrangements for alternative configuration of supply arrangements to cover foreseeable accidents and emergencies
- arrangements for alternative supply for functions that require to continue to function in all circumstances

8.8 Mental Health Areas

8.8.1 Mental health facilities require specific considerations that ensures the built environment is safe and suitable for patients, staff and visitors. Those involved in developing mental health facilities should understand the application and compliance with the Chief Psychiatrist Standards for the Authorisation of Hospitals under the Mental Health Act 2014 and any subsequent updates if they are seeking authorisation of the facility under the Mental Health Act 2014. Mental health services not seeking authorisation may also find the guidance valuable. These standards are relevant to new developments and services who undertake any refurbishment within an authorised boundary. The *Chief Psychiatrist's Advisory: Mental Health Hospital Authorisation Process* outlines the recommended pathway for Office of the Chief Psychiatrist (OCP) involvement in mental health builds.

8.8.2 Mental health facilities require specific matters in engineering detailing to adequately match the needs of patients (known as consumers in the context of mental health); details of which shall be determined in collaboration with the clinical team for the project and in collaboration with the OCP.

This should include a risk-based approach to the specific needs for consumers, with strategies to manage the additional risks to which consumers, staff and others may be exposed.

Recommendations of AusHFG guidelines relevant to Mental Health Facilities shall be considered as relevant to the project specific needs.

8.8.3 The following measures shall be considered and incorporated in mental health areas as determined based on risk assessment in conjunction with the clinical team and OCP:

- locate serviceable equipment (such as plant, switchboards and other equipment) outside of areas normally accessed by consumers and allows access without passing through consumer occupied areas
- position maintenance access provision (e.g. ceiling access panels) external to consumer areas wherever possible
- all services panels to be secure and not accessible to consumers, for example medical gas service panels
- fire hydrants, fire hose reels, and fire extinguishers should be in recessed cupboards with lockable doors (no exposed fire protection equipment)
- locate equipment and switching to be operated by staff in a position not accessible to consumers, including electrical supply shut off (if required)
- all equipment and fittings should be safe, tamper proof, durable and concealed where possible ensuring flushed with surfaces attached to. For example: luminaires, detectors, speakers, sprinkler heads, socket outlets and light switches, control panels, temperature sensors
- flush mount fixtures and fittings with anti-ligature detailing
- provide anti-ligature products of a type specifically manufactured and marketed as anti-ligature/ligature resistant, that have been tested prior to installation or have a proven track record, and are installed in accordance with the manufacturer's instructions
- position ceiling mounted services so they cannot be accessed by climbing on furniture
- provide air conditioning diffusers that do not allow insertion of foreign objects
- air conditioning transfer grilles to be acoustically treated
- no doors grilles to consumer areas

- detailing should include non-detachable sealing trims, anti-picks sealants, tamper proof fixings and shatter proof materials
- plumbing fixtures and fittings attached to structural wall or reinforced wall framing for internal wall linings to withstand significant physical force without breaking or detaching
- services installed hard back to wall to prevent “pull-off”
- shutoff to water supply as an emergency measure
- safety shutters to switched socket outlets
- lighting controlled with gradual dimming On/Off
- night lights available in consumer bedrooms
- avoidance of excessive contrast of light such as glare and shadows
- selection of lighting designs to assist with sensory therapeutic procedures
- avoidance of flickering, stroboscopic effects, coloured fittings, trims or plates and any other visual cue that may adversely impact consumers
- provision for staff override of staff/assistance call systems
- call systems to be installed in a way not to cause disturbing noise

8.8.4 Safety also applies to outdoor areas and the same provisions as noted above shall be considered equally, such as - anti-ligature fixtures and fittings, services selected and securely mounted to avoid breaking and detaching, tamper-resistant fixings and avoidance of abuse of water and electrical fixtures.

8.8.5 Security systems should be determined on the basis of a project specific safety risk and needs analysis including:

- fixed and mobile duress buttons
- enhanced WiFi coverage to avoid “black spots” of mobile duress coverage
- video surveillance
- access control with staff override
- presence and motion detection
- extended UPS autonomy for security systems

8.9 Seismic Restraints

8.9.1 Healthcare facilities shall include seismic restraints in accordance with AS 1170.4 *Structural design actions Earthquake actions in Australia* and in particular Section 8 *“Design of parts and components”.*

8.9.2 As a minimum the following parts and components and their connections shall be designed for seismic restraints for both horizontal & vertical forces:

- substation components including transformers and HV switchgear
- diesel generators
- uninterruptible power supply systems (including batteries)
- solar PV systems
- electrical cubicles and panels including switchboards and control gear panels
- busduct distribution
- electrical and communications cable basket/trays including supports
- all electrical conduits greater than 64 mm inside diameter
- LIOM transformers and support frames
- communication, security and other miscellaneous equipment racks and cabinets

- lighting fixtures that are secured to fixed structures and supported by suspended ceilings
- boilers, chillers and heat pumps
- air handling units, fans and CHW, CWS and HHW circulating pumps
- main duct and pipework reticulation
- mechanical/electrical/BMCS cable trays
- medical gas plant and cylinder storage racks
- mechanical storage tanks and pressurisation units
- drinking water tanks
- water pumps and water treatment systems
- hot water plant, pumps
- LP gas tanks
- pipe fixing for primary and secondary main service runs

8.9.3 Other parts and components may need additional seismic restraints due to specific vibration criteria and should be assessed on a case-by-case basis and all risks eliminated or mitigated.

9 ENGINEERING SERVICES, CIVIL

9.1 Site Investigation

9.1.1 Sites should be subjected to geotechnical investigation as well as an investigation by a suitably qualified environmental scientist for contamination and sub-structure design requirements for the buildings to be erected.

Sites should:

- have a low risk of flooding (refer also to section – "*Drainage"* below)
- be free from chemical, asbestos and other hazardous contamination
- have appropriate sub soil drainage or other effective means to prevent rising damp or salt affected soil problems
- provide a stable foundation for buildings (e.g. where clay is the founding soil, particular care is required as clay is volumetrically sensitive to moisture content and without appropriate design, pavements break up and buildings could potentially move)

9.1.2 The investigation shall comply with AS 1726 *Geotechnical site investigations* and a factual report with sufficient information requires to be submitted to provide recommendations on:

- site classification in accordance with AS 2870 *Residential slabs and footings*
- suitable footing types, geo-technical design parameters and estimated movement characteristics are required from a suitably qualified and experienced geotechnical engineer to guide the civil engineer
- excavation characteristics, particularly with regard to occurrence of any strong rock and need for dewatering; classification and description of rock is required
- site preparation requirements, including any procedures for subgrade preparation, proof rolling, ground water control and excavation of unsuitable soil
- suitability of on-site materials for use as fill and minimum compaction requirements
- site preparation requirements and California Bearing Ratio (CBR) design values for car parking areas, roads and any other hardstands.
- soil reactivity in accordance with Qualitative assessment of soil expansiveness for subgrade (refer to Table 5.2 of Austroads "*Guide to Pavement Technology Part 2*")
- analysis of existing pavement materials (where appropriate) for reuse
- recommended grading curve for stabilisation with Binders (where appropriate)
- soil permeability characteristics for encountered soil profiles at various depths
- design requirements for temporary and permanent excavations and earth pressures behind retaining walls
- assessment of stability against global slip failures associated with retaining structures
- earthquake site factor and acceleration coefficient (where this may be modified due to localised soil conditions) including basis of selection; this shall be in accordance with AS1170.4 *Structural design actions Earthquake actions in Australia*

9.2 Roads, Paved Yards, Car Parks and Pathways

9.2.1 Paved roads and/or pathways shall provide safe access to every car park, entrance, service delivery point, maintenance delivery point, emergency service delivery point and emergency evacuation assembly point.

9.2.2 Roads to service yards and delivery points, yards and car parks should allow for turning radii and axle loads of largest viable vehicle appropriate to the facility and design should consider the following issues as a minimum:

- the intermittent need for cranes to off load heavy loads and place equipment
- the need for marking maximum axle loadings to warn of design load limits of roads and associated structures
- where planned life of the facility exceeds maintenance free life of the pavement; the ability to maintain the pavement without adverse impact on facility operation
- pathways should link with any adjacent public transport stops
- geometric design of the road and pathways shall comply with local government design guidelines and also with Austroads/MRWA requirements at any interface with public roads.

9.2.3 Roads and pathways for accessibility (AS/NZS 1428 *Design for access and mobility*) shall have grades, tactile indicators and other design characteristics to comply with disabled access requirements. Roads shall not double as pedestrian access ways.

9.3 Drainage

9.3.1 Sites shall be provided with:

- storm water drainage routed to prevent flooding of buildings and pooling of storm water on any paved area or recreational space
- sub soil drainage to prevent rising damp or flooding of any basement spaces

9.3.2 Healthcare facilities defined by the FOP as required to comply with clause ”**Disaster or emergency role**” (that is, a facility that is to *withstand natural disasters, or with a strategic post disaster and emergency role*) or clause ”**Continue surgical and/or emergency services during failure**” (that is, a facility that is to *continue to offer invasive surgery or emergency medical services through failure of normal utility services*) shall be designed to cope with 100 year Average Recurrence Interval (ARI) storm conditions and 100 year ARI storm surge event in coastal plains and shall place buildings at least 500 mm above this level so determined or as designated by the Local Authority.

9.3.3 Other Facilities shall comply with requirements of the Local Government Authority. Note – Australian Runoff and Rainfall guidelines (ARR) requires a clearance > 300mm above FFL, take into account high tides with cyclonic surge.

9.3.4 All drainage systems shall be designed with short, medium and long term maintenance requirements in mind. On site storage basins/tanks/infiltration systems shall incorporate contamination removal prior to discharge in accordance with Water Sensitive Urban Design (WSUD) practices. Drainage systems should be designed in accordance with WSUD where possible.

9.3.5 Proprietary products used for stormwater collection and treatment shall be an approved product (i.e. comply with Urban Runoff Design Requirements and treatment requirements for total suspended solids (TSS), total nitrogen (TN) and total phosphorus (TP) plus other pollutants relevant to the Facility location) and should be installed as in accordance with manufacturers recommendations.

10 ENGINEERING SERVICES, COMMUNICATIONS

10.1 Communications Systems Brief

10.1.1 The Licence Holder/Applicant extent of communication services shall be defined with a fully detailed description of services to be provided by the Licence Holder/Applicant as part of their submission that supports the safe, secure and reliable clinical and building operational functionality of the health facility served by the communications system.

The performance required to deliver such services shall be not less than as required by statutory regulations and these Guidelines.

The Licence Holder/Applicant should demonstrate the inherent future flexibility, expandability, and accessibility for adaptation to suit the changing needs of the building operational requirements and clinical services delivery over the life of the building.

10.2 Extent of Services

10.2.1 Communication services required may include but not necessarily be limited to:

- information and communications technologies (ICT)
- structured cabling
- assistance call systems (including emergency call, patient nurse call, staff assistance call, duress alarm systems)
- door call
- intercom
- public address
- hearing augmentation
- radio communication systems, including hospital and healthcare network specific systems
- messaging systems (including paging systems, queuing system, auto-text to mobile, email)
- patient entertainment systems (PES - including MATV, radio and data communications)
- voice communications systems
- wireless access points (WAP)
- mobile telephone Distributed Antenna System (DAS)
- video conferencing and Telehealth facilities
- electronic medical records
- RTLS tracking system interface
- master clock and elapsed time systems
- coordination of engineering systems (such as BMCS, CCTV, PA and sound systems, nurse and assistance call, hearing augmentation, audio visual, security, access control, master clock system, FM messaging, emergency response systems, RTLS tracking, electronic patient records, interactive wayfinding/signage) that may run over a common integrated communications network infrastructure

10.3 Coordination with Other Disciplines

10.3.1 Communications services associated with all aspects of the facility regardless of which discipline they occur (e.g. mechanical, electrical, hydraulic) shall comply with the requirements of this chapter.

10.3.2 Where aspects of other disciplines are applicable to the communications portions of the works (e.g. naming, numbering, colour coding and labelling of electrical supply, cable containment, power quality management) the works shall comply with the respective requirements of the other discipline sections.

10.3.3 Refer to chapter "*Background*", section "*Definitions*" with clauses that contain a list of terms relating to electrical power supplies as relevant to healthcare facilities referenced within The Guidelines.

10.4 Standards and Quality

10.4.1 Communications systems are fundamental to the provision of patient-centred care, providing increasingly sophisticated infrastructure to support a "digital hospital".

Technology in this area continues to advance quickly and it is important that public and private healthcare facilities are fitted with proven and accessible products, with capacity to readily expand and accommodate future developments.

Communication systems and the installations shall comply with the current versions of the following:

- AS/NZS 3000 *Electrical installations - Australian/New Zealand Wiring Rules*
- AS/NZS 11801.1 *Information technology – Generic cabling for customer premises General requirements*
- AS 11801.2 *Information technology – Generic cabling for customer premises Office premises*
- AS/NZS 3084 *Telecommunications installations – Pathways and spaces for commercial buildings*
- AS/NZS 2834 *Computer accommodation (withdrawn but maintained for reference)*
- AS 3811 *Hard-wired patient alarm systems*

  Note: this was withdrawn in 2017, but a new, updated version is currently under development by Standards Australia and is expected to be released in the near future. Once issued, the new standard should be complied with where relevant to the specific electronic system and functional area of the health facility.

- AS/CA S008 *Requirements for customer cabling products*
- AS/CA S009 *Installation requirements for customer cabling (Wiring Rules)*

10.4.2 Communication systems and the installations should comply with the current versions of the following, where appropriate:

- HSS ICT communications room build standards
- WA Health Facility ICT Specification
- WA Country Health ICT Facility Classification Specification
- Digital Hospitals Handbook SA HB 163
- Any other codes that are applicable

10.4.3 For additional guidance reference should also be made to other States' Health ICT Cabling standards where any particular element is not covered herein, including:

- VHBA's Engineering Guidelines for Healthcare Facilities Volume 3 – Data, Comms and Security: HTG-2020-003
- NSW Health Engineering Services Guide
- Queensland Health ICT cabling infrastructure technical standard

10.5 Redundancy and Disaster Planning

10.5.1 All communications systems shall be provided with levels of reliability, maintainability, business continuity, multiple levels of redundancy and disaster recovery in accordance with the facility FRMP and BCP plans.

The system design and the FRMP shall demonstrate the methods used to protect as far as reasonably practical against cyber-attacks and to mitigate the impacts of a successful cyber-attack.

10.5.2 Healthcare facilities defined by the FOP as required to comply with clause "**Disaster or emergency role**" (that is, a facility that is to *withstand natural disasters, or with a strategic post disaster and emergency role*) shall have:

- direct telecom carrier lines (non-PBX lines) present in all key areas (e.g. Emergency Department, ICU/HDU, Laboratories, Security, Radiology, Operating Theatres, EOC) of the hospital
- PABX and data communications systems supported by Instantaneous power source (UPS/Battery Back-Up) and alternative Vital power supply source
- internal 2-way radio network and mobile phones to support Messaging system in event of system failure
- external communications via DoH Metropolitan Emergency 2-way Radio Network
- dedicated email address to be used for information receipt and dissemination
- computer systems which shall be able to access the internet 24 hours a day to ensure connectivity to WebEOC
- satellite phone
- redundant cabling paths and systems to maintain critical ICT systems under all operational and maintenance conditions
- for new developments, redundant and physically diverse carrier network services shall be provided

10.5.3 Healthcare facilities defined by the FOP as required to comply with clause "**Continue surgical and/or emergency services during failure**" (that is, a facility that is to *continue to offer invasive surgery or emergency medical services through failure of normal utility services*) shall have:

- direct telecom carrier lines (non-PBX lines) present in key areas of the hospital, including EOC, emergency department, reception and ward
- PABX and data communications systems supported by Instantaneous power source (UPS/Battery Back-up) and alternative Vital power supply source
- internal radio network
- redundancy communications plan to support messaging system failure
- mobile phones to support messaging system failure or satellite phone for non-mobile coverage areas
- satellite phone for Field Medical Commander (if nominated to deploy medical team)
- redundant and physically separated cabling paths and systems to maintain critical ICT systems under all operational and maintenance conditions

- computer systems compatible with the SHICC crisis information management system (WebEOC)

10.5.4 Healthcare facilities defined by the FOP as required to comply with clause ”**Safely close down surgical and emergency critical services during failure**” (that is, a facility that is to *safely close down surgery and emergency stabilisation, or maintain occupancy of the building under a healthcare function on failure of normal utility services*) shall have:

- PBX and data communications systems supported by Instantaneous power source (UPS/Battery Back-up) and alternative Vital power supply source
- secondary internal communication system in place, such as intercom, mobile phones or satellite phones in non-mobile coverage areas
- redundant and physically separated cabling paths and systems to maintain critical ICT systems required to safely close down current surgery and emergency medical care and then maintain non interventional patient medical care

10.5.5 Healthcare facilities defined by the FOP as required to comply with clause “**Facilities in remote locations or with other critical functions**” (that is, a facility *with limited access or other critical functions that have no viable alternative to provide substitute treatment in the event of failure of normal utility services*) shall have:

- direct telecom carrier lines (non-PBX lines) present in key areas of the facility
- PBX and data communications systems supported by Instantaneous power source (UPS/Battery Back-up) and alternative Vital power supply source
- secondary internal communication system in place, such as intercom, mobile phones or satellite phones in non-mobile coverage areas
- redundant and physically separated cabling paths and systems to maintain critical ICT systems required to continue medical care until the completion of the procedure, through all credible contingencies
- computer systems compatible with the SHICC crisis information management system (WebEOC)

10.5.6 Other healthcare facilities should have:

- direct telecom carrier lines (non-PBX lines) present in key areas of the facility
- PBX and data communications systems supported by Instantaneous power source (UPS/Battery Back-up) and alternative Vital power supply source
- secondary internal communication system in place, such as intercom, mobile phones or satellite phones in non-mobile areas
- computer systems compatible with the SHICC crisis information management system (WebEOC)

10.5.7 Information Systems

Redundancy shall be provided to cover the loss of all hospital information systems including:

- down time procedures for loss of each system used
- facility servers on dual power source – i.e. both UPS and Vital
- information backed up each day and information stored in more than one location off site
- communications rooms AC connected to Vital power to maintain operation in the event of power failure

For details and specifications relating to core ICT infrastructure and the minimum performance standards refer to the most current equivalent to:

ICT Managed Infrastructure Standards with particular reference to the WA Health Enterprise Architecture Facility Classification Specification.

10.6 Common Requirements

10.6.1 Communications services shall:

- provide a secure, robust and resilient network infrastructure that is also future flexible, easily accessible and modifiable and not tied to a specific provider
- aid the proper delivery of healthcare
- not delay the delivery of care
- summons help within best practice time tolerances
- prevent equipment emergencies getting beyond control
- not interfere with medical processes or equipment nor unreasonably disturb the rest and comfort of patients
- provide ready access to the information needed to deliver healthcare services

10.7 Passive Data Communications

10.7.1 There should be a structured cabling network provided for the information and communications technology (ICT).

10.7.2 The backbone communications systems shall provide:

- Main Communications equipment Room (MCR)
- Main Distribution Room for carrier equipment. This may be the same room as the MCR, where appropriate for the facility
- Incoming telecommunications access pathways
- Floor distribution rooms to house the horizontal network cabling and ICT equipment for each ICT service area
- The level of redundancy and duplication of rooms and pathways shall be informed by the FRMP.

10.7.3 The data network shall at least:

- be capable of supporting all facility-wide ICT services and networking requirements, with spare capacity for future expansion
- be provided within locked accommodation facilities
- have backbone cabling suitably protected by installing in cable duct, on cable basket/tray or similar protecting cable management solution
- have risers/communications rooms/cupboards suitably designed, located and/or fire protected (two hour) to ensure that a fire within one compartment does not interrupt the communications services to another fire compartment
- have primary and redundancy backbone cabling, where provided, run along physically segregated and diverse routes to each floor distribution room and downstream distribution closet
- comprise cabling system with a minimum 20-year warranty vendor approved for applications and components

10.7.4 Cabling shall:

- be labelled at each end
- be neatly installed and supported and not run across the floor or ceilings

- be routed remotely away from sources of electromagnetic interference and vulnerability to mechanical damage
- maintain minimum separation clearances between communications and power cables as specified in AS/CA S009
- where provided with consolidation points (CP), such units should be located to be readily accessible with minimal interruption of traffic flows or uses of the occupied space within the facility

10.7.5 Communications rooms should be established to accommodate equipment for the variety of building services as well as ICT and data communications within a secure environment and positioned to be readily maintained without risk of compromise to adjacent equipment and services.

10.7.6 Communication rooms are vital components in the physical infrastructure of the ICT environment. ICT communication rooms should host the necessary functions to support the networking topology for the facility. The distribution of functions should follow the principles specified in AS/NZS 11801 Part 2.:

- Campus distribution (CD) function (also referred to as a Core Communications Room – CCR – in some reference standards and guidelines) – the central and key distributor for a large campus or large premises with multiple buildings. The CD structured cabling system should feed the building distributors located in other buildings. The carrier or public network cables and other services are also found in CD.
- Building distribution (BD) function (also referred to as a Hub Communications Room – HCR – in some reference standards and guidelines) – feed cables to floor distributors and also interconnect with a CD. BD may act as a local floor distributor, double up as a CD and have carrier cables/services terminated within it. BD is the primary distributor in a single physical building.
- Floor distribution (FD) function (also referred to as a Floor Communications Room – FCR – in some reference standards and guidelines) – should be located on each floor of a building to service local IT clients or devices. FDs terminate horizontal cabling run to each client end point. The floor distributor also has building backbone cables connecting the FD to the BD or from the FD to other FDs.
- Server room function – a server room is a room used to store, power and operate computer servers and their associated components. A server room provides the operational and environmental components and services necessary to operate enterprise class servers.
- Distributed antennae system (DAS)/carrier room function – is a central communications rooms where the DAS services would aggregate and terminate into. Telecommunication carriers (such as NBN, Telstra, Optus and Vodafone) would terminate their lead in services into the DAS/carrier room and would also host any carrier equipment in this area.

10.7.7 Combined Communications Rooms.

Communication rooms can host a number of distribution functions. Where possible, communications room functions should be combined into the same room while still meeting all other requirements to host that function. If the communications room functions are combined, then each function should be accommodated in separate racks.

10.7.8 For multistorey buildings, communications rooms should be stacked on top of each other to assist with riser access and located central within the nominated area to be served. Alternatively, there should be careful consideration towards the design for common vertical risers for cable access to communications rooms between floors.

10.7.9 All communications equipment should be securely supported and mounted above floor level.

10.7.10 Campus Distributor (CD) Functions.

Larger critical health facilities shall have two separate communications rooms that host the CD function. There should be a primary and secondary CD room on the campus to provide a level of redundancy and availability.

The CDs shall be physically separated in two different buildings on the campus and connected with two, physically diverse, fibre connections.

To support CD functions in communication rooms, a minimum of two racks shall be provided. One rack for passive termination of CD functions and one rack for active equipment for CD functions. Additional racks, and suitable space allowance, should be provided to accommodate the ICT project requirements and for future growth.

10.7.11 Building Distributor (BD) Functions.

Each new substantial and critical building on a hospital campus should have two communications rooms, operationally functioning as a BD. Smaller, or less critical buildings, may only require a single communications room functioning as a BD.

Primary and secondary BD communications rooms shall provide adequate redundancy and availability for the building to accommodate the requirements of the Facility Operating Plan. The BD communications rooms shall be located in physically separate rooms within the building.

BD communications room may also act as a FD communications room.

BD communication rooms shall be connected to each CD communication room via physically diverse fibre pathways.

To support BD functions, a minimum of two racks shall be provided. One rack for passive termination of BD functions and one rack for active equipment for BD functions. Additional racks, and suitable space allowance, should be provided to accommodate the ICT project requirements and for future growth.

10.7.12 Floor Distributor (FD) Functions.

FD communications rooms should be strategically placed to ensure all horizontal cable run lengths do not exceed their stated performance limits (typically 90m in length). Where horizontal cable runs would exceed their performance limits, an additional FD function should be provisioned to make the cable lengths compliant. FD communication rooms shall be connected to each of the BD communication rooms via physically diverse fibre pathways.

To support FD functions, a minimum of three racks should be provided. The number of racks will be dependent on the FD functions required. Rack requirements will be dependent on allocation of technical outlets and support, including:

- passive termination
- active equipment
- hosting of on-premises local systems (such as nurse call, security and access control systems and patient entertainment systems)

10.7.13 DAS/Carrier Room.

Where the provision of mobile phone coverage requires the addition of an In-building Coverage (IBC) system, then a Carrier-approved solution shall be provided. Depending on the extent of coverage required from the IBC, this may be based on a repeater system or a Carrier-managed Distribute Antenna System (DAS). DAS solutions, where provided, should be designed in accordance the Mobile Carrier Forum's DAS Design Guidelines. DAS designs should be undertaken by an

accredited designer and shall be approved by the Lead Carrier. The provision of a DAS room shall include:

- Sufficient space to accommodate the carrier equipment including clearances for equipment installation and maintenance. Provision should be made for any anticipated upgrades or system expansion.
- Cooling systems provisioned to meet the heat load requirements of the equipment
- Power supply provisioned to meet the electrical load requirements of the proposed equipment. Allowance should be made to manage power distribution independently for each Carrier.
- Fire detection and suppression
- Access control
- No wet services passing through the room

10.7.14 Physical security separation measures shall be provided to the requirements of the telecommunications carriers.

Where DAS/carrier rooms are not combined with CD functions, DAS/carrier rooms should be located relatively close to the campus main communications rooms.

10.7.15 Data communications cabinets shall have dual power supply from differing supply sources each rated to suit the needs of the equipment/service.

10.7.16 Communication room cabinets with active equipment shall have instantaneous power source (UPS Power) plus alternative Vital power supply. Non-Essential power may be used where Vital power is not being provided. Active equipment should be provided with redundant power supplies and each power supply should be connected on diverse power circuits on the same phase.

10.7.17 Data communication equipment should be provided within a suitable environment. Communications rooms should have environmental monitoring (with an auditable record of events) to notify facility stakeholders should the environment create cause for loss of service.

10.8 Assistance Call

10.8.1 There should be assistance call facilities at each public and patient control point that is a barrier to healthcare delivery or healthcare support services.

10.8.2 Call facilities shall:

- comprise audio call from external station to staff answer point and allow two-way voice communication
- be prominently and permanently labelled and include any operating instructions
- be configured for use by the range of people who may have need to use them
- generate a call signal in an area where assistance will always be available
- be provided with facility for staff to remotely open the entry door from answer station position

10.8.3 The provision of video, either directly from the call station or from adjacent CCTV, should also be considered.

10.9 Emergency Call

10.9.1 There should be emergency assistance call facilities, for use by staff, in every patient room, patient bathroom, patient ensuite, treatment room and anywhere else where staff may be alone with a patient and may need help to deal with a patient

emergency (excluding corridors). Requirements for system operation shall meet the requirements of the Facility Risk Management Plan.

10.9.2 An emergency call point installed within a single patient bedroom will fulfil the accessibility requirement for an adjoining patient bathroom/ensuite dedicated for the sole use of that patient room.

10.9.3 Emergency call facilities shall be:

- in standardised positions throughout the facility
- located to avoid misuse
- waterproof if located in areas that may get wet
- connected to an Instantaneous power supply capable of supporting full functionality under all load conditions

10.9.4 The call system operation shall:

- raise audible and visual assistance alarms at destinations where there will always be competent assistance resources available
- identify the source of the alarm
- maintain the emergency alarms until cancelled at source
- be zoned to maintain full local ward functionality without the dependency upon communications via ICT or other building network

10.9.5 If the emergency call system is integrated with other call systems, e.g. patient call, emergency call alarms shall be of highest priority. Lower priority calls should return when emergency calls are cancelled.

10.9.6 Assistance call annunciators (containing description details of location and type of call) shall, as a minimum, be provided in suitably visible location adjacent to each staff station. Annunciators should allow multiple text alerts to be displayed simultaneously with colour coding and different tones.

10.9.7 Alternative means of communicating calls such as via mobile handset phone or through 2-way voice should be assessed in conjunction with the requirements of the Facility Operating Plan and incorporated as appropriate to the clinical needs of the area.

10.10 Nurse Call

10.10.1 There shall be a nurse call system, for use by patients, at every patient location (including bed, toilet, shower, bath, and hand basin), treatment position and any location where a patient may be left unattended.

10.10.2 Systems operation shall meet the requirements of the Facility Risk Management Plan.

10.10.3 Nurse call points shall:

- be in standardised positions throughout the facility
- be waterproof if located in areas that may get wet
- be located and configured to be within reach of patients at each location and:
  - mounted between 800mm to 1100mm AFL adjacent to toilet pans
  - mounted between 500mm to 750mm AFL where installed adjacent to sinks or within showers
- be connected to an Instantaneous power supply capable of supporting full functionality under all load conditions
- enable two-way voice communication between patient and staff, where required

10.10.4 At beds there shall be a call button on the wall at the bed head and on a pendant that can be positioned to suit the circumstances of the patient in the bed (pendants may control multiple services, e.g. television, radio, reading lights, bed position). Pendants should be cabled and have socket connections. An alarm should be generated if the plug is disconnected.

10.10.5 The call system shall:

- raise audible and visual assistance alarms at destinations where there will always be competent assistance resources available
- identify the source of the alarm
- maintain the alarm until cancelled at source
- provide reassurance indication at source that the alarm has been transmitted
- have a distinct alarm signal that will not be confused with other alarms
- be zoned to maintain full local ward functionality without the dependency upon ICT or other building networks

10.10.6 The call system should have provision for attaching special operating devices to suit patients with disabilities and may have pendants or pull cords or similar means of placing operation of the system within easy patient reach.

10.10.7 Assistance call annunciators (containing descriptive details of the location and type of cable) shall, as a minimum, be provided in suitably visible location adjacent to each Staff Station. Annunciators should allow multiple text alerts to be displayed simultaneously with colour coding and different tones. Wayfinding indicators from staff station to position of the call shall be provided.

10.10.8 Alternative means of communicating calls such as via mobile handset phone or through 2-way voice should be assessed in conjunction with the requirements of the Facility Operating Plan and incorporated as appropriate to the clinical needs of the area.

10.10.9 Duress call functionality may be provided by both the nurse call and security systems at the facility. Different responses may be required for different areas and the duress system provision may be a combination of components and shall be coordinated across both systems, to meet the requirements of the Security Risk Assessment and the FRMP (refer to chapter "*Engineering Services, Security*").

10.11 Staff Assistance Call

10.11.1 Licence Holder/Applicant may require a separate system for staff assistance call; where required staff assistance call facilities should be:

- configured to differentiate from Emergency and Nurse calls
- in standardised positions throughout the facility
- located to avoid misuse
- waterproof if located in areas that may get wet
- connected to an Instantaneous power supply capable of supporting full functionality under all load conditions

10.12 Colour Coding and Labelling of Call Buttons

10.12.1 Colour coding of call buttons shall comply with AS 3811. Where non-standard coding is used it should be consistently applied to the whole site.

10.13 Messaging Systems

10.13.1 If the Facility Operating Plan requires services from roaming/remote staff or contracted providers there should be a messaging system interfaced with other communication systems allowing authorised party or automatic calling of assistance as provided for in the policies.

10.13.2 The system shall at least:

- incorporate arrangements to alarm if a response is not registered
- provide sufficient call information to clearly identify the response required
- log calls
- be capable of messaging multiple parties simultaneously
- interface with security, assistance call, fire and other emergency alarms as required by the Operating Policies

10.14 Two-Way Radio

10.14.1 Two-way radio communications may be required for remote sites and for communication with patient and goods transportation.

10.15 Mobile Phone Coverage

10.15.1 Where the provision of mobile phone coverage requires the addition of an In-building Coverage (IBC) system, then a Carrier-approved solution shall be provided. Depending on the extent of coverage required from the IBC, this may be based on a repeater system or a Carrier-managed Distribute Antenna System (DAS). DAS solutions, where provided, shall be designed in accordance the Mobile Carrier Forum's DAS Design Guidelines. DAS designs should be undertaken by an accredited designer and shall be approved by the Lead Carrier.

10.16 Patient Entertainment System (PES)

10.16.1 Where a patient entertainment system is to be provided the system should:

- be coordinated with the clinical functions that will be undertaken at the patient location
- controllable by the patient from their bed
- locate head end equipment to be readily accessible without interference to routine nursing activities with the patient
- have TV/display panel at the patients' bed located to avoid clash with any other equipment (fixed or portable) that may be required at the bed

10.17 Decontamination Shower Messaging System

10.17.1 There should be an integrated communication system to include loudspeaker, clock, signage and recorded voice announcements in multiple languages to aid management of showers when in use.

10.18 Hearing Augmentation Systems

10.18.1 Hearing augmentation systems shall be provided as required for code compliance and as determined by the functional requirements of relevant spaces including reception areas, meeting rooms and waiting areas.

10.18.2 Hearing augmentation systems should interface with public address systems. Consideration should be given to interfacing with entertainment facilities, such as television, radio or music systems.

10.18.3 Music systems may be provided in waiting areas to mask sound transfer for confidentiality purposes or in staff rest areas to create a relaxing atmosphere. Whenever background music or public address systems are installed, the sound quality should be such that it is intelligible and not subject to unwanted reverberations.

10.19 ICT Applications for Healthcare Facilities

10.19.1 Communications infrastructure should address opportunities to achieve better health outcomes and efficiencies by providing systems that will facilitate, emerging technologies.

10.19.2 Some examples of emerging applications may include:

- integrating multiple applications
- patient management optimization
- patient management - integrated and complete patient health management for whole of life
- application of Smart Cards and new approach to ICT at various settings including bedside and staff base functions
- patient education - assist in self-diagnosis and care after discharge
- integrated patient care across all modalities
- access to health informatics
- collaboration of health providers and researchers at all levels to provide optimum diagnosis and individual treatment planning for each patient
- integrated and complete patient monitoring systems
- improved infection management and patient outcomes
- telemedicine
- electronic way finding
- smart phone apps to direct a visitor, patient or staff member

11 ENGINEERING SERVICES, ELECTRICAL

11.1 Electrical Brief

11.1.1 The extent of electrical services shall be defined with a fully detailed description of services to be provided by the Licence Holder/Applicant as part of their submission that supports the safe, secure and reliable clinical and building operational functionality of the health facility served by the electrical systems. The performance required to deliver such services shall be not less than as required by statutory regulations and these Guidelines. The Licence Holder/Applicant should demonstrate the inherent future flexibility, expandability, and adaptability to suit the changing needs of the building operational requirements and clinical services delivery over the life of the building.

11.1.2 The purpose of electrical services in a healthcare facility is to provide safe, reliable, usable and serviceable power, lighting and digital systems necessary for the functional use of each area of the facility under all potential operational conditions.

Reliance on electrical power systems is increasingly important, and infrastructure should support all clinical services, non-clinical functions and all associated services and systems necessary to maintain core functioning, including allowance for future planning and load expansion.

11.1.3 Technology advances in computing and communications continues to expand in the delivery of healthcare, creating greater demand and reliance on the need for resilient power supply to operate the equipment.

11.1.4 Design criteria for the services shall be based on the requirements of applicable Codes and Standards, functional and operational requirements of the Facility and include consideration of the Facility location, external conditions and climate change implications.

11.1.5 Refer to the relevant AusHFG and specifically the Health Planning Units and Room Layout Drawings/Room Data Sheets as a guide for services provisions, applied as determined to meet specific user functional requirements in each defined space.

11.2 Specific Functional Uses

11.2.1 Electrical services provide the systems and infrastructure to support all building and clinical systems requiring all forms of electrical power.

11.2.2 All projects should consider and document the impacts of the project on existing and future planning on the site taking into account any master plans that exist for the site. Issues to be addressed include:

- site location in context to existing substations and/or associated main switch-rooms
- site location in context to any existing standby generation and associated connectivity
- proposed and existing cabling routes to connect a new or refurbished facility to the substations/main switchrooms and standby generation
- the site wide infrastructure needs are to be balanced with the needs of the project and the needs of future projects

Refer to the AusHFG for the requirement of services provisions in rooms as the initial basis of design criteria. Note that the design criteria are provided as an initial basis and should be verified with the project team and user groups to ensure Functional Requirements are met.

11.3 Extent of Services

11.3.1 Electrical services provisions should include but not necessarily be limited to, where relevant to the project specific briefing and functions:

- incoming supply
- high voltage systems
- earthing systems
- power from renewable energy sources
- alternative power sources including various forms of battery supply
- emergency power generation system
- uninterruptible power supply systems (UPS)
- metering
- switchboards
- power quality systems
- wiring systems including submains and subcircuits
- electromagnetic interference (EMI) mitigation
- lighting and power subcircuit wiring
- electromedical protection
- socket outlets
- power supply to appliances, equipment and all other building services
- lighting systems including luminaires
- specialist lighting
- illuminated signage
- lighting controls
- emergency and exit lighting system
- lightning protection systems

11.3.2 Electrical services shall include:

- provision of either normal, vital (30sec), and instantaneous (no break) electricity supplies or combinations thereof as required by The Guidelines
- switchgear and circuit protection to safely operate and control the supplies
- provision to isolate and maintain every item of equipment without compromise to the safety of occupants and functional use of the Facility

11.4 Coordination with Other Disciplines

11.4.1 Electrical services associated with all aspects of the facility regardless of which discipline they occur (e.g. mechanical services, hydraulic, fire protection, communications, security) shall comply with the requirements of this chapter.

11.4.2 Where aspects of other disciplines are applicable to the electrical portions of the works (e.g. pipework, ductwork, communications) the works shall comply with the respective requirements of the other discipline sections.

11.4.3 All naming, numbering, colour coding and labelling of electrical supply, distribution, controls and the like, methods of cable installation, power quality management and protection coordination of circuit protective devices is considered a defined part of the electrical design.

All other disciplines shall follow the standards established in the electrical services design uniformly and consistently across the entire facility. This degree of uniformity

should be followed through on shop drawings, manufacture and as constructed documentation.

11.4.4 Refer to chapter "*Background*", section "*Definitions*" with clauses that contain a list of terms relating to electrical power supplies as relevant to healthcare facilities referenced within The Guidelines

11.5 Standards and Quality

11.5.1 Electrical systems and the installations shall comply with all current versions of the following:

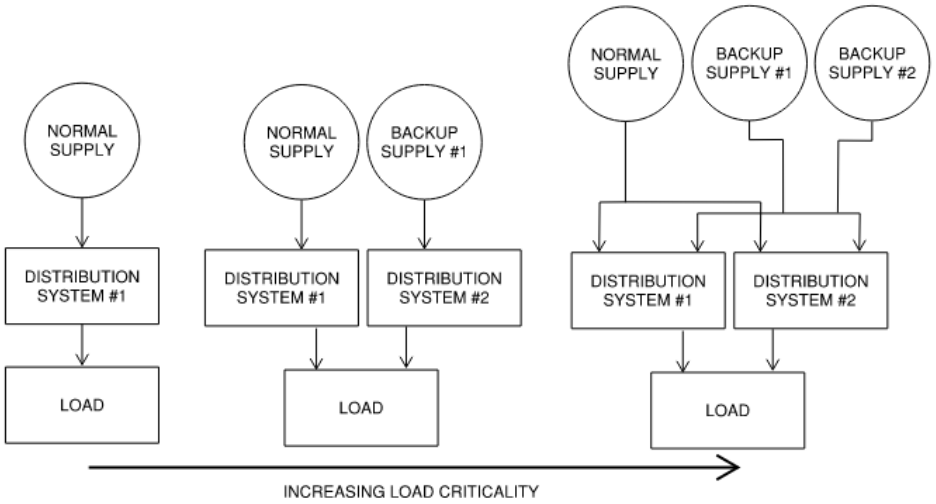
- NCC *National Construction Code*
- AS/NZS 3000 *Electrical installations (Australian/New Zealand Wiring Rules)*
- AS/NZS 3003 *Electrical installations - patient areas*
- AS/NZS 3009 *Electrical installations - emergency power supplies in hospitals*
- AS/NZS 3010 *Electrical installations - Generating sets*
- AS/NZS 3013 *Electrical installations - Classification of the fire and mechanical performance of wiring system elements*
- AS/NZS 2500 *Safe use of medical electrical equipment in health care*
- AS/NZS 61439set *Low-voltage switchgear and controlgear assemblies*
- AS 2676.1 & 2 *Installation, maintenance, testing and replacement of secondary batteries in buildings Vented cells/Sealed cells*
- AS 3011.1 & 2 *Electrical installations - Secondary batteries installed in buildings Vented cells/Sealed cells*
- AS/NZS 1680set *Interior lighting*
- AS/NZS 2293set *Emergency lighting and exit signs for buildings*
- AS/NZS 2243set *Safety in laboratories*
- AS 2252set *Controlled environments*
- AS ISO 14644parts *Cleanrooms and associated controlled environments*
- AS/NZS 60079parts *Explosive atmospheres*
- AS/NZS 61000parts *Electromagnetic compatibility*
- AS/NZS 1158set *Lighting for roads and public spaces*
- AS/NZS 4282 *Control of the obtrusive effects of outdoor lighting*
- AS/NZS 3100 *Approval and test specification - General requirements for electrical equipment*
- AS 1768 *Lightning protection*
- All other codes and Statutory Authority requirements that are applicable

11.6 Electricity Supply Configuration

11.6.1 Power supply to all equipment necessary for the delivery of healthcare services in the facility shall take into consideration the reliability and redundancy features necessary to achieve the outcomes documented in the Facility Risk Management Plan and Business Continuity Plan for the facility.

The power supply strategy shall be developed such that the clinical team at the facility understand the impact of lack of power availability under routine operating conditions and during planned or unplanned outages.

11.6.2 All portions of healthcare facilities that cannot function during a time with loss of power supply shall be provided with alternative (standby) power generation and redundant distribution network regardless of the form or origin of the normal power supply.



11.6.3 Refer to chapter "*Reliability and Redundancy Criteria*" for definition of functional requirements.

11.6.4 The reliability and resilience of power supply required to each portion of the Facility shall be determined in accordance with the approved Business Continuity Plan for the Facility.

11.6.5 Capability shall be provided to undertake maintenance on all electrical supply, distribution and connected equipment, without compromise to the functioning of the facility and without the need for working on live or potentially energized parts.

11.6.6 Healthcare facilities defined by the FOP as required to comply with clause "**Disaster or emergency role**" (that is, a facility that is to *withstand natural disasters, or with a strategic post disaster and emergency role*) shall have a reliable electricity supply into and throughout the Facility to ensure the continuous care of patients in accordance with the approved Facility Risk Management Plan and shall be provided with:

- multiple power supplies from diverse sources and with diverse distribution routing to achieve the following required redundancy
- primary power source for normal routine operation, plus secondary power from at least two back up sources for the entire Facility, comprising:
  - either 2 x 100% normal load capacity supplies plus a 1 x 100% essential load capacity supply, for the entire facility
  - or a 1 x 100% normal load capacity supply plus 2 x 100% essential load capacity supplies to a minimum of 100% of the normal load, for the entire facility
  - together with uninterruptible power supply with a minimum duration of 20 minutes at 100% capacity of all UPS load of the entire facility

11.6.7 Healthcare facilities defined by the FOP as required to comply with clause "**Continue surgical and/or emergency services during failure**" (that is, a facility that is to *continue to offer invasive surgery or emergency medical services through failure of normal utility services*) shall have a reliable electricity supply to ensure the continuous care of patients in accordance with the Facility Risk Management Plan and shall be provided with:

- multiple power supplies from diverse sources and with diverse distribution routing to achieve the following required redundancy
- primary power source for normal routine operation, plus secondary power from at least two back up sources for all “Critical” loads within the Facility, comprising:
    - either a 1 x 100% normal load capacity supply plus 2 x 100% essential load capacity supply, for all critical loads of the facility, or
    - a 1 x 100% normal load capacity supply, plus a 1 x 100% essential load alternative supply authority feeder and an alternative on-site 1 x 100% essential load capacity supply, for all critical loads of the facility
    - together with uninterruptible power supply with a minimum duration of 20 minutes at 100% capacity of all UPS load of the entire facility

11.6.8 Healthcare facilities defined by the FOP as required to comply with clause ”**Safely close down surgical and emergency critical services during failure**” (that is, a facility that is to *safely close down surgery and emergency stabilisation, or maintain occupancy of the building under a healthcare function on failure of normal utility services*) shall have reliable electricity supply to ensure the continuous care of patients in accordance with the Facility Risk Management Plan and shall be provided with:

- power supply and distribution system capable of safely and reliably supplying all loads continuing to be needed until services are shut down, comprising
- 1 x 100% normal load capacity supply plus
- essential and uninterruptible supplies sized for 100% capacity of essential and critical loads
- together with uninterruptible power supply with a minimum duration of 60 minutes at 100% capacity of UPS load of the facility

11.6.9 Healthcare facilities defined by the FOP as required to comply with clause “**Facilities in remote locations or with other critical functions**” (that is, a facility *with limited access or other critical functions that have no viable alternative to provide substitute treatment in the event of failure of normal utility services*) shall have a reliable electricity supply to ensure the continuous care of patients in accordance with the Facility Risk Management Plan and shall be provided with:

- primary power source plus at least one back up source for all “Critical” loads, comprising:
    - a 1 x 100% normal load capacity supply plus 1 x 100% essential load capacity supply, for all critical loads of the facility
    - together with an uninterruptible power supply with a minimum duration of 60 minutes at 100% capacity of all UPS load of the entire facility

11.6.10 Other facilities shall have at least a 1 x 100% normal load capacity supply, and uninterruptible supplies for surgical lights, ICT and any other additional equipment as defined by the Licence Holder/Applicant with a minimum duration of 120 minutes at 100% capacity of UPS load.

11.6.11 In all instances, the UPS duration time shall be confirmed to suit operational requirements defined by the FOP and managed in accordance with the FRMP.

11.6.12 Each normal supply shall come from a separate supply authority sub-station or shall be configured so that a single fault or accident is not credibly likely to cause both supplies to fail.

11.6.13 Electrical supply topologies should consider the extent of resilience and redundancy necessary to maintain a fully operational facility, noting that some portions of the distribution system may require concurrent maintenance.

Cable routes, transformers and switchgear for all primary and redundant/alternative power source distribution shall also be segregated so that a single accident or fault is not credibly likely to cause both supplies to any critical, essential or emergency loads to fail.

11.6.14 A single submain to switchboards providing power to both non-essential and essential services with load shedding to reduce normal supply loads to essential load levels is not acceptable.

11.6.15 In any system where two or more modules of vital or instantaneous supply capacity are needed to cover essential load they shall operate in parallel synchronisation and with a redundant module to take up the load should a module fail to operate. In the event that there is a fault on any module and the load exceeds supply capacity there shall be an automatic loading and load shedding program for controlling loads.

11.6.16 Infrastructure shall be designed so that the distribution network from incoming supply to end load points comprising all switchboards, distribution cabling and switching/protective equipment (including main incoming isolators/circuit breakers) can be routinely maintained without compromising power supplies to any critical loads, essential loads or emergency equipment.

11.6.17 Switchboard form ratings shall be confirmed at AIP Stage and agreed with the health facility's engineering and maintenance team in relation to disruption management, excessive isolation of nonaffected systems and power supplies with all strategies and processes documented in the BCP and FRMP.

11.6.18 Infrastructure shall be designed and located to accommodate credible risk from fire, flood, collision, malicious damage and tempest. All equipment selections shall be designed to accommodate climate adaptation such as increased temperatures.

11.7 Power Quality

11.7.1 Supply distribution shall include means to maintain power quality to:

- mitigate interference from any equipment upon other items of equipment installed at the facility
- enable operation of all loads and equipment without loss of function

11.7.2 Power quality management equipment shall be selected appropriate to the equipment and should comprise:

- metering and event logging
- power factor correction
- harmonic filtration
- surge diverters
- lightning protection

11.7.3 Where installed, power quality management (PQM) equipment should be arranged to allow maintenance of all installed components without compromising supply to critical, essential and emergency loads.

11.7.4 PQM equipment should be connected to the Facility BMCS system to facilitate monitoring and recording for maintenance management and optimisation of operation.

11.8 Capacity

11.8.1 Supply and distribution systems shall have capacity to deliver the facility maximum demand to the quality parameters within tolerance of the end use equipment

specifications without exceeding the manufacturer's requirements for reliable operation of any system component.

11.8.2 System loading and maximum demand calculations should be assessed based on project specific requirements taking into account loads of selected equipment and realistic values for diversity.

Such loads should be determined for each supply source/supply system including UPS and standby generators under most onerous operational condition, including staged development of the facility.

11.8.3 In addition, all power supply and distribution systems should have capacity to accommodate load growth as defined by the project sponsor or Licence Holder/Applicant (in the case of private health facilities). Such load growth factors should include spare capacity within installed equipment and cabling, plus expansion capacity and physical space requirements for additional equipment and cabling.

11.8.4 In the absence of project specific assessed data, spare capacity should comprise the following minimum values:

- site power supply 25%
- main supply infrastructure 25%
- main switchboards 30%
- distribution switchboards 30%
- generators 25%
- UPS systems 20%
- submains cabling 20%

Electrical spare capacity should be coordinated with proposed expansion capabilities for all other services disciplines (such as mechanical and hydraulics services). Design for load growth should provide a strategy for expansion without compromising operation of normal, critical and essential loads.

11.9 High Voltage Installations

11.9.1 High voltage installations shall comply with:

- AS 2067 *Substations and high voltage installations exceeding 1kV a.c.*
- requirements of the applicable Supply Authority (Western Power, Horizon Power)

11.9.2 High voltage equipment transformers and switchgear on site shall be located in a substation which shall:

- be housed in buildings or structures remote from patient areas or be located in a fire isolated part of the facility
- be installed in a location and environment where it can be accessed readily and safely for operation and maintenance during the most extreme credible risk management conditions the facility is required to withstand, e.g. restoration of services during a storm
- be accessible for maintenance purposes without interrupting normal access or day to day activities of the facility
- comply with the requirements of the National Construction Code and Statutory Authority requirements for fire separation and/or isolation from buildings
- be accessible only to authorised persons

- be provided with emergency lighting compliant with AS/NZS 2293, served from vital power supply circuit for egress purposes and instantaneous lighting backed up by vital supply sufficient for safe operation of equipment in the substation
- be provided with uninterruptible power supply to all controls, automated switching and system monitoring, with the UPS supply served from the vital power supply
- comply with the project specific requirements of the Supply Authority where installed equipment is the responsibility of the Authority

11.9.3 Where possible, switching of HV switchgear should be performed from a suitable remote switching panel external to the switchroom. Measures shall be incorporated into the remote switching panel to eliminate inadvertent and unauthorised operation of all equipment controlled from the panel.

11.9.4 A site plan showing the location of the substation and a single line diagram of the high voltage system shall be mounted in the switchroom and show:

- source of supply
- extent of the system
- ownership interfaces of the equipment
- Supply Authority contact details
- ratings of equipment and protection
- settings of all circuit protective devices
- ratings of cables
- the location of any earthing equipment needed for the switchgear
- the location of any standard switching schedules associated with use and maintenance of the switchgear
- the location of safety and test equipment needed for switching

11.9.5 Licence Holder/Applicant Safety signage shall be provided external to and inside transformer rooms, HV and LV switchrooms including:

- entry warning signage
- personal protective equipment (PPE) required for access into the room
- emergency contact details
- contact details of persons authorised to carry out switching. All personnel shall be appropriately qualified to perform such switching

11.10 Vital (30sec) [Essential] Electricity Supplies

11.10.1 Refer requirements in previous section "*Electricity Supply Configuration*".

11.10.2 Standby electrical power to "Vital" or "Essential" power supply systems shall be provided in accordance with AS 3009 plus:

- all subsidiary mechanical, hydraulic, fire, vertical transportation and medical gas systems which are dependent on an electrical power source to operate and are essential in delivering services to critical care areas
- all life and safety requirements as required by the NCC and FER
- all ICT communications room active equipment
- pneumatic tube system
- medical air and suction equipment
- renal dialysis equipment

- where not scheduled elsewhere, minimum 50 per cent of lighting and power in all areas
- full lighting and power in critical areas (e.g. peri-operative areas, ICU, CCU, neonatal intensive care, HDU, CSSD, emergency department, imaging, pathology, burns, oncology, cardiac catheterization, dialysis/renal care, infectious disease isolation/hyperbaric)
- full air conditioning to all critical areas and associated support services, other areas should have, as a minimum, ventilation to meet rates as required in chapter "*Engineering Services*, *Mechanical Services*"
- all air handling and exhaust fans serving spaces requiring pressure management of the space, such as, isolation rooms, theatres, central sterile services department (CSSD), pharmacy, pathology and laboratories
- imaging areas required for emergency departments
- critical storage such as -80ºC fridge and blood fridge
- sewage pumping stations
- domestic water pumps and electrical hot water systems

Refer also to Appendix "*Electrical Design Parameters*" section "*Vital Supply".*

11.10.3 The standby power plant shall have fuel supply arrangements that will keep them in operation for the longest credible normal supply outage as determined by risk analysis and as nominated by the Licence Holder/Applicant. The assessment shall include the overall healthcare services operational needs for business continuity during prolonged unavailability of the Utility main supply network to determine the necessary system capacity.

11.10.4 Vital supply source shall be provided with redundancy to enable continuity of supply to be made available to all essential loads even during periods of maintenance outage. Redundancy shall also be provided to facilities necessary to support operation of the standby power system, e.g. controls, starting, fuel tanks and pumps.

11.10.5 Vital supply submains shall be physically separated from the normal supply submains.

11.10.6 The system shall enable onload and offload testing without interruption to the Facility operations including transfer/retransfer at all changeover switches.

The system shall be regularly tested, at not less than monthly intervals. Black start testing should be undertaken annually.

The power distribution system shall be designed to facilitate testing of the generators on building load without interruption to normal functioning of the Facility to simulate true power outages that may occur in actual fact.

Testing may need to be arranged for an alternative day/time and with switching arrangements to minimise impact on facility operation of power loss and restoration.

11.10.7 Where load needs to be transferred from a normal operating supply source to an alternative source without interruption to power supply to the load (e.g. routine testing or return of load from standby generator after restoration of Utility power), this shall be arranged via managed closed transition or bypass switching, closed transition auto-transfer switch (CTATS), UPS or similar.

11.10.8 Synchronous transfer (CTATS) shall be approved by the Supply Utility. Open transition ATS (break before make) may be used where interruption of power supply to the load does not adversely impact normal functioning of the Facility.

11.10.9 Where the facility necessarily requires a significantly large standby power generation system, such as multiple generators, connection via HV switching and

the like, and the system controls cannot assure a power restoration time within 30 seconds from loss of power, the system shall be configured to:

- connect loads in priority order, starting with loads to support operation of the standby systems and emergency circuits first, then critical loads in sequential order from most to least critical loads as defined in the FRMP, followed by all other loads
- connect all vital/essential services in the shortest viable time
- actively monitor and manage loads connected to the standby supply system to maintain connection of power to the most critical loads in the order as defined in the FRMP

11.10.10 Power supplies to lifts shall comply with section "*Lift Performance and Installation Requirements*".

11.11 Standby Generator

11.11.1 Where Vital or alternative supply source is provided by on-site standby diesel generation, such plant shall:

- be configured to enable operation on 24/7 basis
- have sufficient capacity and redundancy to provide reliable supply to all defined loads plus spare capacity
- have adequate fuel storage plus refuelling supply agreement to enable continuous operation commensurate with the potential "worst credible" loss of primary power supply
- be located in secure position above flood level

11.11.2 Generator systems shall:

- comply with AS/NZS 3009
- have provision for emptying fuel tanks so that fuel can be replaced if fuel condition monitoring indicates quality has deteriorated
- be installed in an environment where they can be serviced and maintained in the most unfavourable conditions that are credible for the Project site, e.g. the need to correct a failure to start problem in an outage caused by a storm would call to question the decision to install the generator outdoors
- have starting arrangements determined by risk analysis, e.g. remote sites may need independent means of recharging starting batteries
- be separately tested on portable load bank if necessary to achieve testing at 100% generator rating

11.11.3 Mobile Generator

A connection point for mobile generator should be provided as identified in the FRMP and BCP for:

- facilities where life-sustaining or invasive clinical procedures are undertaken and no emergency generator is installed, such as small/remote facilities
- locations susceptible to loss of power from weather or similar events (e.g. subject to cyclones)
- where private healthcare facilities require a mobile generator provision as part of their business continuity planning

11.11.4 Where a single generator is provided, the facility should consider connection for an external unit (e.g. to facilitate maintenance or replacement of the on-site unit). Connection/disconnection of the external unit shall be capable without compromising power supplies to critical, essential or emergency equipment.

Connection points shall provide capability for connection of a transportable generator located sufficiently fire separated from the facility, remote from areas susceptible to noise, readily accessible for safe refuelling and secure from public interference. An earth terminal should be provided at the connection point.

The connection point should be connected to provide back-up power selectively all vital and instantaneous loads and if required for operational reasons to the entire facility.

11.11.5 Where a standby generator provides normal power supply (e.g. location where there is no, or inadequate, Utility supply available):

- the generator supply shall be configured to the same conditions as noted for Vital supply
- an alternative supply source shall be provided to back up the primary supply sufficient to accommodate all critical, essential and emergency loads

11.11.6 The Licence Holder/Applicant shall have a binding contract for the provision of a mobile generator where operation of such unit is necessary to comply with mitigation measures identified in the FMRP.

11.12 Uninterruptible Power Supply Systems

11.12.1 Uninterruptible power supply (UPS) systems shall be provided as a principal form of Instantaneous Power Source. The specific UPS arrangement should be determined according to the Facility requirements as determined and recorded in the FRMP and BCP.

The systems shall be configured to have an autonomy duration based upon the resilience of the site electrical supply configuration and take into consideration the time required for alternate supplies to become available and the time taken to recharge batteries. Autonomy duration calculation shall be based on end of life, i.e. the time at which the batteries are considered to have diminished through life to the point when replacement is necessary.

The system supply current during battery recharging should be sufficiently sized to not decrease supply required to fully operate all system electrical loads equal to 100% rating of the system whilst recharging is undertaken with minimum recharge period.

11.12.2 A proliferation of multiple single point UPS units should not be considered unless availability, battery capacity and fault status can be readily monitored and the units maintained regularly.

11.12.3 UPS units should consider to be connected to the BMCS system to facilitate management and maintenance of each system, including identify operation on battery, connected load, remaining battery capacity, loss of battery power, system fault. System test records should be collated by the BMCS.

11.12.4 The specific UPS arrangement shall be determined according to the Facility requirements as determined and recorded in the FRMP and BCP.

11.12.5 As a minimum for centralised UPS systems, they shall be provided with N+1 redundancy of rectifier/inverter and battery modules. A distributed UPS system and associated switchboards should be considered as two separate units/systems, each capable of supplying 100% of the instantaneous load (A + B supply system). With such an arrangement, under normal operation the load shall be divided across all the units and all routine maintenance should be undertaken across the entire system without loss of instantaneous power source to the loads.

11.12.6 Separate UPS systems should be considered for Clinical equipment loads and Communications systems.

11.12.7 Where an individual load requires instantaneous power source standalone separate UPS units may be adequate. Such a system should be co-located with the equipment served, be provided with bypass switching and be connected to BMCS to identify operation and faults.

11.12.8 As a minimum, the uninterruptible supplies shall have a battery duration time as specified within section "*Electricity Supply Configuration*".

11.12.9 Fixed surgical lights:

- shall be connected to an instantaneous power source

11.12.10 Procedure room examination lights:

- examination lights in procedure rooms and similar areas shall be connected to an instantaneous power source

11.12.11 Birth room examination lights:

- examination lights in birth rooms and similar areas shall be connected to a vital power source

11.12.12 Treatment room examination lights:

- examination lights in treatment rooms and similar areas shall be connected to a vital power source

11.12.13 Integration and building services network (BSN) infrastructure:

- servers, ethernet switches, associated network equipment and Licence Holder/Applicant nominated workstations used for critical systems, BMCS systems shall be connected to instantaneous power source

11.12.14 Communications including PBX, paging, alarm and call system supplies:

- equipment with integral batteries such as PBX, radio paging, fire alarm, medical gas warning, nurse call and similar systems shall be connected to vital power source circuits

11.12.15 Critical medical equipment:

- medical equipment necessary for patient safety should be connected to an instantaneous power source in accordance with needs identified in the FRMP. Connection to a vital power supply is a minimum requirement

11.12.16 UPS and battery rooms:

- battery installations shall comply with the appropriate installation requirements of:
  - AS 2676.1 & 2 *Installation, maintenance, testing and replacement of secondary batteries in buildings Vented cells/Sealed cells*
  - AS 3011.1 & 2 *Electrical installations - Secondary batteries installed in buildings Vented cells/Sealed cells*
- room fire rating shall comply with the requirements of the National Construction Code
- room exhaust/ventilation shall be provided in accordance with the National Construction Code requirements, with level of redundancy to match the total system redundancy and be connected to a vital power source
- UPS rooms (and where provided separately, battery rooms) shall be provided with air conditioning, with level of redundancy to match the total system redundancy, connected to a vital power supply
- fire protection/isolation measures of battery rooms shall be provided to suit the chemistry of the cells installed

11.13 Mains and Submains

11.13.1 The types of submains for distribution of electricity supply from the main switchboard or distribution boards shall be arranged in the following groups:

- Group A - emergency/safety services
- Group B - critical care services
- Group C - general services

11.13.2 Mains and submain cables that supply group A services shall comply with all requirements in AS/NZS 3000 and be rated to WS52W as a minimum.

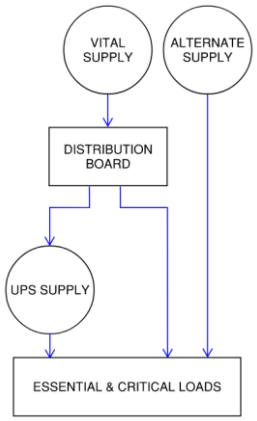
11.13.3 Group B - critical care areas

Group B areas shall be as determined in AusHFG and are those areas where acute resuscitation procedures occur on a regular basis, including:

- all clinical areas of the emergency department
- all clinical areas of operating theatre suite
- day procedures rooms, treatment rooms
- coronary care unit
- intensive care unit, ICU, NICU, PICU
- isolation suites
- renal dialysis units including the RO plant
- angiography, cardiac catheterisation rooms and electrophysiology (EP) rooms
- selected areas of medical imaging
- other areas with functionality crucial to hospital operations and the continuum of care for patients requiring critical attention, such as mechanical services, medical gas, hydraulics, communications and computing systems, security and vertical transportation systems serving these functional areas

11.13.4 Power outlets used for general use purposes in a ‘surgical suite’ shall be connected to either a Vital supply, or an Instantaneous supply that is backed by a Vital supply.

In addition, power outlets served from a completely alternative supply source shall be provided to maintain full functionality of the facility in the event that the primary supply outlets become unavailable for any reason.

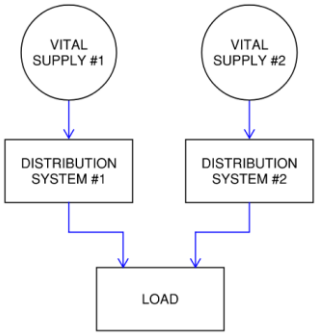


11.13.5 Dedicated distribution switchboards shall be provided to serve lighting and power in Group B critical care areas which shall be fed by dedicated submains originating from the main switchboards.

11.13.6 There shall be a minimum of two, and consideration should be made for three, dedicated submains and distribution boards to Group B areas.

11.13.7 Duplicate distribution switchboards and submains circuits shall be provided to serve critical care lighting and power, with both lighting and power load and circuit allocation divided evenly from each switchboard.

The specific requirements shall be determined by the Facility in accordance with the functional requirements documented in the FRMP, FOP and BCP. A typical example achieving redundancy and resilience could be provided with two sets of



distribution submains and switchboards, which could be Non-essential and Essential, or alternatively Vital A & Vital B. In addition, there would be another submain and switchboard for UPS.

11.13.8 For each pair of submains serving group B distribution switchboards at least one should be a direct feed from a Vital supply main switchboard and if the entire facility is backed by standby generator the duplicate submains should originate from separate Vital main switchboards and provide diverse and redundant supplies to each group B distribution switchboard.

11.13.9 Group B submains cables shall be fire rated, and as a minimum shall be provided with protection against mechanical damage.

11.13.10 Group C - non-critical care areas

Group C – general services submains shall be wired in accordance with AS/NZS 3000 for non-critical services and equipment, including:

- general light and power throughout non-clinical care areas
- mechanical services systems serving non-clinical care areas that do not support clinical functions
- medical imaging equipment not identified as group B
- computer system to non-clinical care areas that do not support clinical functions
- hydraulic services system to non-clinical care areas that do not support clinical functions

11.13.11 Group C services shall be provided with normal, vital and instantaneous power according to the functional requirements of each area as documented in the FRMP, FOP and BCP.

11.13.12 There should be a minimum of two submains and distribution boards to all departments including general lighting and power in all non-clinical/back of house/administration areas and consulting rooms.

11.13.13 General

Submains for fire services and lifts shall be selected and sized to match the rated duties of the equipment and in accordance with the equipment vendor’s requirements.

11.13.14 Submain neutral cables shall be sized the same as the active conductors or the maximum current generated by harmonics, whichever is greater.

11.13.15 Regarding the medical imaging department, in the absence of Facility specific briefing requirements, the following split is to be applied to medical imaging machines connected to a non-essential supply or an essential supply:

- single general x-ray or fluoroscopy machine installed at a facility shall be connected to the essential supply
- multiple general x-ray or fluoroscopy machines installed at a facility should connect at least one and 50% of machines of each type to the essential supply
- single CT or PET/CT scanner installed at a facility shall be connected to the essential supply
- multiple CT or PET/CT scanners installed at a facility should connect at least one and 50% of machines of each type to the essential supply
- single MRI machine installed at a facility shall be connected to the essential supply
- multiple MRI machines installed at a facility should connect at least one and 50% of machines to the essential supply, including the chiller serving the MRI

For computers related to imaging machines consideration shall be made to connect them to UPS supply.

11.13.16 Services shall be provided with Vital supply in accordance with the recommendations of AS/NZS 3009 plus addition of the items as noted in the "*Electrical Design Parameters*" appendix, clause "*Vital Supply*".

11.13.17 Power supply sources shall be provided for major medical equipment, as listed in the "*Electrical Design Parameters*" appendix, clause "*Major Medical Equipment*".

11.13.18 Risk management consideration shall be given to fire protection of all mains and submains to minimise disruption to other fire isolated areas from a remote fire. The Licence Holder/Applicant shall nominate where additional protection is required.

11.13.19 Submains serving surgical operating suites, intensive care units, emergency departments and diagnostic equipment and services critical to these facilities shall be highly reliable. Risk management consideration shall be given to their arrangement and a configuration provided that will allow electricity supply to be appropriately managed through electrical services maintenance or any credible accidental interruption event.

11.14 Earthing

11.14.1 There shall be an earthing diagram mounted in the substation and LV main switch room identifying the earthing arrangements of the complete network and earth resistance test parameters to be achieved.

11.15 Cabling (General)

11.15.1 Cabling shall comply with the requirements of AS/NZS 3000, AS/NZS 3008.1, AS/NZS 3009 and AS/NZS 3013.

11.15.2 Low smoke zero halogen (LSZH) cable insulation is not mandated; however, should be considered for use indoors in public areas and along egress routes.

11.15.3 Cabling should have at least 25 percent spare capacity above the calculated maximum demand (after allowance for voltage drop). Unless briefed otherwise, the Licence Holder/Applicant shall nominate the spare capacity to be provided.

11.15.4 Cabling shall be located so as to not interfere with medical equipment sensitive to magnetic fields. Cabling carrying heavy loads should not be located adjacent to intensive care areas, operating rooms and similar areas where electrocardiograph-monitoring equipment is to be operated.

11.15.5 Special consideration should be given to the impedance limits of cables serving x-ray equipment.

11.15.6 Cabling should be run on cable trays, baskets or in ducts on pre-planned routes where it can be accessed for additions and modifications. Containment should be generously sized so that cables are not entangled and it is practicable to remove redundant cables.

11.16 Electromedical Protection Systems

11.16.1 Electrical installations for all patient areas shall be designed to comply with AS/NZS 3003 *Electrical installations - patient areas*.

11.16.2 Electromedical circuit protection shall be provided where required by The Guidelines or the Facility Operating Policies and as determined by the Facility Risk Management Plan. The project sponsor or Licence Holder/Applicant (in the case of private facilities) shall define the type of protection required determined by the types of clinical activities.

11.16.3 Where provided, the protection shall comply with AS/NZS 2500, AS/NZS 3003 and AS/NZS 3009.

11.16.4 All patient areas in hospitals and healthcare facilities shall be wired as a minimum as body-protected electrical areas and protected with 10mA RCD. Note: patient safety is not increased by the installation of cardiac protection when performing body-protected procedures.

11.16.5 Cardiac type procedures are defined by AS/NZS 2500 and are limited to those which make direct contact with cardiac tissue.

11.16.6 Patient areas should only be wired as cardiac protected in locations defined in AS/NZS 3003 and where cardiac type procedures will be undertaken as determined by the Licence Holder/Applicant.

11.16.7 Areas typically defined for cardiac protection include:

- cardiac catheter laboratories (CCL) and control rooms
- cardiac intensive care unit (CICU)
- coronary care unit (CCU)
- ICU with regular thermo-dilution Swann-Ganz monitoring
- NICU
- operating theatres used for cardiac/thoracic surgery or interventional radiological procedures
- recovery bays for cardiac operating theatres
- emergency department resus cubicles/bays

The Licence Holder/Applicant shall confirm rooms/areas that would ordinarily be wired as BPA as listed in AS/NZS 3003 that must be wired as CPA.

11.16.8 Where an uninterruptible power supply is required in the procedure area, then an isolated power supply comprising line isolation transformer and monitor (LIT/LIM) should be installed rather than RCD protection (e.g. cardiopulmonary bypass pumps, operating microscopes, laser unit, etc.).

11.16.9 Where a patient area is provided with RCD leakage protection device (LPD), the circuit from the local distribution switchboard shall not be protected by 30mA RCD and subcircuit wiring to the patient area LPD shall be suitably protected.

11.16.10 Where staff without an electrical licence are required to reset an RCD (such as, a cleaners outlet circuit) the reset button shall be in or adjacent to the room where the trip originated and located in a logically consistent way so that staff can easily find them. Unauthorised (as specifically identified in the Facility Operating Plan, or in the absence of such FOP definition “Unlicenced”) persons should not be permitted access to switchboards.

11.16.11 Where circuit LPD comprises a line isolation transformer (LIT) with line isolation monitor (LIM) the transformer shall be mounted in a readily accessible position and provided with ventilation/cooling to maintain operation at full output without build-up of heat.

11.17 Switchboards

11.17.1 Switchboard construction shall be to AS/NZS 61439 *Low-voltage switchgear and controlgear assemblies*.

11.17.2 Switchboards shall be designed and constructed in accordance with the FRMP to avoid “Live Working” and thus facilitate routine maintenance to be undertaken regularly without need to isolate power supply to operational portions of the Facility.

11.17.3 Main switchboards (MSBs) and Main distribution switchboards (MDBs) for hospitals required to comply with clauses ”**Disaster and emergency role**” (*withstand natural disasters, or with a strategic post disaster and emergency role*) and ”**Continue surgical or emergency medical services during failure**” (*continue to offer invasive surgery or emergency medical services through failure of normal utility services*) shall be provided with minimum degree of segregation of Form 3b with total isolation of all sections where power originates from separate sources of supply (such as, normal, vital, instantaneous, A + B redundant duplicate systems, etc).

11.17.4 Main switchboards (MSBs) for other Healthcare facilities shall be provided with minimum degree of segregation of Form 2b with total isolation between every section with supply from separate sources of supply (such as, normal, vital, instantaneous, A + B redundant duplicate systems, etc).

11.17.5 Distribution switchboards (DBs) shall be provided with minimum degree of segregation of Form 2 and shall be considered with total segregation between each distribution section (such as, normal, vital, instantaneous, lighting, power, etc).

11.17.6 Unless alternative arrangements are documented in the FRMP, all switchboards shall be fully maintainable without need to isolate power from functional services (i.e. access to each portion of the switchboard shall be fully de-energised when power is isolated and safely accessible for maintenance without the need to isolate power to other portions of the switchboard).

11.17.7 Switchboards shall be provided with separate non-essential, essential and uninterruptible supply compartments, with segregation between each switchboard section (normal, vital, uninterruptible, extra low voltage/ELV, and the like), and total segregation between lighting, lighting controls, general power, special power distribution, metering and BMCS output sections.

11.17.8 Switchboards which have separate non-essential and essential sections should have bus-ties (with appropriate interlocking) between the non-essential and essential supply sections. Consideration should be made for bus-tie breakers to be 4-pole. The same requirement applies to distribution comprising A + B systems with dual supply paths for non-essential, essential and uninterruptible supplies.

11.17.9 Switchboards shall:

- be rated to adequately withstand the prospective short circuit currents at the installed location
- be configured and labelled to permit ready comprehension of the circuits and loads served and the installed and maximum ratings of circuit protection of each circuit
- have separation of switchgear, busbars and other live parts so that:
    - main and submain switchgear can be safely provided with manufacturer’s recommended maintenance without isolating any circuit other than the one being maintained
    - an arcing fault on any main or submain item of switchgear or busbar is unlikely to damage adjacent switchgear and directed away from likely occupants near the switchboard
- where fuses are used, have adequate spare fuse cartridges available at each switchboard
- have main isolating switch(es) controlling the incoming supply and isolating switch(es) for every separate section of the switchboard.
- be labelled with source of supply to the switchboard and incoming supply cable size and construction
- be supplied with a single line diagram and a schedule of circuits identifying the items supplied from the electrical switchboard; the schedule shall highlight the

emergency equipment served; the diagram should be laminated or mounted behind transparent protection within the switchboard accommodation

- for areas with multiple distribution switchboards serving separate zones of the floor or area, be supplied with a floor plan colour coded to clearly identify fire and smoke zone boundaries and the area served by each switchboard

11.17.10 Switchboards shall be colour coded in consistent manner to match the supply distribution strategy for the facility, including:

- colours in line with outlets for AS/NZS 3003 patient areas and AS/NZS 3009 supply source
- safety services in identifiable contrasting colour
- separate readily identifiable colours for A + B systems where provided with dual supply

11.17.11 Application of uniform switchboard colour coding should be considered across the entire facility and be carried through to cabling and containment systems, where practical and particularly in visible locations such as plant rooms, for the various supply sources. Colour coding shall be consistent across all switchboards including those provided by other trades (e.g. mechanical, hydraulics, etc).

11.17.12 Switchboard accommodation shall comply with the requirements of the National Construction Code and AS/NZS 3000. Switchboards distributing electricity within a healthcare facility shall:

- be mounted in a secure, fire segregated, location only accessible to authorised personnel
- be protected from the external environment such that the switchboard can be safely accessed and receive maintenance under the most severe environmental conditions through which the facility is expected to continue to provide healthcare services (e.g. not subject to flooding, sheltered from sun, wind and rain)
- be readily accessible to authorised persons with access doors that do not obstruct any emergency egress route
- not be used for storage, except for provision of a dedicated cabinet to store electrical switchboard spare parts, specifically designed for that purpose and located such that it does not impinge of the safe access to, egress from and maintenance of all aspects of the switchboard(s)
- be provided with ventilation or air conditioning as necessary for maintaining operation of the switchboard and associated equipment under all credible circumstances through which the facility is expected to continue to provide healthcare services
- not have any plumbing or hydraulics services within the space, except for any pipework required for air conditioning of the room, which should be minimised and located as far away from electrical equipment as possible
- be well illuminated by luminaires connected to the vital electricity supply, and with accessways to and around the enclosure illuminated by emergency luminaires in accordance with AS/NZS 2293
- be protected against vandalism, vehicular or other damage

11.17.13 Distribution switchboard locations shall be suitably designed, positioned and/or fire protected (two-hour) to ensure that a fire within one fire compartment does not interrupt the electrical services in another fire compartment. Fire or Smoke isolated areas within major fire compartments are exempt from this requirement. Switchboard locations should be positioned to minimise the number of penetrations through fire/smoke rated walls.

11.17.14 A single line diagram of the low voltage system shall be mounted in the main switch room and at all major and significant distribution switchboards and show:

- source of supply
- outgoing submains
- other interfaces (e.g. emergency power generation, UPS, stored energy & renewable energy source systems)
- switchboard manufacturer details
- ratings of protection
- settings of all circuit protective devices
- ratings of cables
- the location of any earthing equipment needed for the switchgear
- the location of any standard switching schedules associated with use and maintenance of the switchgear
- the location of safety and test equipment needed for switching
- contact details of persons authorised Licence Holder/Applicant to carry out and qualified to perform switching and maintenance at the switchboard

11.17.15 A site plan shall be mounted in the main switch room and show:

- source of supply and incoming mains
- alternative power supplies, including:
  - standby generation plant (including fuel provisions)
  - UPS systems (including energy storage devices)
  - battery supplies
  - renewable power supplies (such as solar PV inverters and all forms of energy storage)
- all main switchboards, major distribution boards and distribution switchboards (for all services regardless of load served)
- EV charging positions
- all trunk submains routes
- safety services locations
- firefighting and alarm equipment locations

11.17.16 At each distribution switchboard the following information shall be provided:

- layout plan showing the area served and all adjacent distribution zones
- distribution circuit schedule for all outgoing circuits, including circuit number, area served, protective device type/rating, subcircuit cable size and type

11.17.17 A safety placard shall be mounted inside the main entry door for all major electrical plant including substations, main switchroom, major distribution switchboards, generator rooms, UPS, batteries, solar PV inverters, energy storage systems, EV switchboards and show:

- recommended personal protective equipment (PPE)
- emergency procedures relevant to the equipment installed
- emergency egress route
- fire protection provisions relevant to that location
- emergency contact details

11.18 Switchgear and Circuit Protection

11.18.1 Main and submain switchgear and circuit protection shall be maintained to comply with the manufacturer's recommendation. It shall be configured, and have any necessary redundancy, to meet the Licence Holder/Applicant's duty of care and business continuity requirements during the maintenance required. The Licence Holder/Applicant shall define the requirements.

11.18.2 Circuit protection shall be co-ordinated for the entire site (or for extensions and alterations to Facilities, as a minimum with the immediate upstream protective device) to provide discrimination.

11.18.3 In the event of a fault occurring downstream from the load side terminals of any submain or final subcircuit protective device:

- protection shall effectively discriminate so that the circuit protective device immediately upstream of the fault is the only device to open

In particular:

- lighting circuits shall continue to operate, apart from lighting which is supplied by the faulty circuit
- power outlets in patient treatment areas shall continue to operate, apart from any faulty circuits in those areas

11.18.4 It should be recognised in the design that maintenance work will at times necessarily require power isolations and that this applies to other switchboard factors including replacement of RCBOs. These activities should be included in the FRMP /BCP and identify which areas require alternative power source to maintain facility functioning during such maintenance.

11.18.5 Residual current device (RCD) protection shall be provided for all lighting and power except for:

- outlets on isolated supplies
- items exempt under AS/NZS 3000

11.18.6 Arc fault detection device (AFDD) protection of lighting and power subcircuits should be considered in accordance with risk assessment.

11.19 Transfer Switches

11.19.1 Where transfer switches are provided in the supply path to critical loads and interruption of power to such loads may interfere with seamless operation, they shall:

- be automatic in operation
- where complying with clauses "*Disaster or emergency role*" and "*Continue surgical and/or emergency services during failure*" shall be synchronised transfer return to normal supply.
- for other Facilities should consider being synchronised transfer return to normal supply
- be "*instantaneous*" upon return to normal supply
- include overlapping neutrals

11.19.2 Transfer switches installed in the supply path to non-essential loads should be automatic in operation.

11.19.3 Alternative or bypass power supply shall be provided to enable transfer switches to be routinely maintained without compromising power supplies to critical, essential or emergency equipment.

11.20 Lighting overview

11.20.1 Light, both daylight and electric light, has direct influence on the perception of the space and the visual performance and comfort of its users. An important issue that should be considered in designing lighting is the visual comfort of patients, visitors and staff. Light should create a comfortable, varied, inviting and interesting atmosphere and support the intention of the architectural design and the functional requirements of the health facility.

11.20.2 Lighting quality - lighting installations should provide operational and functional lighting to the various spaces to fulfil visual task requirements without glare or discomfort. In addition to the functional requirements, one of the key goals of the lighting design is the creation of a healthy and comfortable environment. The following issues should be considered and form part of the design.

11.20.3 Light distribution - light distribution of a luminaire determines how the light output is utilised and distributed into the space or onto an object and plays a key role on the visual results. It is also a determinant in how efficiently the space is illuminated, how the items are enhanced or subdued, as well as in how well glare is reduced or eliminated.

11.20.4 Direction of light and modelling - light should be used to define qualities of surfaces (colour, form and texture) and to draw people to particular areas or down certain routes, facilitating orientation and way finding.

11.20.5 Visual comfort and sense of wellbeing - A qualitative lighting approach needs to be aimed at, rather than a quantitative approach which considers illuminance levels on the horizontal surface only. The creation of a healthy environment without visual discomfort should be aimed for.

11.20.6 Architectural lighting and integration - the lighting approach should also consider the enhancement and reinforcement of the architect's vision and identity of the building and be fully integrated into the architectural design.

11.20.7 Coherence - lighting needs to be addressed with a coherent approach that takes the following issues into consideration:

- existing lighting, lighting control systems and emergency lighting control systems in existing buildings or within other parts of the site
- consistency of architectural lighting concepts within the building
- external and internal lighting and relevant interfaces
- standardization of lamp types across the project and site
- maintenance access.

11.20.8 The design should allow for flexibility and future adaptability of the lighting concepts and approaches, considering and allowing for the technology to advance.

11.21 Lighting design criteria

11.21.1 Lighting design should take into consideration functional and medical requirements, the comfort of patients, staff and visitors, the architectural space and design intent, security requirements, access and way finding and other considerations such as maintenance and coordination.

11.21.2 All areas shall be illuminated by natural light and/or artificial means to afford safety and visibility commensurate with the purposes of each area.

11.21.3 Artificial lighting shall be by means of electricity and the design criteria shall comply with AS/NZS 1680 set *Interior lighting*. Particular reference for general lighting and lighting for clinical tasks, should be made to the requirements of AS/NZS 1680.2.5 *Interior and workplace lighting, Hospital and medical tasks*.

11.21.4 Consideration should be taken of the AS/NZS 1680 to the provision of task lighting provisions for fixed working positions.

11.21.5 The appearance of colour, both in terms of chromaticity (CCT or Correlated Colour Temperature) and colour rendition (CRI or Colour Rendering Index) are important for the overall comfort and visual performance within the space.

11.21.6 Correlated colour temperature of a light source is a measure of the hue of the light output of that source. For medical areas in general, a neutral white colour of approximately 4000K is recommended.

11.21.7 The colour rendering index (CRI) describes the effect of a light source on the colour appearance of objects by comparison with their colour appearance under a reference source. Lighting should have a general colour rendering index (R_a) greater than 85, except where higher standards are required for clinical functions (e.g. dermatological examination).

11.21.8 The Licence Holder/Applicant shall define the extent of areas to be provided with colour corrected lighting for cyanosis observation as defined in AS/NZS 1680.2.5. This should be determined by clinical need for visual observation of the risk of cyanosis in conjunction with other measures such as oxygen saturation monitoring (e.g. pulse oximeter).

11.21.9 To minimise confusion for future maintenance, consideration should be made for all artificial lighting throughout the entire facility to have uniform luminaire selections with CCT and CRI adequate for clinical observation in line with COI requirements of AS/NZS 1680.2.5.

11.21.10 The facility shall be designed to minimise glare including from artificial light sources and daylight. External light source position and direction should avoid nuisance lighting to internal areas of the facility (e.g. patient bedroom).

11.21.11 General requirements:

- luminaires requiring special lamps shall be fitted with labels, visible to the person changing lamps, defining the type of lamp required
- luminaires should be positioned to facilitate maintenance and cleaning without interruption to the routine operations of the facility
- control gear external to luminaires should be located to enable ready access for maintenance without interruption to the routine operations of the facility

11.21.12 Ward lighting: general ward lighting shall be configured to provide each bed with separately controlled:

- patient reading light (to enable comfortable and glare free reading tasks) switched from the nurse call pendant and the bed head
- patient examination lighting (on vital supply) switched from the bed head or from the head of an articulated arm style of examination light
- room lighting switched from the room entrance and/or bed head (with a minimum of one light fitting on vital supply)
- night lighting switched from the room entrance (on vital supply)

11.21.13 Operating room lighting: general lighting in operating rooms and operating set up rooms shall be flush mounted behind sealed diffusers (to suit clean room environment). General lighting shall be connected to minimum two separate circuits from alternative supply sources; at least 50% shall be on vital supply and consideration should be made to put the remainder on an instantaneous supply.

11.21.14 Surgical suite lighting: lighting within the clean/sterile zones of the surgical suite shall be flush mounted with sealed diffusers (to suit the sterile environment).

Lighting shall be connected to minimum two separate circuits from alternative supply sources and at least 50% shall be on vital supply.

11.21.15 Surgical lighting: surgical and treatment luminaires shall comply with the requirements of:

- AS/NZS 3100 *Approval and test specification - General requirements for electrical equipment* and AS/NZS 60598 *Luminaires,* or alternatively
- IEC 598-2-25 *Luminaires - Particular requirements - Luminaires for use in clinical areas of hospitals and health care buildings*

11.21.16 Kitchen lighting: lighting in kitchens and food preparation areas (including lights in exhaust hoods) shall be flush mounted behind sealed diffusers with no exposed edges where dirt and grease can accumulate.

11.21.17 Sterilization department: lighting within the clean/sterile zones of the sterilisation department suite shall be flush mounted with sealed diffusers (to suit the sterile environment) with no exposed edges where moisture and dirt can accumulate.

11.21.18 Night lighting shall be provided to wards with operation/occupation during hours of darkness or requiring general lighting to be dimmed:

- in addition to individual night lighting at each patient bed night lighting shall be provided to wards, ward corridors and associated exit passages where normal lighting may be extinguished whilst occupied
- lights should provide for safe transit (average 0.2 lux on floor over the transit path) of areas where normal lights are switched off/dimmed
- night lighting locations and levels should not disturb sleeping patients

11.21.19 Emergency lighting:

- in addition to the requirements of the National Construction Code and AS/NZS2293 *Emergency lighting and exit signs for buildings*, emergency lighting shall be provided in corridors, stairways, bathrooms, ensuites, utility rooms, patient treatment areas, interview rooms, consulting rooms and other critical use areas for the safe management of patient care
- emergency lighting is not required within patient ward rooms, except as necessary to meet requirements of NCC
- emergency lighting shall be provided at distribution switchboards and in plant areas
- all switchboards shall include appropriate identification of circuits which contain emergency luminaires

11.21.20 Plant and equipment

Plant rooms containing plant and equipment that potentially require operation during periods of power outage shall be provided with emergency lighting compliant with AS/NZS 2293 for egress purposes; and in addition, instantaneous lighting backed up by vital supply sufficient for safe operation of the equipment.

Examples of such locations includes substation HV switchgear, LV switchgear at major switchboards, generators and UPS.

11.21.21 External lighting:

- external paths of travel from each exit, including emergency exits, to a public thoroughfare, roadways, car parks and open space shall be illuminated in accordance with AS/NZS 1158 *Lighting for roads and public spaces*, with spill light limited to the requirements of AS/NZS 4282 *Control of the obtrusive effects of outdoor lighting*; refer also to chapter "*Engineering Services, Security".*

- external lighting shall be provided around the hospital campus to provide a safe and welcoming environment for patients, visitors and staff, with consideration given to:
    - safe movement of pedestrians, cyclists and vehicles
    - visibility of all signage
    - integration with the architectural design intent and overall aesthetics of the buildings and campus
    - avoidance of dark areas
- external luminaires should be controlled via combined programme of time of operation together with levels of natural lighting (such as by time clock with photoelectric cells/PE cells) to provide adequate lighting at all areas around the facility, whilst minimising unnecessary energy consumption. Consideration should also be taken of introducing motion sensors/presence detection to safely illuminate select areas.

11.21.22 Design of external lighting should take into account:

- security requirements: in particular entry points, car park and unattended areas should be given special attention
- preventing light penetration into patient bedrooms

11.21.23 Lighting installation details:

- where automatic control of lighting is used in a patient occupied room, a facility shall be provided in the area serviced to directly override all automatic controls (manual switching On/Off of all lights). This requirement applies where a patient is non-ambulatory or where patient needs are reliant on safe and immediate switching; it does not need to apply to rooms such as consulting, interview, lounges, corridors and the like
- where automated control of lighting is used, the Licence Holder/Applicant shall address the provision of override-off functionality for the automated controls (to facilitate maintenance without compromise to operation of the Facility)
- light switch toggles shall be colour coded as follows:
    - white colour if connected to the normal supply
    - red if connected to the vital supply
    - blue if connected to an uninterruptible supply
- lighting controls (switches, motion sensors and the like) shall indicate by permanent labelling the supply circuit number and phase in addition to the device ID number. Labelling should be engraved, IPA stud type, or as provided by the manufacturer, however in all instances labelling shall not be stick on and/or removable without damaging the faceplate/surface to which it is attached
- extra-low voltage controls (such as touchscreens associated with electronic lighting control systems) shall be provided with permanent labelling identifying the supply switchboard/source. Provide directly adjacent to the switchboard, a diagram of the extra-low voltage controls showing all controllers and circuits controlled (including supply circuit numbers, phases and areas/rooms controlled)
- external lighting shall be connected to circuits separate from those supplying the lighting in foyers, entry porches, emergency escape passageways and similar areas providing means of entry or egress
- luminaires installed within reach shall be suitably constructed or protected by guards against accidental damage so that bare lamps are not directly exposed
- luminaires in plant rooms shall be suitably protected from physical damage

11.22 General Purpose Power Outlets (SSOs)

11.22.1 Quantity: sufficient switched socket outlets (SSOs, previously known as GPOs) for general purpose use shall be provided so that:

- the standard AusHFG Room Data Sheet/Room Layout Drawing provisions for defined clinical/functional areas are the minimum requirements provided in each room
- there is no requirement for multi socket adaptor or power board
- cleaning machines do not need more than a 15-metre extension cord
- plug-in equipment is located within reasonable distance to minimise length of flex cord, avoid use of extension cord and no more than 2 metres from an outlet

11.22.2 Characteristics: outlets shall:

- in patient areas, comply with AS/NZS 2500 and AS/NZS 3003
- in disabled, aged or assisted patient use activity spaces, be installed in accordance with AS 1428 *Design for access and mobility*
- indicate by permanent labelling the supply circuit number and phase, and where connected via isolated supply or RCD, the device number to which they are connected
- if supplying non-standard voltages or frequencies shall have different and incompatible socket configurations to standard outlets and be appropriately labelled
- accommodate low voltage transformers, i.e. be spaced above obstructions sufficiently so that the transformer will not be obstructed and accessible for maintenance or replacement
- where provided to accommodate electronic power pack with integral pins, positioned to ensure the power pack is firmly positioned, does not require friction of the pins to hold the pack in place and cannot be accidentally dislodged
- have permanent labelling in accordance with AS/NZS 3003 where located within body or cardiac protected areas
- labelling shall be engraved, IPA stud type, or as provided by the manufacturer, however, in all instances labelling shall not be stick on and /or removable without damaging the faceplate

11.22.3 Outlets in mental health facilities, nurseries and children's inpatient units, plus any other areas identified in the FRMP, shall be fitted with safety shutters.

11.23 Electromagnetic Interference (EMI) Mitigation

11.23.1 All equipment potentially susceptible to electromagnetic interference shall be protected to ensure correct operation, including:

- separation of susceptible equipment from source of interference
- shielding of interference source (such as substation, switchboard, cable runs, lifts, etc)
- shielding of susceptible equipment

11.24 Hazardous Locations

11.24.1 Where flammable anaesthetics, solvents, fuels or other hazardous liquids or gases are utilised, the electrical light and power services shall comply with AS/NZS 60079 *Explosive atmospheres*.

Refer also to the specific requirements of the Dangerous Goods consultant assigned to the project.

11.25 Materials, Plant and Equipment

11.25.1 General: Electrical materials, plant and equipment shall as appropriate to the item:

- have quality, capacity and modularisation to achieve the availability required by the Licence Holder/Applicant's Operational Policies, Risk Management Plan and Brief
- be suitable for operation in the environment in which they are installed
- have safe access for operation and maintenance
- be installed with provision for replacement of any items needing replacement within the planned life of the project

11.26 Lightning Protection

11.26.1 Lightning protection risk assessment shall be carried out on all facilities. Risks shall be mitigated, and as a minimum be in accordance with the recommendations of AS 1768 *Lightning protection*.

11.26.2 Surge protection shall be included as part of the lightning protection system.

11.26.3 Risk assessment outcomes and mitigation strategies shall be agreed and recorded as part of the FRMP.

11.27 Testing and Commissioning

11.27.1 The electrical services shall be tested and commissioned before they are placed in operation. Testing and commissioning shall include as a minimum:

- inspection of each element to establish it is complete and of the quality required by the contract documentation
- testing of each element and service to establish it performs correctly in each operating mode
- review of arrangements for operation, servicing and maintenance to ensure that they are adequate for hospital needs
- testing of operating sequences and interlocks
- thermographic survey of switchboards, switchgear/control gear, cable joints and batteries
- calibration of controls and protection
- checking the certification provided by the supplier of electrical switchgear that circuit protection discrimination complies with Guideline requirements
- certification that:
    - HV installation switchboards and transformer comply with the requirements of AS 62271 *High-voltage switchgear and controlgear* and AS 2374 *Power transformers* and requirements of Supply Authority
    - LV switchboards comply with AS/NZS 61439 *Low-voltage switchgear and controlgear assemblies*
    - solar PV installation complies with AS/NZS 5033 *Installation and safety requirements for photovoltaic (PV) arrays* and associated codes
    - the low voltage installation complies with AS/NZS 3000, AS/NZS 3013
    - electro-medical power supplies comply with AS/NZS 3003 *Electrical installations - Patient areas*

    - body protection and cardiac protected areas are in accordance with AS/NZS 3003
    - generating plant complies with AS/NZS 3009 *Electric installations - emergency power supplies in hospitals*, AS/NZS 3010 *Electrical installations - Generating sets*
    - uninterruptible power supplies comply with AS/NZS 3009
    - lightning protection system testing complies with AS/NZS 1768
    - lighting complies with AS/NZS 1680 (all parts and in particular AS/NZS 1680.2.5) and AS/NZS 1158
    - emergency lighting complies with AS/NZS 2293 and the NCC
    - battery installations are provided with satisfactory fire protection/isolation measures
    - the installation complies with the requirements of AS/NZS 3000 and all relevant referenced standards therein
    - points list and interface for all data driven aspects of the installation has been verified and updated in documentation
- all operational software provided to the Licence Holder/Applicant sufficient to enable management, operation, modification and maintenance of all equipment and systems
- review of all As Constructed documentation and Operation and Maintenance manuals to ensure that all aspects of the installation are fully and comprehensively covered, including any tuning or adjustments undertaken during commissioning.

12 ENGINEERING SERVICES, FIRE

12.1 Fire Protection and Fire Safety Engineering

12.1.1 Delivery of fire safety and fire protection engineering require differing engineering skills and services. This may involve engagement of separate consulting services to effectively address and deliver the requirements of The Guidelines.

12.1.2 A fire safety strategy which includes a summary of the extent of fire protection services necessary for the facility shall be defined by the Licence Holder/Applicant. This shall provide a fully detailed description of services to support the safe, secure and reliable clinical and building operational functionality of the healthcare facility.

The performance required to deliver such services shall be not less than as required by the National Construction Code, other statutory regulations, Fire Engineering Report, relevant WA healthcare guidelines and the Licence Holder/Applicant's facility risk management plan (FRMP).

The Licence Holder/Applicant should consider the inherent future flexibility, expandability, and accessibility for adaptation to suit the changing needs of the building operational requirements and clinical services delivery over the life of the building.

Where design could impact fire brigade intervention, consultation with the local fire brigade should be carried out at early stages of design to gain "in principle" support and with consideration of any applicable local fire brigade guidelines.

12.1.3 Fire protection services are a critical part of hospitals in their ability to support life and to provide patient care. The design and installation of these systems is governed by Australian Standards. Designers and installers shall adhere to the requirements of the NCC, relevant Australian Standards and these Guidelines. The critical nature of these services demands a high level of knowledge of the standards by both designers and installers. All clauses outlined in the following section are in addition to statutory requirements.

12.1.4 The purpose of active and passive fire safety systems in healthcare facilities is to provide means by one or a combination of methods to achieve the following:

- warn occupants of a fire emergency
- support the safe and managed evacuation of the facility
- restrict the spread of fire and smoke
- extinguish a fire
- provide real time information to support emergency services operations and decision making

12.1.5 Where fire safety engineering design is applicable, key aspects of design that are the responsibility of the fire safety engineer comprise:

- development of fire engineering performance solution(s) in accordance with NCC Clause A2G2 and aligned with the Australian Fire Engineering Guidelines. Detailed risk assessments and quantitative analyses should be considered where appropriate
- submit performance based design brief (PBDB) for review as part of the AIP documentation
- consider integrated fire system design approach
- design contingencies for evacuation of any ward or clinical area or total building, where applicable to the fire engineering design (managed by clinical/emergency response staff as either an immediate, or staged evacuation process)

- definition of fire-mechanical-electrical-electronic system interfaces through preparation of an overarching fire matrix (zone by zone). Ordinarily this would be prepared by the fire protection designer/engineer in conjunction with the mechanical engineer as appropriate and reviewed by the fire safety engineer.
- consideration of critical hospital/clinical areas which require to maintain their functional performance under fire mode conditions, for example, operating theatres, isolation rooms, CSSD sterilization zones or PC2/PC3 laboratories
- construction phase, commissioning and review of fire safety systems to ensure the requirements of the fire engineering report (FER) are met
- maintenance requirements for fire safety systems as applicable to the approved FER
- prepare (or update existing) fire safety handbook at project completion (where in existence)
- co-ordinate the design of fire safety systems with each discipline including the review and input into the fire matrix

12.1.6 The design of fire systems shall comply with the NCC DTS provisions and referenced Australian standards unless approved through a fire engineered performance solution that has been prepared by the project's fire safety engineer and endorsed for use by the clinical team, the project building surveyor and (where applicable) local fire brigade.

The design and performance of individual fire systems shall be defined by the fire safety engineer to achieve the required level of fire safety within the facility. Individual fire service professionals or contractors are then responsible for design preparation of those individual systems. In the absence of an approved fire performance solution, compliance with NCC DTS provisions is mandatory.

Individual fire services designs should not be altered or modified without approval of the responsible fire safety engineer (when applicable) and fire protection design engineer.

12.2 Extent of Services

12.2.1 Fire safety and protection systems shall be provided to comply with requirements of the National Construction Code and these Guidelines including but not limited to:

- provision of materials and methods of construction complying with codes and regulations
- emergency control organisations and procedures for buildings, structures and workplaces, including fire wardens, emergency responders, managed egress and muster point management
- compartmentation of the building(s) into fire and smoke control compartments
- fire egress arrangements (suitable for the nature of the facility and occupant/patient)
- automatic fire detection and alarm system
- emergency warning and intercommunication system (EWIS)
- directional emergency exit and emergency lighting systems
- storage arrangements for firefighting water
- firefighting water pressure boosting arrangements
- smoke hazard management
- escape route stair and fire protected lobby pressurisation
- emergency warning and information equipment

- fire hydrant equipment
- automatic fire suppression systems
- first attack firefighting equipment, including fire hose reels, portable fire extinguishers and fire blankets
- equipment to aid transportation of disabled persons
- fire services master plans, escape /evacuation diagrams
- National Construction Code compliance report prepared by the building surveyor, to be kept at the facility at all times
- fire/smoke compartmentation drawings prepared by the architect, to be kept at the facility at all times

12.2.2 A facility fire safety handbook (FSH) shall be considered for all new healthcare facilities and existing facilities which undergo major refurbishment or extension. Preparation of a FSH should also be considered for all existing healthcare facilities.

The purpose of the fire safety handbook is to define the fire safety strategy in terms of the required levels of compliance, performance, design parameters and maintenance requirements and collate any changes and additions to the facility fire strategy and performance requirements over the life of the building.

The fire safety handbook should be prepared and updated by the fire safety engineer. The FSH should be kept up to date and available at the facility at all times and be incorporated in the Facility Risk Management Plan (FRMP).

The FSH should include details of all fire safety systems, including but not limited to:

- building description, BCA classification and characteristics, population
- NCC compliance report
- occupant and staff characteristics
- holistic fire safety strategy
- list of approved departures to NCC or relevant guidelines via fire engineering performance solutions
- details of active and passive fire safety systems including egress provisions
- fire safety management measures
- fire/smoke compartmentation plans
- sprinkler/hydrant block plans
- details of fire equipment locations
- as-built fire/architectural drawings
- evacuation procedures etc
- base line data
- fire matrix
- references and collation of all past fire safety related documents such as fire engineering reports, CDCs

12.2.3 The fire safety engineering deals with the strategic approaches to fire safety and the development of fire engineering performance solutions which fall outside the prescriptive requirements of the NCC.

Generally, DTS solutions with respect to fire and life safety are preferred. However, it is recognised that in larger more complex healthcare facility buildings that this is not always possible. When a design deviates from the DTS requirements of the NCC, fire engineering performance solution(s) can be developed. This includes, but not limited to, the following potential suggestions:

- the arrangement and size of internal fire and smoke compartments. Variation of the size of compartments can greatly assist the design of more operationally effective clinical spaces, particularly wards and other large areas such as emergency and medical imaging departments
- egress provisions in the building including the number, location and aggregate width of exits, horizontal exits to adjacent fire compartments and vertical exits using stairs
- emergency response strategy including staff response and the use of safe havens and progressive horizontal evacuation to allow ‘defend in place’ strategies for occupants with severely restricted mobility (subject to suitable patient to staff ratios, staff training and the clinical acuity of the patients)
- fire resistance levels of construction including the use of unprotected steel, glazing and environmentally sustainable materials
- coordinated smoke hazard management systems including the use of advanced smoke detection equipment and complementary active smoke management systems
- descriptive emergency warning systems which provide sufficient information to emergency management teams to enable a coordinated response
- development of a coordinated and holistic fire safety strategy that complements the project-specific architectural planning, building functionality and sustainable design initiatives

12.2.4 It is acknowledged that elevators (lifts) may be considered for use as part of an overall emergency evacuation strategy. Where such an option is considered this should be undertaken with full consideration of all relevant building and engineering factors, noting that lifts are considered to be a last resort option for vertical evacuation.

12.2.5 Where specific facility-related fire risks are not covered adequately in the NCC and other relevant regulations, (such as Electric Vehicle and high-powered battery equipment/charging facilities and others), a suitable fire risk assessment shall be considered. The fire risk assessment should incorporate national/state guidance available from SFS, ABCB, AFAC, local fire brigade and other relevant guidelines.

12.2.6 The need for additional measures for a specific facility and the suitable solution should be established during the design process and where fire performance engineering solutions are adopted, the rationale, design details and authority approvals shall be fully documented for future reference and ensure appropriate future testing and certification.

12.2.7 Projects with clearly identified future stages and master plans should be designed so that services infrastructure has the adaptability to cater for proposed future buildings to the site without having to replace or rebuild systems. Future connection should be considered to avoid disrupting hospital services.

12.2.8 In planning a new building project or refurbishment to a facility, the design for fire response shall be considered not only for the building in question but also for the entire site. The level of integration should be determined by the level of functional interaction required between these buildings and the facility fire management plan and emergency procedures. Fire brigade intervention and hospital management of an emergency shall form part of the design input to development of the fire safety strategy for the building and site.

12.2.9 The integration of fire systems between other buildings on the site should be achieved via the appropriate infrastructure so that the integrity and performance of fire systems is maintained in accordance with NCC, relevant Australian Standard and as approved FER (if applicable).

12.3 Coordination with Other Disciplines

12.3.1 Fire services shall be coordinated with all aspects of the facility including civil, communications, electrical, hydraulic, mechanical, medical gas, security, structure, vertical transportation..

12.3.2 Where aspects of other disciplines are applicable to the fire portions of the works (e.g. naming and labelling of electrical supply, cable installation, power quality control and protection coordination of circuit protective devices) the works shall comply with the respective requirements of the other discipline sections.

12.3.3 Where overlapping or similar requirements arise between disciplines, the more stringent/onerous requirement shall take precedence and be implemented.

12.3.4 All input from other disciplines that are related to performance based fire safety requirements necessary for the facility should be coordinated by a fire safety engineer. This should include preparation or update of the fire safety handbook (as applicable).

12.3.5 Refer to chapter "*Background*", section "*Definitions*" with clauses that contain a list of terms relating to electrical power supplies as relevant to healthcare facilities referenced within The Guidelines.

12.4 Compartmentation

12.4.1 The design/layout of each nursing unit patient care area/ward shall comply with the NCC and associated Australian Standards, approved FER (if applicable) and in particular shall:

- comply with part "*Compartmentation and Separation*" in section "*Fire Resistance*"
- be in a separate smoke or fire zone complying with NCC DTS requirements, where the nursing unit is required to be independently closed, locked, isolated or the like
- have access to an escape path/corridor or external exit without passing through another compartment unless that compartment is provided with suitable facilities to maintain patient care

12.4.2 When used for a design to vary from the DTS parts of the NCC, a fire engineering performance solution(s) should optimise the arrangement and size of internal fire and smoke compartments. Variation of the size of compartments can greatly assist the design of more operationally effective clinical spaces, particularly wards and other large areas such as emergency and medical imaging departments.

12.4.3 Medical records storage, similar high-density storage of records or film and electronic data storage shall be fire separated from surrounding areas with the minimum of a 2-hour fire rating.

12.4.4 Smoke and fire partitions above ceilings shall be clearly labelled in a contrasting colour on both sides of the wall every ten metres such that it is clearly visible for inspection.

12.4.5 Penetrations through fire and smoke partitions shall be labelled on each side in accordance with AS 1851 *Routine service of fire protection systems and equipment* and AS 4072.1 *Components for the protection of openings in fire-resistant separating elements* and recorded in a register available at the facility at all times..

12.5 Egress

12.5.1 Egress arrangements shall comply with the NCC and approved FER (if applicable)..

12.5.2 Egress provisions in the building including the number, location and aggregate width of exits, horizontal exits to adjacent fire compartments and vertical exits using stairs shall be submitted along with the FRMP for review at AIP stage and updated (where relevant) at ATC and ATO stages.

12.5.3 Egress routes shall not be compromised by equipment and/or storage. Where necessary, storage recesses should be provided to ensure egress routes are not compromised.

12.6 Suppression Systems

12.6.1 An automatic suppression system shall be provided if required by the NCC DTS or approved FER. The automatic suppression system shall be in accordance with NCC, relevant Australian Standards and approved FER (if applicable).

12.6.2 An automatic sprinkler system should be considered in facilities (or parts of facilities) containing patient care areas as defined in NCC.

12.6.3 The Licence Holder/Applicant shall designate where and what type and capacity of any fire suppression systems exceeding NCC requirements. Fire suppression systems should be provided to deal with special high-risk hazards or the Licence Holder/Applicant's requirements for risk mitigation as documented in the FRMP.

Consideration should be given to providing combined sprinkler, hydrant and hose reel systems.

12.6.4 The design of the sprinkler system should not preclude the use of innovative technologies such as extended coverage sprinklers.

Areas ancillary to patient care shall be defined in line with NCC and AS 2118 categories.

Large areas of the hospital, particularly administration, may be suitable for the installation of light hazard sprinklers.

12.6.5 Flush mounted or concealed type sprinklers fitted off to false ceilings should be avoided except in specific applications e.g. operating theatres, mental health facilities, anaesthetic and adjoining sterile stock rooms and communications rooms (with false ceilings).

In rooms where the air pressure within the room is to be controlled, flush mounted type sprinklers with rubber gaskets may be used.

Sprinklers in plantrooms, stores, communications and server rooms without ceilings should consider placement of the sprinklers to avoid mechanical damage from ladders etc. and be provided with heavy duty sprinkler guards.

12.6.6 Communications rooms, server rooms and rooms containing electronic equipment in sprinkler protected buildings should consider the use of gas suppression system instead of sprinkler system and be supported by a fire engineering performance solution (where required). The requirements shall be documented in the FRMP..

12.6.7 Sprinkler system remote test points shall be provided with drainage to enable testing.

12.7 Occupant Warning Systems

12.7.1 An occupant warning and intercommunication system shall be provided in accordance with the NCC, associated Australian Standards, and approved FER (if applicable).

12.7.2 In facilities provided with an Emergency Warning and Intercommunication System (EWIS), the systems should be divided into managed evacuation zones to minimise disruption across the site. EWIS zone plans should be developed by the fire

protection engineer in collaboration with fire safety engineer where appropriate. Plans shall be provided for review prior to ATO.

A reliable sound system is required to enable the orderly evacuation in the event of an emergency. The EWIS to be provided as required in accordance with AS1670.4 *Fire detection, warning, control and intercom systems - System design, installation and commissioning Emergency warning and intercom systems,* including Manual Call Points (MCP) and Warden Intercom Points (WIP).

This shall be supplemented by a clearly documented emergency management plan developed in accordance with AS 3745 *Planning for emergencies in facilities* and AS 4083 *Planning for emergencies - Healthcare facilities*.

12.7.3 The smoke hazard management systems shall be designed and operated to align with the intended egress strategy, including where relevant, for zone pressurisation and stair pressurization and air relief systems that support the safe and managed egress of patients, staff and other facility occupants.

EWIS shall be configured to minimise patient trauma in inpatient areas. Where speakers are removed from inpatient areas as part of a fire engineering performance solution to minimise patient trauma, provide remote display units and mimic panels in the nurses' station together with visual indication with T3 strobe and audio annunciation with mute facilities at the Mimic Panel.

Descriptive emergency warning systems should be considered to be provided which give sufficient information to emergency management teams to enable a coordinated response.

12.7.4 Where a cascaded ALERT and EVACUATION protocol is designed for, all warden intercom, HVAC systems, door access controls and security release facilities shall be integrated and documented as part of an overarching fire matrix, with operational system integration testing as per AS 1851 carried out as part of the project commissioning stage prior to completion, handover and occupation.

12.8 Fire Detection System

12.8.1 Smoke detectors of the analogue/addressable type shall be installed in accordance with the NCC, associated Australian Standards, and approved FER (if applicable)..

The location of the smoke detectors to protect the occupied spaces of the building shall be in accordance with AS 1670.1 and all its sub-clauses.

Smoke detectors associated with air handling equipment shall be located in accordance with Section 7 of AS 1670.1.

12.8.2 Fire detection systems should be configured such that no more than one smoke compartment is required to be isolated to undertake works which may result in spurious alarms.

12.8.3 Smoke detectors in ward sleeping areas and in mental health areas should be reviewed by the fire protection design engineer in conjunction with clinical and IP&C teams to ensure the light-emitting diode (LED) indicator does not disturb patients.

12.9 Hydrants and Hose Reels

12.9.1 A fire hydrant and hose reel system shall be designed and installed in accordance with NCC, associated Australian Standards, approved FER (if applicable) and with consideration of any applicable local fire brigade guidelines.

12.9.2 Internal fire hydrant cupboards should have bunded floors or drip trays with a minimum depth of 50 mm.

12.10 Portable Extinguishers

12.10.1 The Licence Holder/Applicant shall designate where and what type and capacity of portable fire extinguishers and or fire blankets are needed to cover fire risks associated with equipment to be installed.

Portable fire extinguishers shall be provided in accordance with the NCC, relevant Australian Standards and approved FER (if applicable).

12.11 Signs and Evacuation Plans

12.11.1 The Licence Holder/Applicant's Operating Policies shall define any special requirements for fire signage and emergency evacuation plans needed to suit the functions of each functional area in accordance with AS 3745 *Planning for emergencies in facilities* and AS 4083 *Planning for emergencies - Health care facilities*.

12.11.2 Evacuation of large areas of a hospital presents many safety and logistic issues and should be absolutely minimised; however, it should remain as an option within the fire safety strategy.

Sufficient design redundancies shall be incorporated to enable a progressive horizontal evacuation approach for patients and staff, where relevant.

Nevertheless, a full building evacuation plan should be developed, or alignment with a pre-existing plan demonstrated, and be feasible within the design solution; this includes a means to evacuate critical high dependency wards located above ground level to the outside.

12.11.3 In mixed use/multi-tenancy buildings, especially in multi-storey buildings with patient care planned for levels other than ground floor, the overall building fire and smoke management plan, fire/smoke compartmentation plans, capacity and integrity of egress routes (including corridors and stairs) shall be reviewed and demonstrated as achievable as part of the licensing approvals and suitability for use criteria under the Acts.

12.12 Water Supply

12.12.1 The water supply for facilities shall comply with the requirements of the NCC, associated Australian Standards and approved FER (if applicable).

Ensure that appropriate supplies, storage and pumping facilities are negotiated with the local fire brigade early in the concept design phase (AIP).

Ensure that the water supply flow and pressure is provided for both hydrant and sprinkler systems to operate simultaneously, as required.

12.12.2 Water supply to the facility necessary for the delivery of healthcare services shall take into consideration the reliability and redundancy features necessary to achieve the outcomes documented in the Facility Risk Management Plan and Business Continuity Plan. Refer also to requirements in chapter "*Engineering Services, Hydraulic*".

12.12.3 All water storage tanks shall be accessible for draining and cleaning and be provided with sufficient overflow or automatic water inflow/high level emergency shut off provisions so as not to cause flooding within the building.

Water storage tanks for fire services should have a minimum design life of 30 years.

Reticulation of mains pipework under buildings should be avoided. Mains pipework should offset at the perimeter of the building into a riser shaft at the perimeter of the building.

Backflow prevention devices shall be installed in locations that allow testing and draining to occur.

12.12.4 Water saving initiatives should be incorporated for the sprinkler and hydrant systems, for example:

- installation of an on-floor isolation valve for each level of the sprinkler system so that each level can be drained and isolated individually to minimise the occurrence of the entire installation being drained and avoid large sections of the building being isolated and unprotected during maintenance or alterations
- installation of sprinkler and hydrant system Annubar flow test lines that discharge back into the respective system storage tanks
- recirculated water shall be treated with water treatment chemicals to inhibit corrosion and microbial growth

12.13 Helipad Fire Protection

12.13.1 Helipad fire safety systems shall be determined, designed and approved in conjunction with the appropriate stakeholders including CASA, airwing/aviation, clinical, IP&C and operational personnel and in accordance with a risk management plan prepared specifically for the helipad.

12.13.2 All equipment and the installation shall be supplied, installed and commissioned by suitably qualified and experienced suppliers and contractors.

12.14 Testing and Commissioning

12.14.1 General: The fire services shall be fully tested and commissioned in accordance with the relevant Australian Standards. Full function integrated testing shall be conducted to demonstrate that the building operates as intended by the fire matrix, and approved FER (if applicable).

Commissioning activities shall include:

- inspection of each element to establish it is complete and of the quality required by the contract documentation
- testing of each element and service to establish it performs correctly in each operating mode
- review of arrangements for operation, and maintenance to ensure that they are adequate for the facility's needs
- testing of operating sequences and interlocks
- calibration of controls and protection
- inspection and approval by the building surveyor, fire protection engineer, local fire brigade and fire safety engineer (where applicable)

12.14.2 Alarms:

Test alarm systems to verify they comply with AS 1670.

12.14.3 Compartmentation:

Inspection shall include:

- provision of register of all fire and smoke compartmentation penetrations, for recording of maintenance activities
- check fire door operation, labelling and certificates of compliance
- check fire and smoke partitions are complete and penetrations are sealed and appropriately labelled
- check above ceiling partitions are appropriately labelled

12.14.4 Egress:

Inspect egress routes including:

- check opening sizes
- check door swing
- check for obstructions

12.14.5 Fire extinguishers:

Check:

- correctly installed and in operating condition
- position of signs and labels comply with AS 2444

12.14.6 Hydrant and hose reels:

Check:

- test the system to verify compliance with AS 2419.1 and AS 2441
- check signs and labelling

12.14.7 Suppression systems:

Check to compliance with design codes.

12.14.8 Smoke Hazard Management systems:

Test smoke hazard management systems and fire systems to comply with AS/NZS 1668.1 *The use of ventilation and air conditioning in buildings, (Fire and smoke control in buildings)* (refer chapter "*Engineering Services, Mechanical*").

12.14.9 In fire mode, ensure the required fire and life safety system interfaces are detailed so that the operation of other building services are carried out under the control of the fire system. Ensure that the systems operate in concert with the agreed fire safety strategy and the emergency procedures developed for the facility.

12.14.10 Prepare a "cause and effect" matrix detailing all operating conditions, coordinated with all other associated building services. Interfaces shall be provided between the fire detection system and the building services systems, including, but not limited to:

- mechanical ventilation used for smoke hazard management
- general air conditioning systems
- specialised air conditioning or ventilation systems
- natural ventilation openings/systems
- building management systems
- security and access control systems
- automatic door operators
- door holders for doors in fire or smoke compartment walls and
- elevators (lifts) to assist in controlled vertical evacuation where this is incorporated in the fire engineering strategy.

12.14.11 Consider the use of the latest convergent technology in fire detection systems allowing the integration of other equipment and technologies to provide enhanced response and occupant notification. This may include the provision of graphic displays on colour monitors, text messages to pocket pagers and mobile telephones, interfaces to security and access control systems to initiate pre-programmed functions.

12.14.12 All active and passive fire safety systems shall be tested and maintained in accordance with AS1851 *Routine service of fire protection systems and equipment*

and all other relevant Australian Standards, for the lifetime of the building including undertaking regular system interface tests. System interface test regime shall be suitably performed, witnessed and signed off by the designers and installers as part of the commissioning process, and prior to granting of ATO licensing.

12.14.13 The commissioning reports should fully document all fire safety systems including the methodology deployed and performance criteria, serving as baseline data. This should be reviewed and witnessed by the Facility Manager (FM) and handed over to the FM prior to Practical Completion.

12.14.14 Independent commissioning agent should be considered for large complex healthcare facility.

12.14.15 All Fire Services equipment should be located in adequate space to ensure they can be maintained for all operation and maintenance requirements and able to be cleaned and replaced without disruption to the building's day to day procedures.

13 ENGINEERING SERVICES, HYDRAULIC

13.1 Hydraulic Services Brief

13.1.1 The extent of hydraulic services shall be defined with a fully detailed description of services to be provided by the Licence Holder/Applicant as part of their submission that supports the safe, secure and reliable clinical and building operational functionality of the health facility served by the hydraulic systems.

13.1.2 The performance required to deliver such services shall be not less than as required by the current NCC, other statutory regulations, including but not limited to the Plumbers Licensing Board of Western Australia, Water Corporation of Western Australia, ATCO Gas requirements, these Guidelines and the most current version of the following standards as referenced in the latest version of the NCC:

- AS/NZS 3500 *Plumbing and Drainage Code* incorporating:
  - Part 0 - Glossary of terms
  - Part 1 - *Water services*
  - Part 2 - *Sanitary plumbing and drainage*
  - Part 3 - *Stormwater drainage*
  - Part 4 - *Heated water services*
- Plumber's licensing and plumbing standards regulations
- Plumber's licensing board technical notes
- AS/NZS 1596 *The storage and handling of LP gas*
- AS/NZS 5601 *Gas installations*
- WA gas standards and regulations
- AS 4032.3 *Water Supply – Valves for the control of heated water supply temperatures*
- AS 2845.1 *Water supply – Backflow prevention devices - Materials, design and performance requirements*
- AS 2845.2 *Water supply – Backflow prevention devices- Air gaps and break tanks*
- AS/NZS 5369 – *Reprocessing of reusable medical devices and other devices in health and non-health related facilities*
- AS/NZS 2243 – *Safety in laboratories*
- AS/NZS 2982 – *Laboratory design and construction*
- AS/NZS 3666.1 – *Air-handling and water systems of buildings – Microbial control – design, installation and commissioning*
- AS 4775 – *Emergency eyewash and shower equipment*
- Health (Treatment of sewage and disposal of effluent and liquid waste) regulations 1974 for rural/remote healthcare facilities
- EN 285 – *RO water requirements to produce clean steam*
- ISO/TS 5111 - Guidance on quality of water for sterilizers, sterilization and washer-disinfectors for health care products
- enHealth Guidelines for Legionella Control
- Australian drinking water guidelines
- WELS Water efficiency labelling scheme
- Industrial waste – Water Corporation of Western Australia
- Water Corporation design guidelines

13.1.3 Consideration should be given to other guidelines from industry organizations that would otherwise influence design outcomes.

13.1.4 The Licence Holder/Applicant should demonstrate the inherent future flexibility, expandability, and adaptability to suit the changing needs of the building operational requirements and clinical services delivery over the life of the building.

13.2 Extent of Services

13.2.1 Hydraulic services may include but not be limited to:

- sanitary fixtures, fittings and tapware
- drinking water services (cold and heated water)
- non- drinking water services (cold and heated water)
- water supply to landscaping areas
- water storage and pumping systems
- hot water plant and equipment
- warm water plant and equipment
- ground absorbing heating systems
- filtration and conditioning systems
- purified water treatment and distribution systems for specialised use in areas such as CSSD, Endoscopy, laboratories, etc
- rainwater harvesting and recycling systems
- hydrotherapy pool water and filtration systems
- natural or liquefied petroleum gas services
- sanitary plumbing and drainage systems
- wastewater recycling systems (i.e. greywater and blackwater recycling systems)
- trade and/or industrial waste drainage and pre-treatment systems
- stormwater drainage systems, including rainwater catchment to roofing systems and siphonics
- surface and subsurface drainage systems
- helipad drainage and treatment systems
- chlorine and/or chemical injection systems
- remote monitoring

13.2.2 Where specialised systems such as ground absorbing heating systems, hydrotherapy pool water and filtration or helipad drainage and treatment systems are required, consideration should be given to the following design guidelines and regulations:

- CIBSE TM51
- ASHRAE Geothermal Heating and Cooling Design of Ground-Source Heat Pump Systems
- CSA/ANSI/IGSHPA C448 Series: 25 Design and installation of ground source heat pump systems for commercial and residential buildings
- Australian Government Civil Aviation Safety Authority Guidelines for heliports – design and operation
- AS 1940 *The storage and handling of flammable and combustible liquids*
- DoH Code of Practice for the design, construction, operation, management and maintenance of aquatic facilities.

- Pool Water Treatment Advisory Group – Code of Practice for the management and treatment of swimming pool water.
- WA Health (Aquatic Facilities) Regulations

The design should consider additional guidelines, regulations and/or standards that are otherwise not listed above that would influence design outcome.

13.3 Coordination with Other Disciplines

13.3.1 Hydraulic services associated with all aspects of the facility regardless of which discipline they occur (e.g. mechanical services, electrical, fire protection) shall comply with the requirements of this chapter.

13.3.2 All naming, numbering, colour coding and labelling of electrical supply, cable installation, power quality management and protection coordination of circuit protective devices shall be as defined within the electrical design.

13.3.3 Refer to chapter "*Background*", section "*Definitions*" with clauses that contain a list of terms relating to electrical power supplies as relevant to healthcare facilities referenced within The Guidelines.

13.4 Water Supply, General

13.4.1 Plans shall be in place for possible water shortage or contamination of water supplies. A 72-hour supply of usual usage drinking water is to be provided for each facility.

13.4.2 The Licence Holder/Applicant shall provide details in the business continuity plan (BCP) and facility risk management plan (FRMP) to outline how the facility will function through all scenarios of operation and maintenance, plus in an emergency situation.

13.4.3 Healthcare facilities defined by the FOP as required to comply with either clause "**Disaster or emergency role**" (that is, a facility that is to *withstand natural disasters, or with a strategic post disaster and emergency role*) or clause "**Continue surgical and/or emergency services during failure**" (that is, a facility that is to *continue to offer invasive surgery or emergency medical services through failure of normal utility services*) shall have either:

- two entirely independent connections, with different points of entry, to the water supply sized for full capacity for the entire facility from either supply; or
- one connection to the water supply and storage tanks with capacity to sustain critical water supplies for a period of 24 hours usual usage and should consider maintenance servicing and downtime with identified re-supply for 72 hours and identified water supply alternative to major distribution network (i.e. tankers).

An independent supply is defined as one fed from more than one source which will not be interrupted by any accident or maintenance task on the other supply.

13.4.4 Healthcare facilities defined by the FOP as required to comply with clause "**Safely close down surgical and emergency critical services during failure**" (that is, a facility that is to s*afely close down surgery and emergency stabilisation, or maintain occupancy of the building under a healthcare function on failure of normal utility services*) and those not performing invasive surgery shall have at least a single water source fed off a ring-main network with supply from both directions of the feed. The valving arrangement shall be configured to allow supply for either side of the feed – in case one side is to be isolated for maintenance or repairs. In addition, there shall be an identified water supply alternative to major distribution network (i.e. tankers).

13.4.5 Healthcare facilities defined by the FOP as required to comply with clause "**Facilities in remote locations or with other critical functions**" (that is, a facility *with limited access or other critical functions that have no viable alternative to provide substitute treatment in the event of failure of normal utility services*) shall have:

- an onsite storage tank with sufficient capacity to sustain water supplies for a period of 24hrs with identified re-supply for 72hrs
- consideration of alternative water catchment initiatives and reuse methods (e.g., rainwater harvesting)

Onsite storage tanks should consider geographic location, the environment, and the required downtime for servicing and maintaining facilities in remote locations, including known road closures in winter months due to flooding with prolonged time to reach such facilities.

13.4.6 Prior to design commencement, the designer should complete a site main water pressure test to ensure the facilities water supply meets the minimum requirements for fixture and appliance operation. Additionally, where the water supply is unreliable, demand shall be satisfied with local back-up. Where the supply system includes pumping, pumps shall be provided in an N+1 duty/duty/standby arrangement and pumps be connected to the facility critical power supply.

13.4.7 Storage systems should be divided in two compartments to ensure availability of half of the storage during cleaning and maintenance and an allowance for supply is augmented by offsite services (i.e. tankers).

Where onsite storage tanks are used, water shall be turned over frequently and recirculate the incoming water supply to promote water movement with the ability to constantly flush, disinfect, and sterilise the water system.

Onsite storage tanks should be provided with bypass lines to facilitate future replacement and/or complete disinfection and cleanout.

Where possible, consideration should be given to individual, independent storage compartments to facilitate replacement of storage tank compartments.

Storage tank sizing and design should consider staged construction, development and land acquisition sales or other forms of staged delivery.

Storage tank design should consider disinfectant levels in accordance with the enHealth Guidelines for Legionella Control and the Australian Drinking Water Guidelines.

13.4.8 Water distribution on site should be by ring main or star sub-main arrangements that will allow the water supply to the majority of the site to be maintained though all credible system maintenance and alteration events. Ring mains shall be isolatable by segmenting the distribution supply network to isolate portions of the facility that will not affect critical surgical or ICU wards and/or emergency departments that otherwise require a constant water supply. Design should consider diversified flow of a ring main to avoid oversizing.

Ring mains should have a constant water flow circulating with high velocity flushing points and air release valves segmented along straight lengths and branch take-offs to ensure constant water movement and distribution of disinfectant.

Where future branch take-offs are provided, they should be as short as possible and provided with a flushing point.

13.4.9 Where water supply pipework is buried underground and is located in an area that is subject to elevated summer temperatures consideration should be given to the ambient temperature and pavement/landscape/ground finishes and its impact on the water supply pipework material and water temperature.

13.4.10 Provision of “daisy chain” branch fixture minor supply pipes arrangements to improve water quality should be considered.

13.4.11 Flushing points should be incorporated into the system to enable flushing of each section of the system for possible disinfection.

Consideration should be given to automatic flushing points by a device that discharges water by electronic activation, with ease of access, serviceability and maintenance and as a minimum should be located:

- downstream of the incoming water supply connection
- upstream and downstream of any plant and/or equipment
- on ring mains
- on dead ends and branch offtakes
- at end of line
- remote/sentinel or irregularly used outlets
- all fixtures and tapware

Flushing points for large-bore ring main systems, dead ends, branch offtakes and end of line should consider high-velocity flushing to assist with water hygiene and removal of debris from the system.

Flushing points should be sized (no smaller than 20mm) to achieve a velocity as high as practically possible within the system and be placed in all locations as necessary to effectively flush the entire system.

A “flushing schedule” should be established as part of routine water quality management and the Facility Risk Management Plan (FRMP). Water supply flushing should occur on a weekly basis, with each flushing point operated for one to five minutes, depending on location, system configuration, and frequency of use.

13.4.12 Water sampling points should be provided at main interface points of the water system and as a minimum should be located in the same locations as water flushing points. However, consideration should be given to additional sampling points required, particularly where there is water treatment and equipment.

A “sampling schedule” should be established as part of routine water quality management and the Facility Risk Management Plan (FRMP).

13.4.13 Consideration should be given to equal balancing of the network to assist with water quality and reduce the risk of stagnation.

13.4.14 The design shall be fully coordinated between all services disciplines to facilitate future flexibility and redundancy provisions. Pipework should be mounted on multi-service racks and be reticulated within corridors where possible to permit maintenance access with minimised interruption to hospital functioning.

Where pipework requires installation through an area normally occupied by patients, staff or visitors, the service location should be positioned to minimise the impact to furniture and fittings in the event access is needed.

13.4.15 Pipework should not be cast in concrete where water services pipework is required to cross underground below slab to serve an island fixture or as a method of reticulation. Where pipework is required to cross underground below slab and under a building it should be provided within a sleeve large enough to accommodate pipework casing spacers to centralize the pipework, prevent “snagging”, movement and accommodate future replacement.

13.4.16 Water system valves should be in an accessible location, to minimise the use of a ladder for serviceability and maintenance, to assist in the event of an emergency and as a minimum located at:

- all riser takeoffs
- all branch takeoffs to each Functional Space /Room
- each fixture or appliance
- in locations to comply with OHS legislation

Water supply valves shall be slow closing.

Where water supply valves require a ladder to access, service and maintain the valve it should be provided on a risk-based assessment.

13.4.17 The site main shall be fitted with flow, temperature and pressure test sampling points and where possible connected back to the facility remote monitoring system.

13.4.18 Where reliance on an external water source is required such as a tanker to facilitate alternative water supply, Licence Holder/Applicant shall consider the licence to operate, contractual arrangements, including volume, quality, service delivery response times and include at the delivery point any post-delivery treatment that is required.

13.5 Drinking Cold Water Supply Configurations

13.5.1 A minimum supply pressure of 200kPa shall be provided to the furthest disadvantaged fixture and/or appliance, however, should not exceed 500kPa.

Where fixtures and/or appliances require pressure in excess of 500kPa they shall be provided with a risk assessment and risk mitigation measures clearly identified within design documentation.

13.5.2 Differences in cold and hot water pressure at any item of plant or equipment, fixture and outlet should be a maximum of ± 50kPa.

13.5.3 Water distribution in building internals should be of ring main arrangement with isolation valves on either supply end to provide cross flow within the main reticulation line. Dead legs shall be kept to a minimum, less than two litres.

13.5.4 Water meters shall be provided to all main water users such as cooling towers, hot water systems, CSSD, kitchens, laundries and irrigation. An assessment for additional metering to individual rooms, floor levels and/or wards should be completed to provide a facility monitoring system for data collection and analytics.

13.5.5 BMCS linked gauges and/or inline flow meters should be provided to main and spur lines to verify and provide trend logging of cold-water system pressures, flow rates, velocities and end of line terminals should be in accordance with AS/NZS 3500 and should be reportable as part of the Facility operational monitoring system (BMCS).

13.6 Drinking Hot Water Supply Configurations

13.6.1 Healthcare facilities defined by the FOP as required to comply with either clause ”**Disaster or emergency role**” (that is, a facility that is to *withstand natural disasters, or with a strategic post disaster and emergency role*) or clause ”**Continue surgical and/or emergency services during failure**” (that is, a facility that is to *continue to offer invasive surgery or emergency medical services through failure of normal utility services*) shall have:

- 2 x 100% full load hot water generation capacity; or
- 3 x 50% full load hot water generation capacity; or
- another configuration providing equivalent redundancy and in each case:
  - water distribution that will allow the water supply to the majority of the site to be maintained though all credible system maintenance and alteration events
  - fuel source to each hot water plant shall be of two independent supplies

Primary and secondary (back-up) for two independent supplies can be from the same fuel source where required and shall be assessed on a project by project, case by case basis and all risks eliminated or mitigated.

13.6.2 Healthcare facilities defined by the FOP as required to comply with clause ”**Safely close down surgical and emergency critical services during failure**” (that is, a facility that is to *safely close down surgery and emergency stabilisation, or maintain occupancy of the building under a healthcare function on failure of normal utility services*) and those not performing invasive surgery shall have a configuration that will provide at least half normal capacity throughout any credible accident or maintenance event. Distribution systems shall be configured to allow reduced capacity to be distributed to all areas not immediately affected by the accident or maintenance.

13.6.3 Healthcare facilities defined by the FOP as required to comply with clause “**Facilities in remote locations or with other critical functions**” (that is, a facility *with limited access or other critical functions that have no viable alternative to provide substitute treatment in the event of failure of normal utility services*) shall have:

- the same generation capacity and configuration of facilities not located within remote locations or with other critical functions. However, consideration should be made of alternative fuel source methods for remote locations.

13.6.4 BMCS linked temperature gauges and/or inline flow meters should be provided on flow and return line, and temperature control devices (e.g., thermostatic mixing valve) of a hot and warm water circulation system to verify and provide trend logging of hot water system temperatures, pressures, flow rates, velocities, temperatures and end of line terminals shall be in accordance with AS/NZS 3500.4 and should be reportable as part of the Facility operational monitoring system (BMCS).

13.6.5 A centralized system should be provided with a reticulated circulating loop in a “flow and return” loop arrangement. Where fixtures and/or appliances are isolated, they may be provided with localised instantaneous hot water units.

Dead legs downstream of an instantaneous hot water unit should be as short as possible to a maximum of 2 litres.

13.6.6 Where the facility is multi-storey the flow and return loops should be arranged on a floor-by-floor basis maximising central risers and efficient loop layouts. The layouts should not be unduly complex to avoid potential future balancing or operational issues.

13.7 Backflow Prevention for Water Supplies

13.7.1 Backflow prevention of hot and cold-water supplies shall comply with AS/NZS 3500.1.2 *Plumbing and drainage - Water services,* AS 2845.1 *Water supply – Backflow prevention devices - Materials, design and performance requirements* and AS 2845.2 *Water supply – Backflow prevention devices - Air gaps and break tanks*.

13.7.2 The containment backflow prevention device at the incoming water supply(ies) to the site shall have a duty/standby arrangement of the same size and manufacturer to facilitate annual testing and unplanned maintenance, serviceability and future replacement.

13.8 Redundancy of Hydraulic Equipment

13.8.1 The following hydraulic equipment and plant are essential for an operating hospital and shall have an N+1 redundancy configuration (where components N have at least 1 back up component) to maintain continuation of operation in the event of a failure:

- drinking water pressure pump system including filtration and UV sterilisation systems
- hot and warm water circulation pumps
- hot and warm water plant
- RO systems
- sewer or stormwater pump(s)
- systems and/or equipment that provide life safety and protection of the facility

Where septic tanks or secondary wastewater treatment systems are used, redundancy should be provided with manufacturer or supplier approval.

Where any of the above system(s) are used for critical, surgical or ICU wards, emergency departments and/or other areas that otherwise require a constant water supply they should be connected to the Facility critical power supply and should be monitored for remote data gathering and analytics.

Equipment should be regularly cycled through operation for equal balancing.

For facilities that are in remote locations, equipment should consider fail-safe operation modes or suitable redundant backup systems that enable the facility to safely close down any treatment and make alternative plans for ongoing care of patients. This may include simple, temporary backup systems, offline backup equipment, mains bypass or other reliable alternatives to normal operating modes.

13.9 Water Conditioning

13.9.1 Drinking and process water shall be pre-conditioned before use to control any risks associated with the quality of the water available.

13.9.2 Prior to design commencement, the designer shall complete a site main water quality analysis test to ensure the facilities water supply meets the minimum standards set out within the Australian Drinking Water Guidelines.

Where a water quality analysis test is more than 12 months old, a new water quality analysis test should be conducted.

13.9.3 The incoming main water supply to the site for all facilities shall have a permanent online water quality monitoring system in place and connected to the building management system. The water supply to the site shall be in accordance with the Australian Drinking Water Guidelines, enHealth, AS/NZS 5369 and ASTM D1193-06 (where required).monitored

13.9.4 Effective water treatment is complex and depends on several parameters. Therefore, the designer should consider all the critical factors in the design of the water treatment regime. As a minimum, the following additional treatment shall be provided:

- filtering of the whole incoming water supply before entering any water storage tank to remove particulates over 200 micron
- filtering of the whole water supply after any water storage tank to remove particulates over 100 micron
- biocidal treatment and/or chemical treatment to control legionella and other organisms at the outlet of the tank/pump systems and within the water services network system

Consideration shall be given to a cooling system to keep supply water temperature to hospital below 25ºC (noting that many regional areas of WA have temperatures exceeding this value). Where temperatures exceed 25°C this should be assessed on a project by project, case by case basis and all risks eliminated or mitigated.

13.9.5 Filtration and treatment equipment should not be oversized to the detriment of its design intent.

13.9.6 Where biocides are used to control microbial growth in water systems, meticulous control and monitoring programs should be in place. Careful consideration should be given to any equipment that is connected to the water system that may be affected by the application of a biocide.

13.9.7 Drinking water services for general purposes shall comply with AS/NZS 3500, the Australian Drinking Water Guidelines, enHealth, AS/NZS 5369 and ASTM D1193-06 (where required) and should have a permanent online water quality monitoring system in place and connected to the building management system.

Where drinking water services are not able to comply with AS/NZS 3500 and the Australian Drinking Water Guidelines this shall be assessed on a project by project, case by case basis and all risks eliminated or mitigated.

13.10 Purified Water Treatment

13.10.1 Special consideration should be given to the design of the reverse osmosis water systems regarding the water quality requirements, pipe loop design, material and plant selection.

13.10.2 Pipework delivering reverse osmosis shall not use copper products and shall be of hygiene and food grade.

13.10.3 Reverse osmosis treatment of water shall be provided for steam generators, instrument washers and selected outlets in pharmacies and laboratories. The water quality of the reverse osmosis shall meet the following:

- AS/NZS 5369 in regard to water quality for rinsing of instruments
- EN 285 in regard to water quality to produce clean steam for sterilisers
- ASTM D1193-06 in regard to water quality for reagent water
- other treatment will be required by particular processes, e.g. dialysis, and the like and should be defined by the Licence Holder/Applicant's operating policies

13.10.4 The reverse osmosis treatment system shall meet the following:

- reverse osmosis water storage tank shall have a minimum of 2-hours storage capacity with filtration trains, pumps and the like capable of providing 24 hours demand
- reverse osmosis water storage tanks should have HEPA filtered vents
- dead legs should be as short as possible to a maximum of 1 litre
- RO water reticulation shall be in a flow and return loop configuration with a maximum water velocity of 1.5m/s
- filtration trains, pumps and the like should have N+1 configuration
- outlet taps to rinse/laboratory sinks or the like should be of a design that eliminates stagnation
- flushing and sampling points should be provided prior, during and after water treatment and at outlet tap locations
- drainage shall be capable of withstanding chemical discharge and shall be treated in accordance with AS/NZS 3500 and Water Corporation requirements

For facilities that are in remote locations, equipment should consider fail-safe operation modes or suitable redundant backup systems that enable the facility to safely close down any treatment and make alternative plans for ongoing care of patients. This may include simple, temporary backup systems, offline backup equipment, mains bypass or other reliable alternatives to normal operating modes.

13.10.5 Water for dialysis shall be treated by filtering, carbon adsorption and reverse osmosis and shall meet the minimum requirements within AS/NZS 5369 and ISO 23500

13.10.6 Treated water for dialysis shall be circulated with turbulent flow, i.e. there shall be no dead legs and flow velocity should be at least 1 m/s.

13.11 Stored Cold Water Supply

13.11.1 Where water is stored:

- there shall be at least two modules of storage with individual compartments that can be easily replaced without impacting the adjacent module
- tanks shall be fully enclosed with a filtered breather vent
- tanks should be installed on a concrete plinth
- tanks shall have the necessary clearances to ensure adequate space is provided to access, service, maintain and for future replacement
- tanks should be shaded from the sun and insulated against heat gain
- tanks shall be provided with a bypass line
- tanks shall be chemically injected or dosed to mitigate bacteria and legionella growth

13.12 Pipe Sizing Compliance

13.12.1 Due to limitations of the current deemed to satisfy provisions of the Plumbing Code of Australia, the design should consider probable simultaneous demands and pipe sizing. Design should be evidence-based performance solution to obviate excessive pipe sizes. Consideration should be given to the following pipe sizing methods:

- IAPMO Water Demand Calculator
- HCAA Peak Flow Rate Calculation Method
- CIPHE Loading Units Method
- British Standard 806
- British Standard 8558
- ASPE Tables
- German Institute for Standardization – DIN 1988

The design should consider additional guidelines, regulations and/or standards that are not listed above that otherwise may influence suitable design outcome.

13.13 Cold Water Systems Performance

13.13.1 The water supply velocity within pipework should be as per the acoustic engineer's requirements for the project. In the absence of any acoustic requirements, the maximum water supply velocity internally shall be limited to 1.5m/s for all primary and secondary pipework systems and 2.4m/s where located externally below ground.

13.13.2 Where different pipework material is used (e.g. 316L stainless steel) velocities may be increased to facilitate self-cleansing subject to presentation of report demonstrating suitability.

13.13.3 Branch offtake supply pipes (tertiary pipework systems) may have velocities up to 3m/s subject to the manufacturers and acoustic engineer's acceptance.

13.13.4 Dead legs shall be kept to a minimum to mitigate stagnant water to a maximum of 2 litres water volume.

13.13.5 The design should consider the effects of wave-induced pressure oscillations due to fast closing fixtures and tapware and pressurized systems and include water hammer arrestors where this may occur within the system.

13.14 Hot Water Systems Performance

13.14.1 Hot water systems shall deliver peak draw at the temperatures within the following ranges and at pressures matching those of the cold-water system:

- bathrooms and hand washing 45°C maximum
- nursery 38°C maximum
- utensil washing sinks comply with Food and Hygiene regulations
- dishwashers and sinks in hospital kitchens:
  - rinse water shall be at a temperature of not less than 50°C and contain not less than 50 mg/kg of sodium hypochlorite: or
  - rinse water temperature shall not be less than 75°C (note: dishwashers should have in-built heaters/heat pumps to increase supply temperature to rinse temperature of 75°C)

13.14.2 Thermostatic mixing valves (TMVs) shall be used to control heated water supply temperatures.

Only thermostatic mixing valves in accordance with AS 4032, part 1 *Water supply - Valves for the control of heated water supply temperatures, Thermostatic mixing valves - Materials design and performance requirements*, shall be installed.

Tempering valves are not permitted.

13.14.3 Thermostatic mixing valves should be of point of use arrangement and integrated into the tapware to avoid mixed warm water dead legs.

13.14.4 Where thermostatic mixing valves are provided, they should be installed adjacent the fixture, and incorporate a by-pass for thermal flush, installed within a 316 stainless steel recessed wall box to permit serviceability and maintenance.

13.14.5 Hot water branch/spur lines shall be limited to contain a maximum water volume of 2 litres and should have a maximum delivery wait time of 6-10 seconds.

13.14.6 The water velocity for circulation in hot water systems should be in the range of 0.6 to 1.0m/sec.

The maximum velocity of water for all primary and secondary supply pipework shall be limited to 1.2m/sec irrespective of the piping material. Tertiary supply pipework may have velocities up to 3m/sec subject to acceptance by the acoustic engineer and manufacturer.

13.14.7 Where the design incorporates a flow and return layout the change in temperature (ΔT) from the flow to the return ends of the system shall not exceed 5°C.

13.14.8 Manual balancing valves should be considered over automatic balancing valves to manage inherent variation in operation and enhance operational efficiencies within the hot water system.

13.15 Warm Water Systems Performance

13.15.1 Where a warm water system is proposed it shall be designed and installed to achieve compliance, including but not limited to the latest amendment of:

- AS/NZS 3666.1 *Air-handling and water systems of buildings - Microbial control*
- LGIRS prevention and control of legionnaires' disease
- NCC Warm water systems handbook

- enHealth guidelines for legionella control

The system shall be implemented as a performance solution demonstrating compliance with the performance requirements of the NCC, complete with a risk assessment and fully lodged with the Plumbing Licensing Board and have endorsement from the Government of Western Australia Department of Health.

The performance solution at a minimum shall include:

- design solutions to mitigate legionella growth within the system
- design solutions to provide warning alarms and/or monitoring
- prevention of legionella growth, low temperature, low use fixtures and pasteurization
- scalding prevention for *"thermal disinfection"* of the system
- an operational maintenance plan

13.15.2 Warm water systems where utilized shall deliver peak draw at the temperatures within the following ranges and at pressures matching those of the previous section "*Hot Water Systems Performance".*

13.15.3 Warm water system configuration shall comply with:

- chemical treatment/dosing in duty/standby configuration shall be installed in the warm water flow line and a bypass line shall be provided for chemical dosing for thermal disinfection
- warm water valves shall be in duty/standby configuration and shall have provision for thermal disinfection cycles

13.15.4 Warm water branch/spur lines shall be limited to contain a maximum water volume of 2 litres and should have a maximum delivery wait time of 6-10 seconds.

13.15.5 The water velocity for circulation in hot water systems should be in the range of 0.6 to 1.0 m/sec.

The maximum velocity of water for all primary and secondary supply pipework shall be limited to 1.2m/sec irrespective of the piping material. Tertiary supply pipework may have velocities up to 3m/sec subject to acceptance by the acoustic engineer and manufacturer.

13.15.6 Where the design incorporates a flow and return layout the change in temperature (ΔT) from the flow to the return ends of the system shall not exceed 5°C.

13.15.7 Manual balancing valves should be considered over automatic balancing valves to manage inherent variation in operation and enhance operational efficiencies within the hot water system.

13.16 Non-Drinking Water

13.16.1 Non-drinking water pipework and outlets (hot and cold) shall be clearly identifiable in both exposed and concealed positions. Identification shall comply with AS 1345 – *Identification of the contents of pipes, conduits and ducts*, in both colour and letter form.

13.16.2 The design should consider "zone" protection and rationalization of backflow prevention devices with a distributed non-drinking water main as an alternative to several backflow prevention devices to minimise servicing and maintenance requirements.

13.17 Material Selection Criteria for Water Services

13.17.1 The designer shall complete an assessment on the facilities location in relation to environmental impacts (e.g. harsh environments/rural locations with hard water), material compatibility, water quality, chemicals, temperature, fixture and appliance manufacturer requirements and contact with other surfaces to determine the materiality for water services within the facility; however, at a minimum shall be either:

- type A copper
- 316 stainless steel
- PE-Xa
- high-density polyethylene, or
- polyethylene

When using copper as main services reticulation and PE-Xa as in-wall services rough-in, it shall be assessed and approved by the Licence Holder/Applicant.

High-density polyethylene or polyethylene should be PE100, PN16.

Type B copper is not permitted.

13.17.2 Copper for water services reticulation shall be provided with silver soldered joints of the capillary type, comprising silver alloy hard solders having not less than 15% silver content for copper to copper and copper to brass joints, and not less than 35% silver for copper to steel joints

Where alternative methods of connection are required, such as press fittings (B-press), they shall be used for emergency repairs, shutdown's and connection to existing infrastructure.

13.18 Sanitary Plumbing and Drainage

13.18.1 Sewerage and sanitary plumbing systems shall comply with AS/NZS 3500, these Guidelines and:

- either be connected to the town sewerage and drainage scheme, or
- where approved by the Commissioner for Health to a system conforming to the regulations for *Bacteriolytic Treatment of Sewerage*, and the *Disposal of Effluent and Liquid Waste* under the Health Act.

13.18.2 Redundancy shall be provided where septic tanks are used.

13.18.3 Wastewater pipes shall be of a suitable material and designed and installed to suit the type of waste or wastes carried and the temperature and corrosion characteristics of the waste.

13.18.4 Drainage services shall not be installed within the ceiling or exposed within:

- operating theatres
- data/IT rooms of any kind, such as, communications rooms, building distributor rooms, distributed antenna system rooms
- electrical switchrooms, plant rooms and equipment rooms
- emergency operation centre or other strategic operational portion of the facility
- any other sensitive areas
- electrical plant whether in rooms or isolated locations such as switchgear, transformer, generator, UPS, switchboard, battery, inverter, control panel

Where overhead drainage piping in these areas is unavoidable, specific provisions should be made to protect the space below from leakage such as the use of drip trays.

13.18.5 Where drip trays are installed, they should be drained, with leak detection devices connected to the facility building maintenance system to identify that moisture is present and requires maintenance action.

13.18.6 Polluted water discharges shall be connected to sewer and not the stormwater drainage system.

13.18.7 Accessible inspection and cleaning access should be provided at all changes of direction, at every riser on each floor when the facility is multi-storey, on every branch line servicing a WC and junctions in pipe routes.

Access points should be positioned external to the building wherever possible; and where not possible shall be positioned in ducts or within the wet area it serves and be raised to surface level.

Inspection and cleaning access points should not be positioned in ceiling spaces.

13.18.8 Under building and underground drains shall be provided with adequate inspection openings for inspection at 30m intervals and clean out points for efficient and quick maintenance. Manhole/access chambers should be provided every 100m.

13.18.9 Where sanitary drainage is installed to a depth below more than 4m they should be provided with pre-cast concrete access chambers at changes of direction and at 100m intervals.

13.18.10 Plant rooms containing water vessels and water services should be bunded or graded to an outlet and have sufficient drainage to contain an uncontrolled leak within the plant room.

The materiality of the drainage receiving wastewater discharge from the room shall be selected to withstand temperatures exceeding 80°C (e.g. steam boiler blowdown).

13.18.11 Adequate overflow relief gullies shall be provided to minimise back flow into buildings and paths of overflow relief should be indicated on drawings.

13.18.12 Where overflow relief gullies cannot be installed to satisfy the requirements of AS/NZS 3500.2 they shall be installed with a reflux valve.

13.18.13 Floor drains should not be installed in the clean area of a sterile supply unit or treatment area; and in operating and birthing/delivery rooms. Floor drains should be rationalised to an absolute minimum due to their ability to harbour bacteria.

13.18.14 Floor waste gully grates and surrounds, industrial floor waste grates and surrounds and cleanouts and surrounds shall be heavy-duty stainless steel, with an anti-slip finish.

13.18.15 Where floor waste gullies are subject to “trap dry out” due to insufficient wastewater inflow they should be provided with trap priming valves to discharge water supply to the floor waste gully. Consider environmental and ambient temperature conditions and the impact it has on “trap dry out” and maximise sustainable solution when discharging water for the purposes of charging floor waste gullies. Typical mechanical condensate discharge should not be considered a sufficient source of water to charge floor waste gullies.

Grate seals are not permitted.

13.18.16 Baths should have adequate floor drains adjacent to the edge of the bath.

13.18.17 Wastes and drainage cleanouts in vinyl floor areas and with other membranes shall have clamp rings fitted.

13.18.18 Puddle flanges shall be installed to all pipework penetrations of wet areas and rooms containing floor waste gullies. Puddle flanges should have 3mm diameter drain holes.

13.18.19 Grading to floor drains shall be arranged to prevent ponding of water and to suit transit by trolleys and commodes and positioning of shower chairs, i.e. the path or position should be graded so that under normal use the commode or chair wheels/legs all maintain contact with the floor. This shall be arranged in compliance with AS1428.1.

13.18.20 Vents should be interconnected in roof or ceiling spaces to minimise the number of roof penetrations.

13.18.21 All items requiring power supply shall be connected to a vital power source.

13.19 Trade Waste Discharges

13.19.1 Treatment of trade wastes (any waste other than domestic waste) shall comply with the requirements of Statutory Authorities.

13.19.2 Consider and consult with users to determine the nature of all temperature, chemical, radioactive, biological and catering services discharges to determine requirements for trade waste retention and treatment. Chemical dosing shall ensure discharge to authority infrastructure is within the acceptable criteria.

13.19.3 Trade waste traps and pre-treatment shall be:

- suitable for their purpose
- structurally sound
- airtight and watertight as required by Statutory Authorities
- accessible for maintenance and pumping out when required

13.19.4 Where pre-treatment apparatus is required, it should be located externally to the building where possible. Where located within the building envelope of the facility the arrangement shall be risk assessed and all risks eliminated or mitigated.

13.19.5 Pre-treatment apparatus shall be located to facilitate removal of wastewater sludge. Ensure access provision is made for external tankers to undertake tank pump out when required without impacting hospital operations. Where plant is located internally a pump line should be installed to avoid need for running pump out lines through the building.

13.19.6 Consideration should be given to manage impact of pre-treatment apparatus surcharge. Avoid installation within contaminated soil and the water table.

13.19.7 Where mixing of waste effluents may result in fume emission, the mixing shall occur within the vented drainage system and shall not leak into occupied areas.

13.19.8 Selection of industrial floor wastes; bucket traps, floor grating, and the like, shall be approved by Water Corporation and comply with Occupational Health and Safety requirements for non-slip, non-trip and safe cleaning characteristics.

13.19.9 Piping used for industrial waste discharge should be selected to provide reliable service with the materials handled.

13.19.10 Radioactive wastes and drainage shall comply with all statutory requirements including the Radiation Safety Act, Radiological Council and Water Corporation requirements, which may include requirements for dilution, storage and controlled release.

13.19.11 Should decontamination showers be required, the decontamination storage tank shall be designed and sized to match the requirements of the Licence Holder/Applicant’s FRMP. Calculations shall be provided on request.

13.20 Stormwater Drainage

13.20.1 Refer also to chapter "*Engineering Services, Civil*", section "*Drainage*".

13.20.2 Stormwater drainage systems shall comply with AS/NZS 3500 Part 3 and Chapter 2 of the Institute of Engineers Australia publication Australian Rainfall and Runoff and the latest rainfall data available from the Bureau of Meteorology.

13.20.3 Box gutters shall incorporate 100% overflow. Where eaves gutters are used, they should have integral overflow provisions (e.g. overflow slots), however, they shall not replace the overflow requirements nominated in AS/NZS 3500.3.

13.20.4 All flat concrete roofs, balconies, and plantrooms that are exposed shall have overflow provisions within the building edge/façade to permit overflow discharge. The system shall be designed with a freeboard of at least 25mm such that water ponding depth over the outlets and the overflow outlet mitigates rainwater surcharge to the facility.

13.20.5 Consider cross directional fall and water ingress into the building by providing channel drains to mitigate bi-directional slab falls typical to rainwater outlets and raised barrier channel drains for floor levels below site specific finished floor levels to mitigate flooding during severe storm events.

13.20.6 Fire test water flow should be reused with a separate piped system back to the fire tank. Where this is not possible fire test water flow should discharge to stormwater.

Where fire test water is reused, it should recirculate water back to the fire water storage tank with a corrosion inhibitor and biocides to preserve the fire system pipework.

13.20.7 Stormwater from buildings and paved areas shall be disposed of to comply with requirements of the Local Government Authority.

13.20.8 Pollutant traps should be installed prior to connection to the authority drainage system.

13.20.9 Drainage systems should be by gravity and pumping used only where gravity connection is impractical.

13.20.10 Paving areas shall be designed for the run-off intensities nominated in AS/NZS 3500.3.

13.20.11 Rainwater pipes shall incorporate relief grates at connection between pipes and storm water drains with downpipe sump boxes or rainwater relief overflow outlet.

13.20.12 Rainwater pipes shall have cleaning access at their base.

13.20.13 Stormwater and soak well drainage systems shall incorporate relief grates, for air and stormwater relief.

13.20.14 Stormwater drainage grates shall be of types suitable for wheelchair, walking stick and crutches and trolley traffic in all areas where such traffic may occur.

13.20.15 There should be no open drainage channels adjacent to any area where disabled persons traffic may occur.

13.21 Material Selection Criteria for Drainage Services

13.21.1 The design shall carefully consider all impacting and contributing environmental factors which affect materials used in the hydraulic systems. Materials should be selected that are suitable for both the specific environmental characteristics of the locality of the facility and the service being installed.

13.21.2 Issues such as water quality and hardness, piping materials in locations which experience temperatures below 0°C or above 50°C, exposure to sunlight, proximity

to coastal waterways (exposure to saltwater spray) etc. should be considered in the final selection of materials. Materials shall be specifically suitable for:

- temperature, e.g. drains from CSSD sterilisers and washers, steam boilers blow down, humidifiers
- chemical waste, e.g. from laboratories, cleaning chemicals
- the pressure exerted upon them
- RO water in haemodialysis units
- acoustic treatment

13.22 Rainwater Harvesting

13.22.1 Rainwater harvesting is encouraged and where planned for a facility, a thorough reuse assessment should be conducted to minimise the risk of harm to occupants and visitors to the facility. Where incorporated into the design of the facility, this shall form part of the FRMP.

13.22.2 Applications of rainwater which have an increased risk of human contact and therefore increased risk of ingestion or inhaling include:

- high pressure washers
- above ground spray irrigation systems
- manual washdown using handheld water nozzles
- water features
- drinking fountains

13.22.3 Typical recommended treatment of rainwater for the above uses include first flush diverters, suitably sized water filters and UV filtration.

13.22.4 Applications of rainwater which have a lower risk of human contact and therefore lower risk of ingestion or inhaling include the following:

- subsoil irrigation
- toilet flushing and urinal in non-clinical areas.

13.22.5 drip irrigation Typical recommended treatment of rainwater for the above uses include first flush diverters and suitably sized water filters.

13.22.6 All water treatment systems should take into consideration pollutants which may be deposited on the roof and ultimately into the rainwater from the surroundings.

13.23 Sewage and Stormwater Pumping

13.23.1 The facility wastewater and stormwater systems should discharge by gravity. Only when this is not practicable to achieve should pumping of wastewater and stormwater be an option for discharge.

13.23.2 Where pumps and tank reservoirs are required for the disposal of sewerage, effluent or stormwater they shall:

- be installed with duplicate pumps
- be connected to the hospital emergency power supply
- pump sewage from storage vessels with capacity to hold at least any four-hour discharge to the system at the average hourly rate, with calculations provided on drawings to record how this was determined
- have alarm systems to provide early warning of pump failure and storage overflow

- be protected from entry of debris harmful to the operation of the pump (e.g., an additional macerator pump and/or screen)

13.23.3 The Water Supply Code of Australia WSA 02, Sewerage Code of Australia and WSA 04 Sewage Pumping Station Code of Australia shall be complied with when designing precinct or entire building wastewater pump stations.

13.23.4 Where pumps and tanks are installed internally within a facility the designer shall complete a risk assessment to demonstrate mitigation of sewer surcharge discharging within the facility.

13.23.5 Pumps should be provided in duplicate to facilitate complete isolation of one part without disabling the entire system:

- protect the life safety of maintenance staff
- re-lining of tanks when required
- ensure constant operation of wastewater inflow during typical maintenance activities

Consideration should be given to different transfer methods of sewerage, effluent or stormwater to accommodate repairs, transfer pumping, permanent diversion lines, etc., and should consider the requirement for an additional tank, particularly in areas such as basements or lower floor levels where sewer surcharge or primary pump and tank failure could result in damage to hospital and research equipment

13.24 Natural Gas/LP Gas Service Configuration

13.24.1 Where gas is required for space heating, drinking water heating, or cooking, healthcare facilities defined by the FOP as required to comply with clause ”**Disaster or emergency role**” (that is, a facility that is to *withstand natural disasters, or with a strategic post disaster and emergency role*) or with clause ”**Continue surgical and/or emergency services during failure**” (that is, a facility that is to *continue to offer invasive surgery or emergency medical services through failure of normal utility services*)shall have at least either:

- an alternative means of maintaining heating and cooking services during any credible failure of the gas supply; this shall be outlined in the Licence Holder/Applicant’s FRMP and shall be supplied for review, or
- a gas distribution ring main configuration that will allow the gas supply to the majority of the site to be maintained though all credible on-site system maintenance and alteration events

13.24.2 Healthcare facilities defined by the FOP as required to comply with clause ”**Safely close down surgical and emergency critical services during failure**” (that is, a facility that is to *safely close down surgery and emergency stabilisation, or maintain occupancy of the building under a healthcare function on failure of normal utility services*)and those not performing invasive surgery shall have at least:

- a gas ring main distribution configuration that will allow the gas supply to the majority of the site to be maintained through all credible on-site system maintenance and alteration events and
- an alternative means of providing heating and cooking to functions that will continue to operate through the gas supply failure

13.24.3 Healthcare facilities defined by the FOP as required to comply with clause “**Facilities in remote locations or with other critical functions**” (that is, a facility *with limited access or other critical functions that have no viable alternative to provide substitute treatment in the event of failure of normal utility services*) shall have:

- an LPG gas ring main distribution configuration that will allow the gas supply to the majority of the site to be maintained through all credible on-site system maintenance and alteration events and
- an alternative means of providing heating and cooking to functions that will continue to operate through the gas supply failure

13.24.4 Gas distribution systems shall have emergency isolation valves in each building fire zone served by gas. Valves shall have an adjacent warning notice requiring a check that terminal outlets are off before turning emergency valves on after any isolation.

13.24.5 Area isolation valves (e.g. for plant rooms and kitchens) should be located at the exit/entrance to the space, accessible for emergency use and installed at a height that does not require ladder access.

13.24.6 Areas with gas supply shall be provided with an emergency stop at all entry and exit points.

13.25 Gas Service Performance

13.25.1 The gas service shall comply with AS/NZS 5601 *Gas installations* (all parts) and AS/NZS 1596 *The storage and handling of LP gas* and relevant statutory authority requirements.

13.25.2 Gas services shall be designed to operate from delivery point to gas outlet at the complying “prescribed pressure”.

13.25.3 Where over prescribed pressure is required to operate equipment, approval shall be obtained from the Statutory Authority and regulators installed to limit the over prescribed pressure to just the equipment that needs the higher pressure.

13.25.4 Where there is a possibility of natural gas being available at a future date, LPG gas lines should be sized for natural gas.

13.25.5 LP Gas tanks and all gas mains control valves should be located in locked compounds only accessible to authorised persons.

13.25.6 Where gas services are installed within a laboratory, they should be on a timer and with a gas and oxygen sensor. If the appliance requires constant gas supply a risk assessment shall be undertaken complete with ATCO Gas and WA Health endorsement.

13.26 Hydraulic Fixtures, Fittings and Equipment

13.26.1 All plumbing and drainage products and fittings shall be WaterMark certified and stamped as administered by the Australian Building Codes Board.

13.26.2 Where plumbing and drainage products are required for project specific requirements, such as environment, water quality, temperature, etc., they should be assessed on a project by project, case by case basis and all risks eliminated or mitigated. Tap ware shall:

- be suitable for the intended purpose and in accordance with room detail sheet requirements
- be located and arranged to permit their proper use and operation:
  - particular care should be given to the clearances required for elbow action type handles
  - shower taps shall be able to be operated from outside the shower recess without getting wet
- have non-thermal transmitting handles with effective finger grips

- be mounted at heights to suit the particular function e.g. paediatric, disabled, standard
- have thermostatic mixing valves integrated where required by The Guidelines
- have free draining spouts and outlets. Gooseneck outlets should not be installed
- meet specific physical containment requirements
- assessed on user operability to determine the requirement for *"hands free"*
- be installed to mitigate *"splashing"* and so that the water discharge does not drain directly over the waste outlet

Hands free, electronic tapware is strongly recommended as they are more hygienic and assist with hygienic flushing functions that can be activated on a schedule to assist with the facilities "flushing schedule" to remove any water impurities, promote water movement and prevent stagnant water.

13.26.3 Basins shall suit the function and:

- be appropriately sized for clinical hand washing
- have hands free operation in isolation rooms and scrub areas
- provide knee space for seated use by patients in wards
- be the appropriate type (A, B or C) to suit the function and facility

13.26.4 WC pans shall suit the application, and:

- accommodate commode chairs
- be at appropriate heights for the users
- shall be rimless type pans

13.26.5 Accessible service valves should be provided at least on every spur off main distribution hot and cold-water supplies to provide localised isolation of water when servicing tap ware and should be accessible without the need of safety at height equipment where possible.

13.26.6 Noise emitted to occupied spaces from hydraulic services shall not exceed the levels defined as satisfactory in AS/NZS 2107.

13.27 Decontamination Shower and Eyewash Stations

13.27.1 The Licence Holder/Applicant shall develop a specific decontamination plan appropriate to the Facility.

Functional requirement is the removal of contaminant/harmful substances from the contaminated body as soon as possible. The aim is to eliminate or reduce absorption of the substance from patients and reduce the risk of contamination of healthcare workers.

13.27.2 Guidelines for decontamination showers and eyewash stations should include:

- ideal water temperature at skin is 22 to 26ºC
- water flowing through the showers and eyewash should be high volume, low pressure (400kPa-600kPa) to avoid damaging the skin
- water used for decontamination purposes shall be drinking water
- wastewater from the decontamination process should be contained to prevent run off into the sewer system or water table
- wastewater from the decontamination process should be contained within a waste tank and should be accessible by vacuum tanker if the wastewater is unsuitable for discharge to sewer

- single mobile shower system for those patients that require assisted decontamination, e.g. patients on stretchers
- non-permanent structures for mass decontamination may be acceptable if they can be erected rapidly in a disaster (within 15-30 minutes of the event)
- decontamination shower and eyewash design to allow gender segregation and unidirectional patient flow, with ingress and egress pathways away from the main Emergency Department entrance and ambulance access
- strategically located to permit use and operation within 10 seconds when exposed to a hazardous substance avoiding obstructions such as doors, furniture, structure
- provided with audible, visual alarms and linked to the BMCS system when isolated and located remotely

13.27.3 The design should consider a separate distribution pressure main independent of any other water service to ensure shower activation has no impact to pressure loss of the water supply to the facility.

Decontamination showers and eyewash stations should be arranged to operate simultaneously in an extreme event.

Decontamination showers and eyewash stations should have a decontamination plan appropriate to the facility.

13.28 Monitoring and Control

13.28.1 All hydraulics monitoring and control systems should be physically connected to facility building services monitoring and management system. This should be provided though high-level interface using an appropriate open protocol. This includes:

- water treatment and water quality
- pressure pumping sets
- emergency safety showers and eyewash
- pump stations
- reverse osmosis treatment
- domestic cold-water systems
- domestic hot and warm water systems
- hot and warm water circulation pumps and equipment (e.g., storage tanks, heat pumps)
- UV radiation and backwash filtration system
- gas services
- tank levels

13.28.2 Data collection should be used to obtain data including but not limited to:

- consumption
- pressure
- flow rates
- velocity
- temperature
- chemical composition
- tank levels
- pump parameters

13.29 Testing and Commissioning

13.29.1 General: Testing and commissioning of hydraulic services should follow industry approved procedures, including but not limited to:

- Department of Finance Technical Guideline TG036
- CIBSE Commissioning Code W
- BSRIA Commissioning of Water Systems (BG 2/2010)
- BSRIA - Pre-Commission Cleaning of Pipework Systems (BG 29/2012)
- PIPA Technical Guidelines

13.29.2 Methodology: A testing and commissioning methodology statement outlining the testing and commissioning methodology for each hydraulic service shall be provided for review.

13.29.3 Statutory authority tests: Following completion the sanitary plumbing, drainage, and water shall be tested to prove compliance with statutory authority by laws.

13.29.4 Natural gas tests: Following completion the natural gas system shall be tested to prove compliance with AS/NZS 5601 and supply authority code requirements.

13.29.5 LP gas tests: Liquefied petroleum gas services shall be tested to prove compliance with AS/NZS 1596.

13.29.6 Noise tests: Where excessive noise is evident, in accordance with the acoustic requirements, noise level measurements should be undertaken to assist determine an acceptable resolution.

13.29.7 CCTV footage: All drainage should be CCTV camera inspected twice: initially upon installation and then at practical completion of the project.

13.30 Maintenance

13.30.1 Fixed services and maintenance points should be provided in a manner that does not interfere with healthcare procedures, disturb patients, or create unacceptable risk to patients, visitors or staff including maintenance personnel and allows for each component and equipment to be repaired, replaced, removed or otherwise that does not require removal of any structure or “breaking down” of components and equipment and accommodates maintenance personal with tooling without hindrance and at a minimum should consider:

- NatSpec TECHreport TR 07
- UK Ministry of Defence Space requirements for plant access, operation and maintenance
- BSRIA AG 11/92 Design for Maintainability
- CIBSE Guide M – Maintenance Engineering and Management

13.30.2 A plant maintenance and replacement plan shall be provided for review.

13.30.3 Plant and equipment shall have the necessary clearances to ensure adequate space is provided to access, service, maintain and for future replacement.

13.30.4 Serviceable elements such as pipes, isolating valves, operating switches and alarms shall be clearly identified and positioned in a location that is accessible without the need of safety at height equipment where possible.

13.30.5 All valves should be numbered and labelled with robust valve tags which fully coordinate with valve charts, pipework schematics and as-constructed layout drawings. A valve chart and pipework schematic drawing should be installed adjacent to main plant and equipment.

13.30.6 Fixtures shall be easily cleanable.

13.30.7 Water discharge devices such as toilet cisterns and shower roses shall be selected to improve water conservation.

14 ENGINEERING SERVICES, MECHANICAL

14.1 Mechanical Services Brief

14.1.1 The extent of mechanical services shall be defined with a fully detailed description of services to be provided by the Licence Holder/Applicant as part of their submission that supports the safe, secure and reliable clinical and building operational functionality of the health facility served by the mechanical systems. The performance required to deliver such services shall be not less than as required by the NCC, statutory regulations, applicable codes and standards and these Guidelines.

The Licence Holder/Applicant should demonstrate the inherent future flexibility, expandability, and adaptability to suit the changing needs of the building operational requirements and clinical services delivery over the life of the building and also where relevant, to suit defined climate change adaptation requirements.

14.1.2 The purpose of heating, ventilation and air conditioning (HVAC) systems in healthcare projects is to satisfy internal environmental conditions for **infection control**, **comfort**, and **safety** for patients, public and staff alike. HVAC systems shall control the concentration of airborne particulates in high-risk areas to minimise the risk of infection by means of air pressure, flow control and air filtration. The level of control will be proportional with the risk associated with each clinical and functional area.

The clinical briefing shall take into account the specific risks associated with healthcare facilities where the airborne spread of infection between occupants is more likely and the consequences more significant than is the case with other building types. This should be at the forefront of discussions during the user consultation process

The built environment should provide for occupant comfort. In some instances, a controlled environment reduces stress on patients and occupants. Poorly controlled environments (extremes of heat and humidity) can exacerbate the risk of violence, such as in mental health units, waiting rooms, and emergency departments (ED).

Uncontrolled environments (warm and humid, and often poorly ventilated) are more conducive to mould growth, pathogens, insect infestation and increase the risk of infection. Care should be taken especially in locations where extreme instances of heat and humidity are more prevalent.

14.1.3 Design criteria for the services shall also be based on the functional and operational requirements of the Facility and include consideration of the Facility location, external conditions and climate change implications, with applicable differentiation between critical and non-critical clinical, functional and support areas.

14.1.4 Where pressure gradients are specified to assure maintenance of sterile conditions in areas such as sterile stock/storerooms, pharmacies, laboratories, isolation rooms and operating theatres, local pressure gauges, audible alarms and pressure monitoring devices should be installed. Each pressure gradient step should be designed to a minimum of 10 Pa (15Pa preferred), or as specified in this guide for specific room types. Monitoring device alarms shall be installed and allowances made to prevent nuisance alarms. Short term excursions from required pressure relationships will be allowed while doors are moving or temporarily open. Simple visual methods such as smoke trail, ball-in-tube, or flutter-strip should be used when commissioning for verification of airflow direction.

14.1.5 Refer also to guidance in the "*Mechanical Design Parameters"* appendix, which includes content from this section (and the other States' reference sources cited in the acknowledgements) in a quick reference tabular format based on the VHBA

Mechanical Design Parameters document and adjusted/added to where necessary for WA room description types and input values. These are for general design guidance purposes and any deviations shall be signed off by the project sponsor, clinical leads and infection prevention and control team on a project-by-project basis to suit the specific clinical needs of each project and facility.

14.1.6 For private health facility submissions, a response to these design parameters shall be included in the licensing submissions at ATC stage, with appropriate clinical and IP&C endorsement of any planned deviations.

14.1.7 Generally, critical and non-critical external design weather data should be used appropriate to the facility's geographical location, type of facility and functional areas served, and with consideration of both individual and combined dry bulb and wet bulb extremes including shoulder season conditions where this potentially impacts sensible and latent cooling coil capacities.

14.1.8 Climate change resiliency should be determined on a project-by-project basis, depending on clinical acuity, location and type of facility, with reference made to the latest editions of AIRAH DA09 – Air Conditioning Load Estimation and Psychometrics and AIRAH DA20 – Humid Tropical Air Conditioning. For locations not listed in the aforementioned AIRAH guidelines, the designer should undertake an assessment based on review of historical weather data sources such as Bureau of Meteorology for the nearest suitable listed location with similar climatic characteristics. Where climate change adaptation is considered in relation to HVAC design criteria and plant capacity/selection the spare capacity should flow through central plant (e.g. chillers) as well as pump/hydronic circuit capacities and AHU coil capacities.

14.1.9 Noise and Vibration

Noise and Vibration Levels: Mechanical ventilation system noise generation in combination with other building services noise sources shall not exceed the levels defined in subsection *"Acoustic Services Brief"* and the *"Mechanical Design Parameters"* appendix.

14.2 Extent of Services

14.2.1 Mechanical services may include but not be limited to:

- Air conditioning – cooling, heating and humidification control
- Mechanical services direct digital control (DDC) systems
- Cool and freezer rooms
- Building and energy management systems
- Fume and dust extraction systems
- Energy recovery and reclaim systems
- Smoke control systems
- Steam systems
- Ventilation and air movement services
- Laboratory and clean room services (inc. filtration and pressure control)
- Water treatment systems associated with air cooling and heating systems
- Pneumatic tube transport systems

14.3 Coordination with Other Disciplines

14.3.1 Mechanical services associated with all aspects of the facility regardless of which discipline they occur (e.g. electrical services, hydraulics) shall comply with the requirements of this chapter.

14.3.2 All naming, numbering, colour coding and labelling of electrical supply, power distribution, cable installation, power quality management and protection coordination of circuit protective devices shall be as defined within the electrical design.

14.3.3 Refer to chapter "*Background*", section "*Definitions*" with clauses that contain a list of terms relating to electrical power supplies as relevant to healthcare facilities referenced within The Guidelines.

14.4 Standards and Quality

14.4.1 As a minimum ventilation shall comply with:

- The National Construction Code
- AS/NZS 1668.1 *The use of ventilation and air conditioning in buildings, (Fire and smoke control in buildings)*, AS/NZS 1668.2 *The use of ventilation and air conditioning in buildings and (Mechanical ventilation in buildings)*
- AS1670.1 *Fire detection, warning, control and intercom systems (systems design, installation and commissioning fire)*
- AS/NZS 3666 *Air and Water Handling Systems of buildings*
- AS 16890 *Air filters for general ventilation*

and, as appropriate, shall comply with:

- AusHFG: Pandemic Preparedness – Health Infrastructure Planning & Design Guidance September 2023
- Aus HFG: Isolation Rooms – Engineering and Design Requirements, Feb 2017
- HB 260 – *Hospital acquired infections – Engineering down the risk**

  (*although formally withdrawn by Standards Australia, this Handbook is still cited in AS 1668.2 and is considered a useful historical design guidance reference document in relation to infection prevention and control. Also comply with the Aus HFG Pandemic Preparedness and Isolation Rooms design guidance referenced above.)
- Sterile stock /store area – AS/NZS 5369 *Reprocessing of reusable medical devices and other devices in health and non-health related facilities*
- Pharmaceutical – Code of Good Manufacturing Practice – Australian Government Therapeutic Goods Administration
- Food – Australia New Zealand Food Standards Code, Local Authority and Cook Chill Guidelines
- Laboratories – AS/NZS 2243 (All parts) *Safety in laboratories*
- Cleanrooms – ISO 14644 series *Cleanrooms and associated controlled environments*, where applicable
- Laboratory Equipment, Workstations, Cytotoxic and Biological Safety Cabinets – AS 2252 *Controlled environments* (all parts)
- Laboratory and dispensing areas in pharmacies - AS 2982.1 *Laboratory Design and Construction*
- National Environment Protection (Assessment of Site Contamination) Measure (1999, amended 2013)
- AS 1807 *Separative devices – Biological and cytotoxic drug safety cabinets, clean workstations and pharmaceutical isolators – Methods of test*

14.5 HVAC Fire/Smoke Control

14.5.1 Mechanical Services shall be configured and controlled to minimise fire hazard and smoke spread with particular consideration given to the location of the facility, the mobility of patients, staff to patient ratios (for managed emergency egress) and any fire engineered solutions that may be adopted for the facility. Systems shall comply with the following standards as appropriate:

- AS/NZS 1668.1, AS/NZS 1682.1, AS/NZS 1682.2 and AS 1670.1
- National Construction Code – Building Code of Australia
- Chapter "*Engineering Services, Fire*"

14.5.2 Additional guidance in relation to air handling system design and fire/smoke hazard risk mitigation includes:

- HVAC Smoke control systems have to be designed and controlled to support the managed, and potentially phased emergency evacuation of patients from the facility, and to control the spread of smoke and fire within the building.
- Provide air flow and/or pressure, in the event of fire, to prevent smoke entering escape routes and non-fire affected fire zones where required by the national construction code and the project FER.
- Whole of building fire strategies, egress provisions, compartmentation, active and passive fire safety measures have to be taken into consideration where health facilities are located in multi-use, mixed classification buildings, especially where health facilities are located on upper floors. The pre-existing fire safety measures provided for a non-healthcare building are likely to be inappropriate for a healthcare setting and special additional provisions may be necessary in unlicenced facilities or areas of buildings in support of the location of health facilities in a particular building setting.
- Combustion equipment shall not be in a fire compartment that houses air-conditioning and supply air ventilation equipment.
- Where zone pressurisation is adopted, the matching of air handling systems with functional floors and departments and fire compartments is preferred in order to simplify the required fire matrix cause and effect system integration of HVAC Smoke control systems, to reduce the extent of fire rated ductwork and complex automated fire/smoke damper controls, and to potentially use return air ductwork as part of the smoke hazard management system through a fire engineered solution.

14.5.3 Air supply and exhaust ventilation systems that are required for fire smoke control shall:

- be supplied with electricity from the vital (30sec) [Essential] or designated life safety emergency supply
- be fitted with alarms that detect failure of air flow
- be suitable for the required fire/smoke/heat rating defined by the fire safety engineer and/or AS/NZS 1668.1, and have circuit protection to suit the duty
- be controlled and monitored in accordance with the requirements of AS/NZS 1668.1, AS 1670.1 and the local fire authority

14.6 Redundancy and Disaster Planning

14.6.1 Plant and equipment shall have at least the availability defined by the Licence Holder/Applicant's Facility Risk Management Plan (FRMP) and Business Continuity Plan (BCP).

14.6.2 Plant, equipment and controls shall have reliability and redundancy provisions to ensure continuity and safety of the health service delivery appropriate to the level of clinical acuity of the patients treated within the health facility, and to the facility's role within the WA Government state-wide emergency response and disaster preparedness requirements.

14.6.3 Healthcare facilities defined by the FOP as required to comply with clause "**Disaster or emergency role**" (*withstand natural disasters, or with a strategic post disaster and emergency role*) or with clause "**Continue surgical and/or emergency services during failure**" (*continue to offer invasive surgery or emergency medical services through failure of normal utility services*), and functional areas that are required to continue to operate during normal electrical supply failures, shall be independently ventilated, and have all cooling and heating plant needed to serve the following, shall be on vital (30sec) [Essential] power supplies:

- operating suite and associated set-up area
- areas required for contamination control or patient protection (e.g. isolation rooms)
- emergency department
- each intensive care unit, high dependency unit, critical or coronary care
- midwifery and maternity services
- critical support areas such as the Central Sterile Services Department, pharmacy and emergency imaging and diagnostic services
- any other areas as required by the clinical services lead for the project

14.6.4 For healthcare facilities defined by the FOP as required to comply with clause **"Safely close down surgical or emergency critical services during failure"** *(will safely close down surgery and emergency stabilisation on failure of normal utility services)* or "**Facilities in remote locations or with other critical functions**" *(that is, a facility with other critical functions that have no viable alternative to provide substitute treatment in the event of failure of normal utility services)*, the Licence Holder/Applicant shall assess the need for maintaining cooling, heating and ventilation (and associated pumping/control systems) during the shutdown of the clinical services, and where required shall provide means of maintaining the HVAC systems in order to mitigate the medical risks.

14.6.5 Air supply ventilation systems that are required to provide for odour, sepsis, and contamination control and general ventilation systems that may be interdependent with the same shall:

- be supplied with electricity from the normal and vital supply, where the facility is required to have a vital (30sec) [Essential] supply
- be fitted with alarms that detect failure of air flow
- be designed and built to provide highly reliable performance
- where necessary to maintain positive air flow from clean to dirty areas or a clinically necessary pressure regime, be provided with duplex fans or fan motors and automatic change over from duty to standby in the event of a failure of the fan or motor. Applicable areas and systems should be defined in consultation with the IP&C team
- where single motor fan systems are used for less clinically sensitive areas, they should be fitted with differential pressure switches, to provide remote alarm indication of fan failure. This does not have to apply to independent toilet exhaust systems serving single use toilet/shower or bath areas

14.6.6 Air exhaust ventilation systems that are required to provide for odour, sepsis or contamination control, including Class N and Class Q Isolation Rooms, shall:

- be supplied with electricity from the normal and vital (30sec) [Essential] supply where the facility is required to have a vital supply
- be fitted with alarms that detect failure of air flow
- be provided in duty and standby configuration or with dual drives, dual impellers and automatic change over in the event of lead fan/fan drive failure
- be capable of providing continued operation whilst the failed drive/impeller is being repaired

14.7 Ventilation Service, General Principles

14.7.1 The ventilation systems shall:

- Provide breathing air free from contamination harmful to building occupants or from the local environment or processes undertaken in and around the building
- Capture, as close as practicable to source, any air contaminated by persons or processes within the buildings and discharge in a manner compliant with the building code, and where necessary, having first removed or neutralised any contamination hazardous to the environment.
- Be designed to control the higher level of odours often generated within healthcare facilities and ensure a high standard of indoor air quality.
- Prevent or control risks associated with legionella and other potential hazardous organisms.
- Provide special air environments for:
  - isolation of infectious disease
  - protection of immune-deficient patients
  - surgery
  - handling, storage and processing of sterile instruments and goods
  - safe handling and storage of hazardous materials
  - body holding, viewing, and mortuary areas
  - processes that; generate excessive heat output that may impact room conditions, generate dust or produce biological waste which may present increased exposure risk to occupants
- Provide overall positive air pressure within the building to limit outside air infiltration
- Provide an internal airflow gradient from clean to dirty areas and processes, where necessary
- Provide room by room bulk airflow direction via relative pressures and in-room directional airflow patterns that minimise cross infection and provide a balance of patient protection (where acutely ill or immune-suppressed) and staff/visitor protection (from potentially infectious patients) – refer to airflow design guidance in the "*Mechanical Design Parameters*" appendix for further details of design intent in each space. The entire air pressure and distribution regime shall be endorsed by the project clinical lead and IP&C team as part of private health facilities submissions to LARU. This is also advisable for public health project designs.

14.7.2 Supply and outside air shall:

- Be provided in designed quantities to every room. Reliance on natural ventilation via openable doors and windows for NCC compliance shall be avoided. Regardless of whether the area has operable windows, forced fresh air shall be provided in line with these guidelines to all occupied spaces. When complying with AS 1668.2, air may be drawn from another room by an exhaust system

providing the room does not require specific temperature control and is generally unoccupied.

- Be provided in quantities:
  - to comply with the National Construction Code, AS 1668.2 and these Guidelines
  - providing pressure and flow sufficient to prevent air infiltration into controlled environments and prevent any contamination build up in the supplied room
  - to provide approximately uniform ventilation and temperature within the space, with a design target of 30-70% RH unless noted otherwise for specific functional areas within the *"Mechanical Design Parameters"* appendix (specific discussion and agreement on the provision of humidification for lower range RH% control in winter will be required)
  - without causing drafts detrimental to occupant comfort
  - without causing dispersing turbulence to air streams capturing and conveying contamination
- Consideration can be given to effective outdoor air calculations as outlined within AS1668.2. This should only be developed in consultation with the IP&C team and is not recommended to be applied to clinical areas where air quality and turnover rate are key drivers. Any specific requirements introduced through design to comply with the effective outdoor air calculations needs to be maintained throughout the life of the project.
- Outside air may be used for cooling when ambient temperatures are suitable. Operation on outside air/economy control should not jeopardise odour and sepsis control.
- As far as practical be located so as to create a general flow of clean air to protect staff and visitors from air borne contaminants from infectious patients. In-room airflow direction should be discussed with the IP&C team and where possible, in general, with the exception of immuno-suppressed patient areas, design for supply airflow towards the patient bedhead and the en-suite in order to create a relatively safer "upstream" airflow zone near the bedroom doorway to all nursing/care staff to enter.
- Have an outside air component to at least comply with AS 1668.2. Where AS 1668.2 Table A.1 does not specifically list air volumes under 'Healthcare' for the space being designed, an equivalent class of occupancy from other areas of the Table should be used. Refer also to Section 5 of AS 1668.2 covering mechanical ventilation of particular healthcare functions. A minimum level of 2 air changes per hour of outside air shall also be achieved for all clinical spaces – for further guidance refer to the3 "*Mechanical Design Parameters*" appendix.
- Have supply air volumes maintained above minimum levels throughout any variations in ventilation system flow resistance due to damper movements, filter loading (through the clean to dirty filter cycle) or similar system variables. Suitable fixed relief paths should be provided to ensure airflow rates are maintained irrespective of the room door being open or closed.
- Where ventilation systems are shut down or operate at reduced flow during periods when the area they serve is unoccupied:
  - the change of operating mode shall not compromise the performance requirements of ventilation in adjacent areas
  - the shut down and restarting shall comply with AS/NZS 1668.2 requirements
- Not include any unfiltered induced air in any area where airborne infections or contaminants may be present.

- Where variable volume supply air systems are used; incorporate controls to ensure minimum outdoor air supply and minimum air change rates are maintained to all areas as volume is varied from Vmax to Vmin.
- Where no other specific temperature control deadband provisions are nominated, the NCC/BCA nominated provisions shall be applied.
- The air velocity and temperatures within occupied zones should be provided to maintain suitable comfort limits. The mean air velocity should be less than 0.25 m/s within the occupied zone. Where individual user room temperature control is not provided, the temperature difference between rooms on the same zone should generally vary by not more than 2°C.

14.7.3 Exhaust air shall:

- be removed in quantities in accordance with AS1668.2 and also to Appendix "*Mechanical Design Parameters*" which provides additional room-by-room mechanical design parameter guidance.
- be discharged to comply with AS 1668.2. All exhaust systems to be fully ducted and discharge to external and not into common roof space or ceiling space
- if necessary be decontaminated before discharge to meet national guidelines, e.g.:
  - Safe Work Australia Guidance on the interpretation of Workplace Exposure Standards for Airborne Contaminants and Safe Work Australia Adopted National Exposure Standards for Atmospheric Contaminants in the Occupational Environment (NOHSC 1003)
  - Interim National Indoor Air Quality Goals recommended by the National Health and Medical Research Council (NHMRC)

14.7.4 Exhaust systems shall:

- draw contaminated air away from and not across any breathing zone or protected process
- not serve clean and dirty process rooms from a common system
- draw heavier than clean air contamination from below staff breathing zone, e.g. nitrous oxide. Where staff breathing zones are not defined, exhaust points should be not more than 300mm above floor level
- not have multiple intake sources if there is a risk of any backflow through the system
- have adequate fixed relief paths to maintain required ventilation rates at all times. relief paths to be acoustically treated where privacy is required and not diminish the acoustic rating of the room's construction
- consider site specific wind directions and topography that may require greater separation from supply intakes than those specified within the AS 1668.1 and AS 1668.2 regulatory separation to avoid odours and objectional effluent exhaust being re-entrained back into areas of the facility via openings or ducted supply air means
- exhaust system performance - where provided with energy recovery coils in the exhaust airstream, should have protective filters installed upstream of the coil, filter pressure drop monitoring via the BMCS, and variable duty fans to cater for the filter loading and to prevent any airflow or pressure imbalance over the filter clean to dirty cycle. Cross-contamination of exhaust and supply airstreams should be avoided where required from an infection control perspective.

14.7.5 100% outside air systems;

- Except where required in the "*Mechanical Design Parameters*" appendix, 100% outside air systems should only be considered only after a comprehensive and

informative energy study has been undertaken, considering how to meet clinical and functional requirements, while also considering initial capital cost and ongoing recurrent cost implications (both energy costs implications and ongoing maintenance requirements). Selection of 100% outside air systems should be based on value judgements of the additional costs and the benefits gained. Systems providing 100% outside air shall be provided with energy recovery in line with BCA/NCC requirements as a minimum.

14.8 Ventilation System Selection and Component Performance

14.8.1 Plant and Equipment – General

Plant and equipment in general shall:

- maintain reliable performance in the climatic and environmental conditions (e.g. temperature, humidity, salt, dust and chemicals) in which installed
- provide stable and reliable operation and appropriate levels of redundancy
- operate below maximum limits for capacity, speed, temperature and pressure
- be provided with safety devices for the protection of the equipment, operators and users
- be provided with controls to automatically maintain correct operation in each of the required modes of operation, including fire mode, and efficient operation in non-peak, low load conditions
- deliver at least the performance and operational efficiency required by these Guidelines and NCC/BCA requirements
- have safe and clear access for maintenance, component replacement and end of life replacement
- have capacity and modules and parts availability to achieve the availability required by the Licence Holder/Applicant, and to suit the Statewide operational criticality of the facility where relevant
- be located to avoid service access through ceiling/walls within sterile zones and clinical areas in general

14.8.2 Air Handling Units

Every effort should be made to ensure that all Air handling units, and fan systems where relevant, achieve the following minimum requirements.

- Air handling units (AHUs) and fans should be secured from unauthorised access.
- AHUs and fans located on roofs should have a safe and permanent means of access. Suitable precautions should be in place to prevent personnel or equipment from falling during maintenance activities.
- AHUs and fans located outside at ground level should be secured within a compound to prevent unauthorised access. Vehicles should be excluded from the vicinity to ensure that exhaust fumes will not be drawn into intakes.
- All parts of the AHU, fans, controls, and maintainable elements of all HVAC ductwork, pipework and equipment should be easily and safely accessible for routine inspection, maintenance and replacement.
- Plantrooms that house AHUs and fans should not be used for general storage. Care should be taken to ensure that combustible material is not kept in the plantroom, and gas fired equipment is suitably separated in line with NCC and Australian Standard requirements.

- The air handling plant should not contain any material or substance that could support the growth of microorganisms, or that could cause or support combustion.
- Access to items that require routine service, such as filters, heating and cooling coils, should be via hinged doors where possible. Only use screw off panels (even if quick turn handles are used) when retrofitting and access space allowances do not permit the use of hinged doors.
- Items requiring infrequent access such as attenuators may be via clipped or bolted-on lift-off panels.
- All doors and panels should be close-fitting, with good quality seals and without air leaks.
- Other services should not restrict or impede access to those parts of the AHU or fan that require inspection.
- Air handling units over 3000L/s. Viewing ports and internal illumination should be fitted into all sections of the AHU in order to inspect filters coils, fans and drainage trays.
- Internal illumination of AHUs should be provided by fittings to at least IP55 rating. Fittings should be positioned so that they provide both illumination for inspection and task lighting. A single switch should operate all the lights in a unit.

14.8.3 Variable Air Volume Systems

Where HVAC systems are variable volume type in order to achieve adequate temperature control, the minimum air volumes required by these Guidelines shall not be compromised. Control devices should be incorporated and set up to ensure minimum outside air introduction, minimum air change rates and exhaust rates, relative pressures and airflow direction to all areas are maintained at all times, including when the VAV system is turned down to Vmin. VAV air diffusers should only be used in very isolated cases to overcome unique zoning situations.

Humidity control across a variable volume air handling system can be influenced by turn-down based solely on temperature monitoring only. Where VAV systems are implemented, humidity monitoring shall be provided and integrated within the control loop to ensure both temperature and relative humidity design conditions are maintained. Active humidity control (i.e. humidification) is not normally required in non-critical spaces to achieve design condition compliance.

Where climatic conditions permit, low-temperature VAV systems may provide energy efficiency benefits through lower energy usage and lower initial capital cost. Implementation of low-temperature VAVs shall include consideration of humidity control and the increased condensation risk where surface temperatures of air diffusion devices are approaching or below dew point. The risk associated with ambient air contacting surfaces in lobby and spaces with direct external access should be reviewed.

14.8.4 Chilled Beam Systems

Chilled beam systems incorporating active or passive chilled beams within the ceiling space can be a viable solution for general, non-clinical and low acuity applications. They have the potential for reduced ceiling space requirements, limitation of recirculation of air between adjacent spaces, high induction rates, long-term life expectancy and good thermal zonal control.

Implementation of chilled beams requires a very well-sealed façade and resultant building pressurisation to prevent ingress of ambient air and any adverse impact on room relative humidity control. Particular care is required when considering chilled beams in warmer and humid environments, such as in, but not limited to, parts of

northern WA, as any ambient air ingress will likely form condensation and lead to potential moisture and/or mould issues.

Chilled beam systems often result in higher initial capital investment. This may be offset though by potential to reduce floor-to-floor heights slightly, reduced primary air handling and ductwork system sizing, and overall operating energy efficiency. Where considered at the Concept Design or AIP stage, a whole-of-life cost analysis and associated design discussion should be provided in the design report(s).

14.8.5 Evaporative Cooling Systems

Evaporative cooling may be used for support areas where relief cooling only is required such as kitchens (without cold rooms, or other cold surfaces) and workshops and some other non-critical, unoccupied areas, where suitable. Where evaporative cooling is used, the systems shall:

- be readily and safely accessible for cleaning
- to minimise legionella risk, have sumps automatically drained when idle
- be sanitised for bacterial control in accordance with AS/NZS 3666
- have provision to prevent backflow heat leakage through convection during the heating season

Waste handling rooms should not be evaporatively cooled.

Evaporative cooling shall not be used in clinical areas or where condensation on room or equipment surfaces is a risk. This should be specifically considered for areas such as food preparation where cool rooms and freezers with cold surfaces are located adjacent.

Verify the suitability of the available site water quality for use with evaporative cooling systems.

Evaporative coolers shall not be used where there are any limitations restricting their use due to Bushfire Attack Levels as per AS 3959.2.

14.8.6 Ductwork and Insulation:

Ductwork and insulation shall:

- Comply with the requirements of the National Construction Code, AS/NZS 1668.1 and AS 4254 *Ductwork for air-handling systems in buildings*
- In all clinical areas, when thermally insulated, ductwork shall be externally insulated. IP&C team shall be required to endorse any deviation from this requirement, where proposed by the Licence Holder/Applicant. Notwithstanding any clinical team endorsement, any internal insulation proposed within clinical areas shall be sealed and lined to facilitate infection prevention and control and ease of cleaning and the avoidance of mould and bacteria growth. Exposed insulation, loose or leachable materials, and perforated foil faced internal insulation will not be deemed acceptable.
- The use of flexible ductwork should be minimised, particularly on systems requiring cleaning for infection prevention and control. Where terminal HEPA filters are used, no flexible ductwork connections are permitted. Where discharge scrubbers or filters are used on exhaust systems from potentially contaminated areas, no flexible ductwork connections are permitted, e.g. isolation room exhausts. When flexible ductwork is used, conform to clause 2.8 of AS 4254. The total length of flexible ductwork between primary metal ducts and diffusers/grilles shall not exceed 3000mm, including multiple shorter lengths either side of solid ductwork sections.

- Where ductwork requires acoustic treatment the extent of treatment shall be kept to the minimum necessary to meet acoustic performance and shall comply with the below.
- Noise Attenuation: Duct acoustic treatment and equipment such as sound attenuators, fan coil and air handling units, VAV boxes and the like incorporating fibreglass and mineral wool products shall not have fibres exposed to the airstream. Perforated facings shall have impervious linings and access panels shall be provided to allow access for cleaning the facings.

14.8.7 Exhaust, Relief and Return Air Grilles: Egg-crate grilles shall not be used. Exhaust and return air grilles shall have washable removable cores and be of a design to minimise collection of lint.

14.8.8 Supply air diffusers and grilles shall have removable cores or have faces that can be easily cleaned using a swab or similar cleaning implement. All components such as temperature sensors and wall grilles within an occupied space should be suitable for swab down cleaning.

14.8.9 Filters

Filtration Efficiency: The first filter listed in the matrix of specific requirements is the prefilter if two filters are listed, second is the main filter and the HEPA if listed, is the final filter, with a preference for these not to be AHU mounted but to be in-room terminal HEPA filters. Filtration efficiencies shall comply with ISO/AS 16890 (issued in Nov 2024, transitioning from the previous AS1324 *Air filters for use in general ventilation and air conditioning)*.

It is recognised that ISO/AS 16890 will supersede all elements of AS 1324 over time and is the harmonised international standard for HVAC filtration systems. In the interim period, both classifications of defined filter efficiency may be in use. There is no direct equivalent between the old and new filter classifications, however this table, sourced from AIRAH Design Application Manual DA15 – Air filters and Cleaning Devices shows the approximate equivalent ratings.

AS 1324* Rating	ISO 16890 Rating (approximation)
G1	ISO Coarse> 50%
G2	ISO Coarse> 65%
G3	ISO Coarse> 80%
G4	ISO Coarse> 90%
F5	ISO ePM_{10} > 50%
F6	ISO ePM_{10} > 50% ISO ePM_{10} > 60% ISO $ePM_{2.5}$ > 50% to 65%
F7	ISO ePM_{10} > 85% ISO $ePM_{2.5}$ > 65% to 80% ISO ePM_1 > 50% to 65%
F8	ISO ePM_{10} > 90% ISO $ePM_{2.5}$ > 80% ISO ePM_1 > 65% to 80%
F9	ISO ePM_{10} > 95% ISO $ePM_{2.5}$ > 95% ISO ePM_1 > 80%

Manometers or Differential pressure monitoring devices shall be installed across filter banks with efficiencies greater than grade F6, with a preference for each filter type to have individual pressure monitoring devices.

Air filters may present a health hazard to maintenance personnel either due to the nature of the HVAC system, through collection of bio-aerosols or from microorganisms collecting and multiplying in the presence of nutrients and moisture.

Suitable health and safety practices shall be incorporated into HVAC systems for the high-risk area such as patient isolating rooms to eliminate (or mitigate as far as reasonably practicable) the risks and hazards associated with filters and filter maintenance. Designers are encouraged to consider alternative air treatment technologies. Where specific air treatment types are noted in the guidelines this should not be taken as an endorsement of any specific product or treatment type's exclusive use.

For details of minimum filter specification on a functional area basis, refer to the "*Mechanical Design Parameters"* appendix.

14.8.10 HEPA Filters

HEPA filters should preferably be installed at the air outlet terminal diffuser and comply with AS4260 High efficiency particulate air (HEPA) filters - Classification, construction and performance Type 1 class A Grade 2 with minimum efficiency of 99.99%. Visual indication will not be required on terminal HEPA filtration, however full testing facilities will be required, and reference terminal filters chosen with static pressure sensing for fan airflow control. For central or ducted systems, HEPA filters:

- shall be accessible for cleaning and/or replacement
- shall be installed with provision for safe handling and replacement of contaminated filters
- shall have facilities for replacements to be made without contaminating the clean side of the filter or the system downstream from the filter
- where located in a terminal position should be mounted with minimum separation from the outlet diffuser where possible.
- shall incorporate a pitot tube to allow for testing of the upstream concentration of DOP during testing without risk of damage to the HEPA filter.
- where HEPA filters are not in a terminal position, all ductwork (inclusive of fittings and the like.) downstream shall be of cleanable, seamless 316 grade stainless steel or coated with chemical resistant anti-microbial finish
- shall have filter resistance gauges or electronic sensors and BMCS linked pressure monitoring devices installed to indicate when the filter needs replacement, either due to a full dust load or filter resistance causing flow to fall below required minimum values
- where HEPA filters are installed all fan systems shall be variable duty to react to filter loading during the filter clean to dirty cycle and shall automatically adjust airflow in order to maintain designed airflow and pressure regimes and room sterility.

14.8.11 Modular HEPA Filter Canopies

Consideration to be given to the use of bespoke, modular HEPA filter units housed in prefabricated stainless steel ultra clean canopies as part of an integrated and proprietary system. Where utilised, airflow and acoustic performance at both diffuser face and at the operating table height shall be certified via airflow laboratory and/or CFD tested and airflow patterns verified on site. Variants on these HEPA/ULPA modules may offer integrated lighting, pendant support stems, recirculating fan assemblies (for increased in-room air change) and clear, transparent downstand hoods to assist with downward airflow distribution. Where these are used, consideration for pendant, operating light and workflow panel movement is necessary as part of a co-ordinated design solution that minimises impact on downflow air movement. Dimensions of HEPA filter units shall be determined in conjunction with the clinical team and be aligned with defined sterile zones within the operating worskspace as per the AusHFG room data sheets for the theatre type

and worst case surgical procedures to be carried out. In any case, the HEPA filter modules shall have a minimum filer face area of 1.8 m x 1.8 m.

14.8.12 Air Intakes

Air intakes shall be inaccessible to unauthorised access. Where accessible plenums (or plenum plantrooms) are used for passage of outside air they should have impervious, sealed internal surfaces and shall not be used for storage of any equipment or materials. Appropriate signage must be provided at entry points to outside air plenums to prevent their use as stores. Outside air intake louvres shall be accessible for routine inspection, cleaning and maintenance in compliance with AS 1851 requirements. Louvres and air intake plenums shall be designed to avoid excessive rain ingress, the proper drainage of any such ingress and to inhibit any pooling of water that can lead to corrosion or mould growth within the plenum or AHU intake sections.

Air intakes shall be located to eliminate the potential for accidental or deliberate contamination of outdoor air from sources of pollutants in accordance with AS 1668.2 and AS 3666.1.

14.8.13 Exhaust Hoods

Exhaust Hoods should be provided to capture any significant quantities of equipment or waste process heat or vapour near source before it is detrimental to the general environment. Any large exhaust ventilation hoods, e.g., kitchen hoods, should have a separate tempered and filtered air supply to minimise the hood exhausting air-conditioned air. Particular attention should be given to the heat rejected by grouped refrigerators or laboratory equipment. When required, appropriate hoods and exhaust devices, for the removal of noxious gases, or chemical vapours or fumes, or airborne contaminants should be provided in accordance with AS1668.2.

14.8.14 Ultra Violet Germicidal Irradiation (UVGI)

UVGI filters for cooling coil and filter bank protection (perpendicular banks) and additional airflow cleaning (parallel banks in low air velocity sections of the AHU and/or ducting to maximise contact time) and assess their application based on extent of recirculated air, occupant cohort, safety benefits to maintenance staff, local supply chain, life cycle economics and clinical risk benefits as these products become more commercially viable. Designers should also consider space provision for such devices, and/or similar alternative technologies in the future in high-risk clinical areas such as ED Waiting/Treatment, ILI streams, ICU, Negative Pressure Isolation Rooms and Temporary Isolation/Cohort Wards, where standard IPU Wards may be converted to house airborne infectious patients as part of an emergency planning regime.

Use of other UV based cleaning and sterilisation systems, such as enclosed UV sterilisation chambers within floor, wall or ceiling mounted modules or integrated within luminaires, or robotic surface cleaning UV technologies, should be considered on their own merits, as a potential additional air quality improvement measure, and not as an alternative to complying with the defined Mechanical Design Parameters herein, within the NCC/BCA and AS 1668.2 provisions, or any other such referenced design guide.

14.8.15 Gas Heaters

The use of gas heaters should only be used where suitable air based heating systems are not practical. If used they shall be visible, readily accessible and easily maintainable; or, where not installed in such locations they shall be enclosed in a structure that shall not hinder maintenance and inspection, but which shall provide a

minimum fire resistance level of 60/60/60. The enclosure shall be monitored by smoke alarm as defined in the National Construction Code

14.9 Ventilation of designated areas

In addition to overall compliance with the Guidelines, ventilation of designated areas shall comply with the specific elements noted below and also the "*Mechanical Design Parameters*" appendix, for additional room-by-room mechanical design parameter guidance.

14.9.1 AHU Zoning - General

Separate clinical departments should generally have separate air handling plant. The same department on separate floors should have separate air handling plant where possible. A pragmatic assessment should take place depending on relative departmental sizes, functional areas and fire compartmentation. Zoning of all air-conditioning systems should acknowledge different dynamic loads and conditions likely to occur due to building fabric, orientation, hours of operation, functional and clinical needs, infection prevention and control, and internal environmental control requirements (e.g. individual room control or zonal control).

The air handling systems serving separate floors and departments should be able to be isolated without interrupting other areas. Each air handling system should serve either a floor or a department on a floor and match as closely as possible both the functional areas and fire compartments. Variable control of air flow either by variable speed motor controls or step controls on smaller units may be used where deemed beneficial, unless constant volume systems are necessary to serve areas to ensure that pressure regimes and minimum air change and outside air rates are maintained. Constant volume systems should also have variable speed drives to cater for filter loading. The interaction of varying pressure regimes between areas should be assessed. Air cannot be recirculated to other areas, as a minimum, from the following spaces: Emergency department triage, ICU, recovery, operating rooms, delivery rooms, autopsy and isolation rooms.

Separate localised air conditioning plant should be provided for rooms with unusually high heat gains, year-round cooling requirements or intermittent operation, i.e. meeting rooms, data rooms, control rooms and the like.

14.9.2 Isolation Rooms

The following guidelines shall be used in the design and operation of Isolation Rooms:

- AusHFG: Pandemic Preparedness – Health Infrastructure Planning & Design Guidance September 2023
- Aus HFG: Isolation Rooms – Engineering and Design Requirements, Feb 2017
- AusHFG: Part D Infection Prevention and Control, Section 02.06 Isolation Rooms
- HB 260 – Hospital acquired infections – Engineering down the risk*

  (*although formally withdrawn by Standards Australia, this Handbook is still cited in AS 1668.2 and is considered a useful historical design guidance reference document in relation to infection prevention and control. Also comply with the Aus HFG Pandemic Preparedness and Isolation Rooms design guidance referenced above.)

Class S, N, P and Q isolation rooms are covered in the AusHFG design guidance noted above. Class P+N is a hybrid type, with a positive pressure patient room and a negative pressure anteroom. All other elements remain the same. For further details of Class P+N Isolation Rooms refer to the VHBA health design standards.

Alternating pressure in isolation rooms must not be used (that is, rooms can not be switched between positive and negative pressure for patient protection vs patient isolation). In addition to clinical and operational risks, the cost of ongoing maintenance, cleaning between patient occupation, and special equipment will outweigh any perceived benefit.

The plant and engineering systems should be designed so that Maintenance teams can assess from outside the isolation room where possible. This improves the safety of maintenance staff while maintaining containment and therefore patient safety.

Supply and exhaust systems shall incorporate dual motor and dual impeller fans and automatic change over from duty to standby in the event of a failure of the lead unit. System shall be capable of providing continued operation whilst the failed drive/impeller is being repaired.

All exhaust air from negative pressure isolation rooms shall be HEPA filtered prior to discharge. HEPA filters should be located as close to discharge as possible. Consideration will need to be taken of the risk of exposure and contamination for any maintainable items prior to the HEPA filter location (i.e. fire dampers). Exhaust discharge shall be in accordance with AS1668.2 requirements.

A negative pressure isolation room may be configured to be convertible to normal Class S patient room and /or a chemical decontamination room, retaining airflow direction with inflow into the room from the corridor. Switching between modes shall be controlled by staff (via key switch or similar). The room mode of use must be clearly identified via a control panel at the entry to the associated airlock. The minimum differential pressure between the isolating room and adjacent areas shall be as defined in the AusHFG: Isolation Rooms – Engineering and Design Requirements, and as noted in the guide in the "*Mechanical Design Parameters"* appendix.

For Class N and Q Isolation rooms, motorised airtight damper controllers should be provided to enable safe isolation of HEPA filter units. HEPA filter modules on the exhaust air system should be of the safe change type where possible.

Particular attention must be paid to room construction and sealing to minimise leakage. Fan systems shall be able to deliver the required air change rates and pressure regimes including for all designed and actual air leakage through the construction envelope of the isolation suite (doors, walls, floors and ceilings and any interconnecting conduits, piping etc without air gaps). Design engineers shall consult with the architect and builder on appropriate air leakage allowances to add to required minimum fan duties prior to final selection.

Interim leak testing and any required remediation of the room construction should be undertaken prior to the concealment of services and completion of final room finishes. Delays should be programmed into pressure gradient monitoring systems to prevent nuisance alarms due to normal movement in and out of the room, and locally mounted visual pressure difference indicators (in addition to BMCS monitoring feedback) should be used to indicate that required pressure difference is being achieved. Door open too long (DOTL) reed switch alarms should be fitted to external doors (ante room and main bed access doors) and active local audible alarm to the appropriate Staff Station as part of the pressure monitoring system. Alarms can be disabled when room is not used in Isolation mode.

14.9.3 Operating Theatres

Standard ORs (see also specific requirements for different OR types in the "*Mechanical Design Parameters*" appendix) shall be arranged such that:

- Each operating suite should have its own dedicated ventilation system, serving the OR, sterile prep/set-up, anaesthetic induction room and/or any enclosed scrub room and exit bay (depending on the layout).
- Where 2 operating rooms share a common sterile prep/set-up room, each AHU serving the individual ORs shall be capable of providing the full airflow and pressure regime set up for the shared sterile prep and can operate on reduced airflow when both AHUs are operational.
- If an operating theatre is taken offline, it shall not have a detrimental effect to the operational needs and pressure regime of any other areas within the functional area.
- Where a central sterile prep/sterile stock room serves multiple ORs, this area should be served by a dedicated AHU, providing the highest pressure in the operating department, and be able to cascade through all ORs separately.
- The clinical requirement will determine the type of HEPA air diffusion, i.e. either single/banks of HEPA filter diffuser modules or bespoke ultra clean ventilation systems. HEPA diffusers should generally always be perforated plate type.
- In hybrid operating rooms containing ceiling mounted rails for interoperative imaging equipment and rooms such as HEPA filtered procedure rooms, locate individual HEPA filter modules to suit the ceiling mounted rails, equipment arms, pendants and the like to optimise uniform downward airflow over the operating/procedure table. Where bespoke ultra clean ventilation canopies are required for clinical needs such as general operating rooms or orthopaedic operating rooms, air should be uniformly diffused downward over a minimum 1800mm x 1800mm ultra clean zone directly over the operating table (2400mm x 2400mm is preferred for general ORs and shall be provided for orthopaedic and similar highly invasive procedures). The ultra clean zone dimensions shall be determined by the clinical and IP&C team for each project and may be larger than the minimum described above. Air distribution arrangements should minimise re-entrained room air into the air supply stream in the unoccupied test state.
- Supply air velocity through the ultra-clean zone shall be at between 0.2 and 0.3 m/s at the operating table level (900mm from the floor). HEPA filter face velocity should be no greater than 0.5 m/sec at the terminal.
- Room pressurisation of the operating room relative to adjacent rooms shall result in:
    - using the exit bay/theatre corridor as the reference point, provide a minimum of 10Pa (preferably 15Pa) pressure differential steps through the theatre suite, from most sterile (Sterile Prep), through the Operating Room, then through less clean associated rooms such as Anaesthetic Induction Room, Scrub Rooms etc, and spill to the exit bay/theatre corridor
    - inflow to the operating room, across the entire opening, through any opening of door(s) connecting to the sterile preparation area
    - outflow from the operating room, across the entire opening, through any door(s) connecting to other adjacent rooms
- Response to a change of temperature setting should be achievable within a target of five minutes under any ambient weather conditions and any change of setting.
- Supply air temperature should be controlled by a temperature sensor located in the supply duct. A wall mounted space temperature sensor located outside the clean zone should be provided for monitoring.

- For digital operating theatres, designers shall ensure adequate provision for current known and proposed digital theatre requirements. These requirements include:
  - additional cooling loads for digital screens and workflow monitors
  - ventilation to equipment cupboards and recessed screens (where relevant)
  - electrical and communications interfaces
  - communications infrastructure and AV Racks
  - the designer shall ensure allowance is made for known intrusions into the laminar airfield caused by digital theatre equipment. Revised air distribution may be required altering the above requirements to ensure appropriate air distribution.
- Local pressure gauges, audible alarms and pressure monitoring devices should be installed to assure maintenance of sterile conditions. Consider linking to BMS for monitoring and alarms.
- Consider use of counter balanced air pressure stabilisers to assist in the control of airflow direction and maintenance of barrier flow when interconnecting doors regularly open and close (note, these are not intended to be used for active pressure control and have a different function than a barometric damper).
- Exhaust ventilation shall limit the anaesthetic gas exposure to comply with the Safe Work Australia Adopted National Exposure Standards (NOHSC 1003):
- 50 ppm average anaesthetic concentration level represented in terms of an eight-hour reference period or an eight-hour time weighted average exposure (TWA). 500-ppm short-term exposure limit (15 minutes) (STEL).
- There should be mid or high level return air and low-level exhaust air intakes arranged to provide directional air flow from clean to less clean areas within the OR. Exhaust air shall account for not less than 50% of the minimum outdoor air, with the lower edge of the grilles not more than 300mm above floor level. Consider high level ceiling mounted return air locations where necessary to support directional airflow and the impact of pendants and workflow terminals.
- With reference to Clause 5.3.7 of AS 1668.2 – 2024, this clause is in reference to exhaust air only.
- Mid to high level air not required for exhaust or sepsis control may be reconditioned and recycled.
- Where return air is utilised, a full size 100% outside air purge cycle shall be provided. Outside air purge shall be incorporated and activated where procedures may be septic or where obnoxious odours may be produced, or where any spillage occurs within the OR.
- When unoccupied, ventilation shall be maintained at a rate to maintain airflow and pressure gradients across the operating suite, provided the upper and lower temperature and humidity control ranges are maintained. Space temperature and humidity control can be setback to conserve energy in un-occupied periods. Set-back conditions shall not compromise condensation control or pressure regime across the OR suite.

14.9.4 Operating Theatres with Laser Surgery

Depending on the type of laser and surgical procedure undertaken, laser surgery can produce a plume, which can be of noxious odour and create an infection control risk to either the patient or health service personnel. Plumes can contain blood-borne pathogens, air-borne contaminants, bacterial and viral particulates. If these risks apply, they should be managed via either centralised or portable localised and in either case, dedicated mechanical extraction systems. Where surgical diathermy

and surgical laser equipment is used, the preference is for self-contained, portable laser plume smoke evacuators/exhaust systems to be used.

Air containing odour, bacterial and viral particulates, and other contaminants shall be HEPA filtered to the same standard as that for Class N Isolation Rooms and should incorporate activated carbon filters where necessary.

14.9.5 AS/NZS 4173 *Guide to the safe use of lasers and intense light sources in healthcare* provides additional information and should be incorporated in the design.Specific Cross-Infection Risk Areas

Non-recirculatory, dedicated exhaust systems should be used for rooms likely to house patients with infectious like illnesses (including specific ED Triage facilities for ILI presentations), for rooms used to test patients for Tuberculosis and other infectious like illnesses, and for the delivery of specific aerosolised medications, induced sputum and similar. The room shall achieve inward negative airflow (at least 5Pa, and 10% by air volume) with respect to its immediate surroundings.

14.9.6 Anaesthetic Gas Use Areas

- Recovery, Delivery, Intensive Care, Dental Procedure and other rooms where anaesthetic gases are administered or patients that have been gas anesthetised shall have;
  - Exhaust rates shall comply with AS1668.2.
  - Exhaust ventilation that limits the anaesthetic gas exposure to comply with the Safe Work Australia Adopted National Exposure Standards (NOHSC 1003).
  - Low level exhaust intakes adjacent to each patient position
  - A minimum exhaust rate of the greater of 10L/s/person and 4L/s/m^2.
  - Cupboards used to store anaesthetic machines that are ventilated to remove the build-up of N2O within the cabinet.
- Anaesthetic gas scavenging.
  - Each space routinely used for administering inhalation anaesthesia and inhalation analgesia shall be served by a scavenging system to vent waste gases. Gases from the scavenging systems shall be exhausted directly to the outside. If the centralised medical suction system is to be used to capture waste anaesthetic gases, the gas collecting system shall be arranged so that it does not disturb patients' respiratory systems. The space should also include low level ventilation. Scavenging systems are not required for areas where gases are used only occasionally, such as emergency rooms and offices for outline dental work or where portable cylinders are used.
  - Anaesthesia scavenging systems may be connected to the room exhaust systems, provided that the system is a single pass system and the exhaust is directly to the outside or via heat recovery unit in line with NCC Part J5. Any scavenging system is recommended to be designed to remove as much of the gas as possible from the room environment. It is assumed that anaesthetising equipment will be selected and maintained to minimise leakage and contamination of room air.

14.9.7 Cohort rooms and cohort wards:

- Shall comply with the Aus HFG: Pandemic Preparedness – Health Infrastructure Planning & Design Guidance 2023.
- The air conditioning system serving cohort rooms/wards shall be capable of being isolated from other areas and served by a dedicated AHU and exhaust fan system.

- Cohort rooms shall be at negative pressure relative to adjacent rooms, and the Cohort Ward shall be at negative pressure relative to the surrounding wards and circulation areas when operating in Cohort Mode.
- Supply and exhaust systems shall have variable volume fans and incorporate dual motor fans and automatic change over from duty to standby in the event of a failure of the lead unit. System shall be capable of providing continued operation whilst the failed drive/impeller is being repaired.
- Exhaust air shall be HEPA filtered prior to discharge, with variable volume fans and parallel discharge air streams to be able to bypass the HEPA filter bank when not in Cohort Mode. Motorised airtight damper controllers should be provided to enable bypass of the HEPA filter bank during smoke spill mode.

14.9.8 Kitchens

Kitchens shall be provided with conditioned air to ensure an appropriate working environment. Supply air systems for kitchens should not be shared with other areas. Air distribution strategies over cooking equipment should be considered to ensure proper operation of the equipment, and as direct as possible extraction of heat, fumes and vapours from kitchen equipment.

The various areas within a production kitchen shall be ventilated or air-conditioned to ensure compliance with food safety standards including:

- Relevant sections of the Australia New Zealand Food Standards Code, Food Standards Australia New Zealand
- Australia Cook Chill Council, Guidelines for chilled food production systems including Food safety programs 2000
- AQIS code of hygienic practice for heat-treated refrigerated foods packaged for extended shelf life, 1992
- HACCP Food Safety Management standards.

14.9.9 Helipad

In hospitals where helicopter operations occur – be designed to ensure that outside air inlets are clear of helipads and the rotor air currents with entrained jet exhaust. Where this is unavoidable, consideration should be given to an appropriate air treatment system to combat odorous and harmful VOCs and fuel/combustion by-products, and/or temporary closing of outside air intakes through motorised dampers. If carbon filters are adopted, consideration should be given to provision of a bypass for normal operation. If closing of outside intakes is adopted, measures should be taken to ensure that areas with pressure regime controls are maintained, one possible method may be to temporarily increase the exhaust air quantities in the more negatively pressurized areas. Refer also to the VHBA document HTG-2020-006 for further details on additional provisions related to Helipads.

14.10 Cooling, Heating and Humidity Control

14.10.1 Space cooling and heating, and where relevant humidity control, shall be provided to:

- provide a comfortable internal environment for patients and staff
- provide specialist controlled environments for surgery or management of particular medical treatment conditions (e.g. close temperature and humidity control for Burns patients)
- provide safe environments for handling of food, storage of goods (including temperature sensitive pharmaceuticals/products within clean utility rooms and sterile stores), conduct of processes or protection of equipment

- provide humidity control and prevent condensation on internal building surfaces as required within these guidelines (see also the ”*Mechanical Design Parameters*” appendix for additional room-by-room mechanical design parameter guidance).
- provide sufficient cooling and heating capacity and resiliency to cater for equipment gains for major medical equipment (MME). Review procurement methods for MME and whether any specialist process cooling plant and equipment is required, and/or is provided within the MME procurement package or as part of the mechanical installation package. In either case, the base design should take account of space, heat rejection airflow pathways and location/replacement of MME process cooling plant and equipment as part of the design

14.10.2 Cooling, heating and where relevant humidity control shall be provided to comply with the “*Mechanical Design Parameters*” appendix, but may be varied to suit specific medical, clinical or equipment requirements as briefed on a project by project basis. In addition, the following general requirements should apply;

- HVAC systems should be capable of maintaining the space at any set point within the defined temperature range during normal operation (allowing for suitable deadband control), and at any time of the day or year. Local in-room user control requirements are noted within specific areas where relevant. All other design temperature ranges not noted as user controllable are standard upper (cooling) and lower (heating) temperature bands, with up to 2°C deadband control, generally centrally controlled and not individually user controlled per room.
- For equipment and process rooms, temperature and humidity should be controlled within the equipment supplier’s specified limits.
- Evaporative coolers shall only be provided for the cooling of spaces where there is no requirement for temperature, condensation prevention or humidity control.
- For specialist equipment rooms i.e. central ICT rooms, rooms shall be provided with close control air conditioning systems and in-built redundancy as appropriate to their importance level. Refer also to the ICT brief for specific system redundancy requirements where necessary. For public healthcare facilities this would be the latest version of the HSS ICT specification, with differing servicing requirements per room type.
- Waste handling rooms should have a maximum temperature of 27°C.
- General occupied spaces (i.e. where not specifically listed in the ”*Mechanical Design Parameters*” appendix should be temperature controlled within the range of 21°C to 25°C, and with upper-level relative humidity control such that there is no condensation on room surfaces.

14.11 Cooling and Heating Plant Configuration

14.11.1 Cooling and heating plant shall be provided in at least two complete operational modules of capacity. The capacity required to support all functions that the Licence Holder/Applicant requires to keep operating, as defined within their Business Continuity Plan shall not be affected by the failure of the lead module.

14.11.2 All cooling and heating plant shall be designed and installed to provide adequate and measurable reliability by providing plant items and systems that satisfy design requirements for critical areas, through standby, modular or load shedding arrangements that are clearly defined. For all Licence Holder/Applicants submitting for LARU approvals, this should be defined at early Concept stage and no later than Approval in Principal stage.

14.11.3 Where the facility is fed by three or more elements of heating and/or cooling plant, power supplies should be arranged such that failure of a mechanical switch board or bulk power supply does not affect all heating/cooling plant elements.

14.11.4 Cooling General – The choice of refrigeration systems should consider system capacity and the appropriate application of the various available and proven technologies. For systems below 200 kW, VRF systems can be considered, for systems between 200 to 2000 kW, air cooled chillers should be considered, and for systems above 2000 kW, water cooled chillers should be considered. Cooling towers, fluid coolers and evaporative condenser systems shall be designed and installed in line with the Health (Legionella) Regulations and AS 3666 – Air handling and water systems of buildings – Microbial control. Cooling towers and evaporative condensers should include a side stream filter or cyclonic separator system to provide solids removals from the circulating water systems.

Central cooling plant chiller sets should be selected to ensure that in the event of failure of a compressor, the chiller shall continue to operate at a reduced capacity. Select chillers that maintain reliable, energy efficient low-load operation. Large systems should consider a low load chiller as part of the chiller plant configuration.

For major projects with condenser water systems these shall be arranged such that a failure in the condenser water loop does not disable all of the heat rejection plant capacity within the facility, and cooling can still be supplied to critical areas. Make-up water meters linked to the BMCS shall be provided to cooling tower and fluid cooler systems for monitoring and control purposes.

A holistic review of design and plant capacity for HVAC systems, including consideration of future climate expectations should be carried out.

14.12 Tropical and Marine Environments

14.12.1 Tropical environments: special consideration is required for humidity control in ceiling voids, under floors and void spaces adjacent to occupied areas to avoid condensation. Particular attention should be paid to operating theatres, pharmacy, sterile storage and medical records.

14.12.2 Marine environments: all intake louvers and exposed metalwork shall be 316 stainless steel. All duct connections for outside air shall be stainless steel.

14.12.3 Tropical and marine environments: additional coil protection shall be provided for internal and external coils exposed to the environments to reduce the impacts of corrosion.

14.12.4 Tropical and marine environments: consideration shall be given to provision of tempered plantrooms to control dust, humidity, heat and salt for prolongation of life of plant and equipment, and for maintenance purposes.

14.13 Control and Monitoring Systems

14.13.1 This section is largely based on the Victorian Health design standards, and sets out at a high level, the functions of the Building Management and Control System (BMCS), the standards to be applied in order to achieve a reliable and accessible system that gives enough information to enable the functions of the hospital to be carried out safely, securely and efficiently and for the relevant monitoring and alarm notification of events linked to system performance and environmental control. It is not intended as a detailed design guide for building services control and monitoring systems.

14.13.2 The provisions of the section are to be applied to all new BMCS and enhancements of existing systems. The implementation of BMCS with digital technology and open communication standards should provide a unified approach to automation systems

throughout healthcare facilities. The aim is for seamless integration, energy monitoring and intelligent automation, control and monitoring of the building services systems.

14.13.3 The BMCS shall be an open building control system with full interoperability. Selection of a BMCS system should be appropriate to the size, nature and location of the project. The degree of BMCS sophistication should also be considered on a project-by-project basis; for example, overly sophisticated systems requiring a high level of maintenance and programming are not appropriate in remote, regional locations, or for relatively small, non-acute facilities or extensions to existing facilities. It is preferable to reconfigure or expand an existing BMCS system on small to medium size projects. Systems and plant should generally be selected with high level interface compatibility and packaged plant controls. Where this is not possible or where service continuity is critical for patient care, low level interface between systems should be used for system integration.

14.13.4 New BMCS systems should consist of a high speed, peer to peer network of DDC controllers, run and standby servers and operator workstations. The operator workstation should provide for overall system supervision and configuration, graphical user interface, management report generation and alarm annunciation. Typical scope of BMCS provision should include:

- engineering services control
- engineering services monitoring and alarms
- vertical transport systems monitoring
- medical gas systems monitoring and alarms
- communications network
- open communications capability, such as BACnet, LON, Modbus Connectivity
- all associated field devices such as: sensors, control valves, etc.
- all associated hardware including computer workstation
- all associated software
- graphical Interface
- remote access via web pages
- energy management and reporting
- historical data logging

14.13.5 Building management and control systems shall be reliable systems, with components which have been in commercial or industrial use prior to any project delivery. The system architecture should be flexible, expandable and backward compatible throughout the given life expectancy of the project. Systems should be configured to maximise energy efficiency without detriment to environmental conditions with all proposed control strategies pre-approved and tested.

14.13.6 Operator workstations should be engineered to provide clear three-dimensional animated graphics for all connected plant and systems with summary information of operational profiles such as times, conditions and energy usage. The operator interface should include energy dashboards and building performance information.

14.13.7 Alarms shall be clearly identified in plain English with all point identifiers /references labelled without acronyms and in line with any existing identification convention or as directed by the facility engineer or maintenance team.

14.13.8 Projects with an existing BMCS should consider the life cycle of the existing system, integration of legacy technology and migration options onto a single open communications platform. BMCS software shall enable interrogation of stored historical data. The BMCS should be capable of output to database which shall use

an open standard such as SQL for operator queries integration to enterprise systems for seamless data transfer for a digital hospital.

14.13.9 Functionality
The following functions should be provided by the BMCS system as a minimum:

- plant control (temperature, humidity, pressure)
- monitoring and trend logging
- scheduled start and stop plant
- optimisation
- outside air economy cycle control (enthalpy)
- alarm annunciation
- data gathering and logging
- electrical load shedding

14.13.10 The BMCS should also form an integral part of the energy management system

- emergency metering from supplier including (as appropriate) kWh and kVA
- energy metering from supplier including (as appropriate) kWh and kVA
- chiller and boiler kW output
- power metering kW and kWh
- data logging of plant run hours
- emergency power mode operation

14.13.11 Where appropriate for clinical care resiliency, emergency response and disaster recovery mode, the control system and mechanical switchboards shall be arranged such that, in the event of a failure or disaster which causes the general BMCS to fail, it is possible for, as a minimum, all critical care and operationally essential areas of the facility to run all plant in a 'manual' mode from the local mechanical switchboard, without relying on the BMCS interface. The VSD systems should be robust and resilient. VSD drives should automatically re-set to last known setting after a power isolation or power failure.

14.13.12 The Licence Holder/Applicant shall establish an appropriate method of monitoring the control system and associated alarms so that continuity of service matches their facility management plan.

14.14 BMCS Requirements

14.14.1 If the Licence Holder/Applicant chooses to use an integrated platform, it should be physically linked to a Building Management and Control System (BMCS) via TCP/IP and capable of high-level interface using an appropriate open protocol.

14.14.2 Where extensions are made to an existing health facility the new controls should integrate with either the existing BMCS system, or a new system installed to monitor the entire facility.

14.14.3 The BMCS should utilise duty and standby servers to ensure reliability and have at least one operator terminal with graphical user interfaces located on the site, in addition to secured, web-based accessibility.

14.14.4 The BMCS should monitor all alarms associated with mechanical services operation including all equipment faults and pressure, temperature and humidity measurements that are outside of required limits and annunciate these alarms to the facility manager in the manner set out in the Licence Holder/Applicant's Facility Management Plan. A criticality matrix of system alarms shall be provided for review at ATC submission stage.

14.14.5 The BMCS shall store historical data for at least 6 months and the software installed should allow graphical logging and data analysis.

14.14.6 The BMCS and associated digital controls shall be arranged so that in the event of BMCS failure, it is possible to still operate the plant from local switchboards/field controllers.

14.14.7 Where Variable Speed Drives are fitted to plant they shall automatically restart at the preset output after power failure. Password protected/secure access Fire mode shall be integrated into variable speed drive functionality.

14.14.8 The switchboard and electrical systems supporting mechanical services shall comply with chapter "*Engineering Services, Electrical*" of these Guidelines. The communications network associated with the BMCS shall comply with chapter "*Engineering Services, Communications*" of these Guidelines. Switchboards serving critical equipment required for odour or sepsis control shall be provided with appropriate segregation that allows work to be carried out on the switchboard while critical plant continues to operate. In most instances this will require either form 3b segregation or separate switchboard sections serving duty and standby equipment.

14.14.9 Packaged mechanical equipment with built in controls should be linked to the Integration Platform via the BMCS using an appropriate open protocol. These include:

- chillers
- boilers
- variable speed drives
- fume cupboards (to the extent permitted by AS/NZS 2243.8)
- refrigerant monitoring
- condenser water treatment
- computer room units
- package DX units

14.15 Pneumatic Tube Transport Systems

14.15.1 Consideration should be given to the installation of a pneumatic tube transport system (PTS) on larger facilities to allow the reliable, quick, convenient and safe transport of medical consumables and samples from one location to another. System performance and configuration (e.g. point to point travel time and system reliability) requirements should be developed through stakeholder engagement including:

- Pathology as the system 'owner', head-end PC
- Preferred supplier
- Pharmacy to IPUs and OPD (located on separate zone to Pathology)
- Blood Bank transfer of blood products criteria
- Multi-zone system serving most clinical departments
- Dedicated point-to-point systems
- Overlapping zones for redundancy in high traffic
- Station type
- Carrier size
- RFID carrier tracking
- Location/access to in-ceiling air diverters clear of high traffic areas
- Plant and turbine location

14.15.2 System performance requirements shall meet the following as a minimum:

- Velocities and bend forces suitable for transport of blood products
- Carrier transit times less than 3 minutes
- Carrier temperature variance +/- 1° K of set point (deadband control)
- Carrier speed, acceleration and deceleration at terminal stations adjustable to suit blood products (adjustable via the VSD control system)
- System control priorities; assign high priority to any blood product traffic (to override normal traffic)

14.15.3 The items that will be transported by the PTS should be identified at the design stage and a system shall be selected that can safely transport these items giving consideration to their sensitivity to temperature, velocity, acceleration and jerk forces.

14.15.4 Systems should be designed for the most direct route of tubing runs (to keep specimen travel times to a minimum) with care taken to allow for large turning radius bends. Tube carriers shall be leakproof and tamper proof, and have integrated RFID tracking system with security accessed transfer stations at each terminal.

14.15.5 Fire compartment crossing shall be fitted with proprietary fire collars.

14.15.6 All motors and controls that are associated with the PTS shall be provided with essential power and all controls, shall be provided with UPS (no break) power supplies, that will continue to track and identify the location of all tube carriers.

14.15.7 Pneumatic tube systems shall be provided with a “clean out” carrier that is used periodically to clean and disinfect the inside of the tube system

14.15.8 Spill-secure containers shall be provided for carriage of Pharmacy and Pathology products

14.15.9 Tube systems provided should have a proven history of operation in healthcare systems that demonstrate a high degree of reliability and shall have the following control functions:

- setting of priority for each carrier when loaded
- security code requirements for access to operate each station

14.15.10 Full operating instructions shall be provided to all staff who will use and operate the system to ensure that the system is never used to transport items that are not suitable.

14.16 Testing and Commissioning

14.16.1 Reference should be made to industry available commissioning documentation as the basis for developing project specific testing and commissioning plans:

- SA TS 5342 – Building Commissioning (Standards Australia)
- AIRAH DA27 – Building Commissioning
- Technical Guideline TG009 Commissioning and Handover
- CIBSE – Commissioning Codes (various)
- BSRIA – Commissioning Books (various)

14.16.2 Project certified commissioning and test reports shall be presented demonstrating:

- work is completed to specification
- system input parameters meet specified requirements
- systems are free from construction dust loads and contamination

- pressure integrity and safety of fluid systems
- flow volumes of service inlets and outlets under all operating modes are within tolerance and required pressure gradients and air flow direction are verified
- correct airflow directions are achieved in operating suites and other spaces requiring relative pressure gradient control for asepsis purposes
- drains and vents are unobstructed
- correct calibration, sequence and operation of controls
- correct operation of safety devices and interlocks
- noise and vibration are within specified limits
- materials quality and installation quality complies with specification
- service outcomes comply with intent and are stable
- arrangements for operation and risk management of services comply with duty of care
- end to end testing of the DDC in conjunction with the integration platform
- HEPA filter integrity. Ongoing testing shall be carried out at a minimum 12 monthly intervals, including a check of overall airflows, air change rates and relative pressures to ensure that filter loading has not impacted designed airflow and pressure regimes

14.16.3 Airflow reports shall include air balance diagrams for each system and show interdependence between systems. Provide air gradient diagrams for all sterile airflow areas.

14.16.4 All project commissioning test reports shall be reviewed and accepted by an appropriately qualified and registered mechanical engineer or independent commissioning agent. Refer to chapter ”*Background*”, section “*Definitions*” for personnel definitions.

15 ENGINEERING SERVICES, MEDICAL GASES

15.1 Medical Gas Service Brief

15.1.1 The extent of medical gas services shall be defined with a fully detailed description of services to be provided by the Licence Holder/Applicant as part of their submission that supports the safe, secure and reliable clinical and building operational functionality of the health facility served by the medical gas systems. The performance required to deliver such services shall be not less than as required by the NCC, statutory regulations and these Guidelines. The Licence Holder/Applicant should demonstrate the inherent future flexibility, expandability, and adaptability to suit the changing needs of the building operational requirements and clinical services delivery over the life of the building.

15.1.2 Medical gases are a critical part of hospitals in their ability to support life and to provide patient care. The design and installation of these systems is governed by Australian Standard AS 2896 *Medical Gas Systems – Installation and Testing of Non Flammable Medical Gas Pipeline Systems*. Designers and installers shall adhere to the requirements of this standard. The critical nature of these services demands a high level of knowledge of the standards by both designers and installers. All clauses outlined in the following section are in addition to statutory requirements.

15.1.3 Carry out risk analysis for the following as defined in AS 2896:

- Sizing of cylinder manifold and VIE supplies:
- Dedicated emergency backup supplies for Special Care locations (in consultation with the Facility Management team and the HFR)

15.1.4 Medical gas systems in a healthcare facility are recommended to be located in a central storage or generation location and reticulate to functional departments throughout the facility. Medical gas equipment, gas storage and reticulation should consider the future expansion potential of the facility. Plant layouts should be arranged to account for additional future plant or larger capacity gas storage vessels where reasonably expected to be required over the life of the facility. Headers used as central distribution points should be arranged to allow for future connections without shutting down the service.

15.1.5 Medical oxygen shall be supplied from liquid oxygen VIE vessels or cylinder manifold based on risk assessment including AS 2896 minimum and site specific conditions of guarantee of supply, post-disaster etc. Medical oxygen, medical air and nitrous oxide multi-cylinder storage manifolds shall be arranged in a duty/standby configuration incorporating automatic change-over facility and BMCS status monitoring interface. Each manifold should include enough cylinder storage to meet a risk assessment including AS 2896 minimum and site specific conditions on both the duty and standby side, with additional cylinders held in storage to meet demand where relevant to the facility type, patient acuity and geographic location and ease of securing replacement supplies. The extent of storage and standby, above the minimum stated requirements in AS 2896, should be discussed and agreed with the health facility clinical leads and FM team. All medical gas cylinder manifolds are recommended to be sited adjacent to each other in a location which facilitates ease of access for cylinder delivery and pick-up.

15.2 Extent of Services

15.2.1 Medical gas services may include but not be limited to:

- oxygen storage and reticulation
- nitrous oxide storage and reticulation

- medical breathing air storage and reticulation
- medical breathing air compression and conditioning
- surgical tool air
- dental air and suction systems
- gas scavenging systems
- medical gas mixtures
- medical suction/vacuum pumping, storage and reticulation

15.2.2 The principles of this section of The Guidelines shall also apply to other gas services that may be found in some hospitals, e.g.:

- nitrogen and liquid nitrogen systems
- carbon dioxide systems
- instrument medical air systems
- laboratory special gas supplies

15.2.3 Refer to chapter "*Background*", section "*Definitions*" with clauses that contain a list of terms relating to electrical power supplies as relevant to healthcare facilities referenced within The Guidelines.

15.3 Coordination with Other Disciplines

15.3.1 Where aspects of the requirements for medical gas services are applicable to other disciplines (e.g. separation of services) the works shall comply with the respective requirements of this section.

15.3.2 All naming and labelling of electrical supply, power quality management and protection coordination of circuit protective devices shall be as defined within the electrical design.

15.4 Standards & Compliance

15.4.1 Medical gas services shall comply with:

- AS 1894 *The storage and handling of non-flammable cryogenic and refrigerated liquids*
- AS 2896 *Medical gas systems - Installation and testing of non-flammable medical gas*
- AS 2568 *Purity of compressed medical breathing air*
- AS 4332 *The storing and handling of gases in cylinders*
- AS 2473.3 *Valves for compressed gas cylinders – Outlet connections for medical gases (including pin-indexed yoke connections)*
- AS 2902 *Medical gas systems – Low pressure flexible hose assemblies*
- AS 3840 *Pressure regulators for use with medical gases – Pressure regulators and pressure regulators with flow-metering devices*
- AS 4484 *Gas cylinders for industrial, scientific, medical and refrigerant use – Labelling and colour coding*
- ANZCA *PG66(A) & PG66(A)BP Guideline on the role of the anaesthetist in commissioning medical gas pipelines and associated Background Paper*

15.5 Medical Gase Services, General

15.5.1 A readily accessible and visible zone isolating valve assembly shall be provided on each service in each fire zone adjacent to the point of entry or egress to the

compartment. Designers should agree with the healthcare facility/clinical leads on the locations of department emergency isolation valve and alarm panels as well as the location of central alarm panels. Each operating theatre shall include a dedicated emergency isolation valve and alarm panel and in-theatre repeater panel.

15.5.2 For large systems ring main reticulation should be provided with isolating valves at appropriate intervals thus allowing system alterations without the need for total system shut down. These valves shall be accessible and located in plant rooms, ducts or accessible ceiling spaces and labelled “Normally On – Close only on written work order instructions”. Ring mains should include upstream and downstream sampling points (both sides of isolation valves) so after cut-in works the gas can be sampled to ensure purity and cleanliness of the pipework.

15.5.3 Reticulation pipework shall generally be in copper, oxygen cleaned where appropriate, or in min grade 304 Stainless steel where higher purities are required at terminal outlets, (e.g. specific laboratories). Where pipework is installed underground it shall be protected in PVC conduit against corrosion. Underground distribution routes should be accurately recorded with in-ground and surface markers installed to identify service routes and changes in direction. Where critical gases are run underground, the lines shall be duplicated for redundancy with minimum 2m separation and isolation valves at each point of entry/exit to underground.

15.5.4 Pipework sizing shall be calculated using the flow rates as set out in AS 2896, with additional consideration for pandemic mode provision where the more extensive use of higher flow mechanical ventilators in department such as ICU and any temporary pandemic/cohort isolation wards will result in increased oxygen and medical gas use.

15.5.5 Valving shall be provided within the Hospital to allow isolation of sections of the installation with the remainder of the installation operating normally. In the case of intensive care units, maintenance isolation valves located upstream of pendant NIST connections should be included to allow for the isolation of individual bed positions or pairs of beds. The number of pendants per zone isolation valve box in ICU, NICU, ED Resus and the like shall be limited to four, to minimise disruption in the case of emergency shut-off, unless otherwise agreed by the clinical operations team.

15.5.6 Access panels shall be provided to give access to above ceiling isolation valves and pendant NIST (non-interchangeable screw thread) fittings where supplying medical gases to pendants.

15.5.7 Medical service panels should be provided to combine a series of common clinical/medical services at a patient point of care location. They can comprise various combinations of electrical, communications, nurse call and medical gas services and in some cases only medical gas services. When they are installed within medical service panels, it is essential to maintain the concentricity of the terminal unit bezel with the fascia plate aperture to avoid malfunction.

15.5.8 The numbers of medical gas outlets to each location shall comply as a minimum with the AusHFG and AS 2896 and as briefed on each specific project by the clinical team, with ‘optional’ outlets to be confirmed for each project. Where possible, medical service panels should be installed flush or duct mounted on masonry walls in a single panel. Where installed in fire walls, the installation shall be detailed to maintain the integrity of the fire wall. Back-to-back installation within common walls cannot always be achieved, and room to room acoustic separation will also have to be considered. In such cases the height of the panels may have to be staggered.

15.5.9 The configuration of medical gas outlets should be standardised across a healthcare facility, and where extended or refurbished in an existing facility, should replicate the

existing configuration as much as possible in order to minimise risk of confusion over order of gas outlets.

15.5.10 Outlets should be mounted in positions that result in the shortest practicable routes for flexible connecting assemblies, between the terminal unit and apparatus.

15.5.11 Consideration should be given to “left to right/top to bottom” order of medical gas outlets in all medical service panel and wall panel configurations in standardised room types, and also whether this order is reversed in a mirrored room of the same type. Discussion with the relevant clinical team and user groups should determine the final layout of gases in each facility. Consider also standardised line of heights development of outlet types, as well as DDA and ergonomic considerations, especially where medical gas outlets are concealed in in-built furniture in patient bedded areas (and other similar applications).

15.5.12 Installation and commissioning shall be by specialist organisations certified to AS 2896.

15.5.13 An adequate supply of terminal equipment should be provided, held at the point of service in a suitable manner for immediate use as required.

15.5.14 Warning system power supplies shall be from a vital supply.

15.5.15 Structural and Earthquake Loads: All equipment, pipework, cable trays and the like shall be installed to comply with AS 1170.4 *Structural design actions Earthquake actions in Australia* in particular Section 8 “*Design of parts and components*”.

15.6 Alarm, Monitoring and Interface Requirements

15.6.1 The Medical Gas monitoring system shall interface with the BSN (where available), using an appropriate open protocol with monitoring also via the BMCS.

15.6.2 The medical gases installation shall incorporate appropriate low and high pressure audible and visual alarms for each medical gas system and vacuum system and departmental sub-systems respectively. The alarm system shall also be hard wired from the essential power supply, if available, with status indication panels sited strategically throughout the hospital on a master and slave arrangement. The master panel shall be in a permanently occupied location (such as the emergency unit) with local panels sited in critical areas (such as operating unit, intensive care unit, manifold room and plantrooms).

15.6.3 Alarm panel ELV plug pack power supplies shall be powered from a separate “vital” supply electrical circuit.

15.7 Testing and Commissioning

15.7.1 Testing shall comply with AS 2896 *Medical Gas Systems – Installation and Testing of Non Flammable Medical Gas Pipeline Systems*.

15.7.2 As required a member of the healthcare facility experienced in administration of medical gases to patients shall witness integrity and purity testing for non-respirable gases in accordance with AS 2896.

15.8 Permit to Work

15.8.1 For medical gas systems being altered in an operating hospital facility work shall be controlled under a permit to work documentation system with any isolation or recommissioning of the whole or part of systems signed off to by the facilities nominated medical officer.

16 ENGINEERING SERVICES, SECURITY

16.1 Security Services Brief

16.1.1 The extent of security services shall be defined with a fully detailed description of services to be provided by the Licence Holder/Applicant as part of their submission that supports the safe, secure and reliable clinical and building operational functionality of the health facility served by the security systems. The performance required to deliver such services shall be not less than as required by the NCC, statutory regulations and these Guidelines. The Licence Holder/Applicant should demonstrate the inherent future flexibility, expandability, and adaptability to suit the changing needs of the building operational requirements and clinical services delivery over the life of the building.

16.1.2 The purpose of security services is to facilitate an environment that ensures safety for all staff, patients and public, plus to ensure that ongoing operation of the facility and equipment is not compromised by theft or damage.

16.1.3 The extent of security services shall be underpinned by a security risk assessment, carried out in accordance with HB 167 *Security risk management* and AS/NZS 4485 (all parts) *Security for healthcare facilities* and includes architectural planning, physical construction, as well as electronic security systems. Where the Licence Holder/Applicant engages a third-party security consultant to provide these or other security services this consultant shall be licenced in accordance with the requirements of WA Police.

16.1.4 This risk-based approach shall identify threats and evaluate risks and provide management strategies to reduce those risks to a level that is “as low as reasonably practical”.

16.1.5 Outcomes from the risk assessment shall include the extent and details of the systems to be applied to the facility including access control, monitoring and lighting systems.

16.2 Extent of Services

16.2.1 The Licence Holder/Applicant design shall assess needs for the facility including:

- crime prevention through environmental design (CPTED)
- defence in depth (DiD)
- segregation of areas, such as, public, semi-public, controlled public, secure service, back of house staff only areas

Security provisions should be complementary to the clinical and medical functions of the facility.

16.2.2 Security systems shall be planned to each part facility including management of the following areas where they are included in the facility:

- main perimeter
- main entrance(s) and drop off points, other entrances
- foyers, lifts, stairs and exits
- car parking, secure and general
- reception areas
- emergency department
- intensive care units
- mental health facilities

- inpatient units
- research facilities
- laboratories
- pharmacies
- administration areas
- cashier desks, safes, strong rooms, ATMs and cash transit routes
- plant areas and risers
- IT facilities, communication rooms and data centres
- loading docks
- hazardous bulk storage
- lock down, including CBRN response

16.2.3 The following services should be provided as part of security systems:

- access control systems
- intrusion detection systems
- asset tracking systems
- patient tracking systems
- duress alarm systems fixed and mobile
- automated barrier controls
- video surveillance systems, including cameras, monitoring and data storage
- key management systems
- communication systems including door intercommunication systems, radio systems and voice and data communications systems
- electronic security interface with lifts, BMCS and fire systems
- security lighting
- security screens and fences

16.2.4 Security system and management provisions shall incorporate:

- security response resources and procedures
- credential management
- security information systems recording and controlling access events, authorised entry parameters, security time schedules, video records, and the like

16.3 Coordination with Other Disciplines

16.3.1 Where aspects of other disciplines are applicable to the security services portions of the works (e.g. labelling of electrical supply, cable containment) the works shall comply with the respective requirements of the other discipline sections.

16.3.2 Refer to chapter "*Background*", section "*Definitions*" with clauses that contain a list of terms relating to electrical power supplies as relevant to healthcare facilities referenced within The Guidelines.

16.4 Redundancy and Disaster Planning

16.4.1 All security systems shall be provided with levels of reliability, maintainability, business continuity, redundancy and disaster recovery in accordance with the facility FRMP and BCP plans.

In particular, systems shall be capable of withstanding the potential or actual impact or repercussion from cyber-attacks.

16.4.2 CCTV

The functional requirement of security CCTV is to facilitate the safety of staff, patients and visitors and assist WA Police in the investigation of crime or unwanted behaviour, whilst respecting the expectation of reasonable privacy.

All system design and registration should be undertaken in collaboration with the WA Police and associated bodies established for management of Crime Prevention. Registration with the WAPOL CCTV register is encouraged.

16.4.3 Healthcare facilities defined by the FOP as required to comply with clause ”**Disaster or emergency role**” (that is, a facility that is to *withstand natural disasters, or with a strategic post disaster and emergency role*) shall have:

- CCTV system determined by objectives and risks
- frame rates and image resolutions suitable for use as evidence
- recording of CCTV images with data storage capacity; the storage system shall be standalone (not used for other purposes); digital data shall be stored for a minimum of 31 days
- embedded information shall include time, date and camera identifier
- cameras should be located at designated entry(s), exits, pharmacy and radioactive waste storage areas
- security systems shall be on UPS and essential (instantaneous and vital) power supplies
- monitoring of footage shall be undertaken by a person capable of responding to incidents or with the ability to notify someone who can respond

16.4.4 Healthcare facilities defined by the FOP as required to comply with clause ”**Continue surgical and/or emergency services during failure**” (that is, a facility that is to *continue to offer invasive surgery or emergency medical services through failure of normal utility services*) shall have:

- CCTV monitoring with recording capacity positioned to monitor designated entry(s), exits and pharmacy

16.4.5 Other healthcare facilities are not required to provide specific facilities for the purposes of disaster preparedness, unless determined by the facility risk management plan.

16.4.6 Perimeter Security.

The functional requirement of perimeter security is to facilitate the ability to secure a hospital building in the event of a disaster, for example, to prevent armed or contaminated persons entering.

16.4.7 Healthcare facilities defined by the FOP as required to comply with clause ”**Disaster or emergency role**” (that is, a facility that is to *withstand natural disasters, or with a strategic post disaster and emergency role*) shall have:

- automated perimeter security system, and be connected to UPS and essential power (instantaneous and vital power sources)
- areas providing patient care with immediate lockdown
- designated key entrances to the hospital with the ability to be manually overridden to ensure the hospital complies with its statutory & common law duties to staff, inpatients & potential patients

16.4.8 For other healthcare facilities securing the hospital perimeter manually is acceptable unless determined otherwise by risk analysis in the FRMP.

16.5 Access Control

16.5.1 Access to facilities by persons and goods shall be controlled, with all access beyond control points being limited to persons authorised to be on site and goods that are appropriately risk managed to prevent harm to persons or facilities.

16.5.2 Access control shall:

- be implemented in strategic areas as identified by the risk assessment
- not unreasonably impede legitimate access requirements of persons
- prevent unauthorised access to:
  - patients
  - patient's records
  - dangerous goods
  - ventilation air intakes
  - controls of services
  - operation of machines and equipment
  - confined spaces
  - high places
  - pits and trenches
- coordinate with clinical management requirements

16.5.3 Mechanical locks shall be master keyed and the Licence Holder/Applicant's Facility Risk Management Plan shall include a key issue and management protocol that protects the integrity of the system.

16.5.4 Where practical the master keying system should be designated to limit or remove the requirement to issue or routinely use Grand (or Great Grand) Master Keys (GMK or GGMK)

16.6 Door Intercommunication

16.6.1 Intercommunication systems should be considered to allow two way voice communication with any locked entrance doors out of sight from any attended response point.

16.7 Duress Systems

16.7.1 Duress functionality can be provided by both the Nurse Call system and the Security system. Different response procedures may be required for different areas, so the Duress System may be a combination of components from both systems. The overall design shall be informed by the Security Risk Assessment and the FRMP. Duress alarm systems shall be provided:

- in strategic areas as identified by the risk assessment, coordinated with clinical management requirements
- including any area where staff are regularly alone with patients or the public
- specifically, wherever staff may be alone and threatened with duress, e.g. interview rooms, mental health counselling rooms, pharmacies, drug storage cupboards, cashier stations, emergency admission points

16.7.2 The facility should have a combination of fixed and mobile duress alarm points.

16.7.3 Fixed duress may or may not be a component of the Security/Access Control system but should be separate to any mobile duress system. Fixed duress is only appropriate in locations where the aggressor is unable to get between the staff member and the duress button.

16.7.4 Mobile duress should be considered as determined by the risk assessment to functional areas including:

- emergency service
- inpatient areas
- outpatient areas
- technical suites
- back of house and loading dock areas
- pharmacy
- mental health areas
- high security areas

16.7.5 Duress alarm systems shall:

- complement clinical and operational procedures to minimise and mitigate the risk of a duress event, by being the “last line of defence”, not the first line
- report to a position where there will always be an appropriate response
- report the location of the alarm, uniquely identifying the device triggering the call
- identify the location of the event with a message consistent with way finding and room naming
- maintain the alarm until reset at the point of origin
- have initiating mechanisms and alarm annunciation suited to the particular location and risk, i.e. configured to be unlikely to exacerbate the duress
- report the identity of the person activating the alarm in addition to their location where locating remote duress is available
- consider bi-directional integration to a Message Integration Engine to allow alerts and resets to be passed to other end points and systems

16.8 Security Lighting

16.8.1 Security lighting shall be provided to:

- facilitate protecting people and property
- provide coverage of strategic areas, both internal and external to the building, as identified by the security risk assessment
- deter unauthorized entry
- assist security staff conducting patrols
- illuminate access ways to entrances and car parks to provide good visibility and minimise dark areas where undesirable persons may lurk and confront patients, visitors and staff
- illuminate car parks to reduce risk of theft and confrontation threats
- illuminate areas vulnerable to forced intrusion or vandalism
- illuminate areas with CCTV coverage to levels sufficient for the effective operation of CCTV cameras

16.8.2 Ensure security lighting characteristics and levels are compatible with and fully support the effective performance of any installed or provided video surveillance system.

16.9 Security Screens and Barriers

16.9.1 Security screens, barriers and fences should be considered for:

- strategic areas as identified by the risk assessment, coordinated with clinical management requirements
- security of the facility building perimeter
- security segregation of all department areas of the facility
- emergency department admissions counter
- pharmacy dispensing counters
- any cashier counters
- all entry/exits to the facility with specialist treatment of afterhours entry points
- ground floor windows
- staff car parks

16.9.2 Fences should control the number of entry points to the site to reduce the risk of undetected unauthorised entry.

16.10 Intrusion Detection

16.10.1 Intrusion detection should be considered for:

- strategic areas as identified by the risk assessment, coordinated with clinical management requirements
- unattended areas of buildings
- security of all serviced areas
- windows and doors vulnerable to misuse or forced entry

16.11 Video Surveillance

16.11.1 Video surveillance should be considered for:

- strategic areas as identified by the risk assessment, coordinated with clinical management requirements
- all entrances and exits
- after hours entrances
- car parking
- otherwise unobserved waiting areas
- areas designated for the handling or management of currency
- reception and administration desks exposed to the public or patients
- drug dispensing areas
- outside each department main entrance door
- within emergency, mental health and pharmacy departments
- lift foyers
- inside lifts
- ambulance bays and loading dock areas
- stairwell doors
- high-risk areas

Individuals' right to privacy and the need to identify by signposting areas shall be considered when installing video surveillance.

16.12 Baby Location

16.12.1 Where identified as part of the FRMP, baby location monitoring may be required. The system shall alert staff if:

- a baby leaves a ward
- monitoring is removed from the baby

16.13 Response Resources

16.13.1 The Licence Holder/Applicant FRMP shall identify security risks and duty of care response to each risk.

16.13.2 Security response resources shall at least match the FRMP requirements.

17 ENGINEERING SERVICES, STRUCTURAL

17.1 Structural Brief

17.1.1 The Licence Holder/Applicant shall define the planned life of the facility as this will impact on the durability requirements for the project. The brief shall define in service duty required to first maintenance (in years) as this may impact on the choice of reinforcement type in reinforced concrete, and corrosion protection for, among other things, steel elements incorporated in the external fabric of the building.

17.1.2 Healthcare facilities defined by the FOP as required to comply with clause "**Disaster or emergency role**" (that is, a facility that is to *withstand natural disasters, or with a strategic post disaster and emergency role*) or clause "**Continue surgical and/or emergency services during failure**" (that is, a facility that is to *continue to offer invasive surgery or emergency medical services through failure of normal utility services*) shall be assigned with an Importance Level of 4 in accordance with the NCC. All other facilities shall be designed for an Importance Level as appropriate to the NCC.

17.1.3 The loadings to be applied to the structural design shall be not less than the minimum required by the NCC, the relevant Australian Standards and these Guidelines but may be greater if the building has to serve a post disaster function or where the planned life exceeds 15 years.

17.1.4 The building structure shall:

- have adequate foundations to not exceed settlement limits nominated in the Australian Standards for the defined service life particularly where clay soils are present.
- have foundations not solely based on Standard Designs outlined in AS 2870 *Residential Slabs and Footings*.
- for healthcare facilities defined by the FOP as required to comply with clause "**Disaster or emergency role**" (that is, a facility that is to *withstand natural disasters, or with a strategic post disaster and emergency role*) or clause "**Continue surgical and/or emergency services during failure**" (that is, a facility that is to *continue to offer invasive surgery or emergency medical services through failure of normal utility services*) possess sufficient redundancies and adequate ductility to prevent progressive collapse.

17.2 Structural Drawings and Specifications

17.2.1 Project documentation shall at least define:

- the design codes used in the design
- the design live loading including service loads
- the wind loading parameters used for determining loads; (region, terrain, category, shielding multiplier, topographic multiplier, importance multiplier)
- the earthquake parameters used for determining loads
- any imposed construction/erection loadings, e.g. earth moving equipment
- any load limitations applying to the use of particular areas
- foundation design parameters
- required concrete strength, slump, cover to steel reinforcement and type of reinforcement e.g. reinforcing steel complying with AS 3600 or Glass Fibre Reinforced Polymer complying with Canadian Standards Association standard CSA S806-12
- structural steel grades used

- deflection limits/criteria used
- welding categories
- corrosion protection treatment
- demolition requirements for any demolition associated with the project
- erecting sequence requirements for structures requiring a specific sequence. in particular, where tension elements have been used in the design
- any other details necessary to define the action and performance of the structure

17.3 Wind Loads – Loads in Cyclonic Areas

17.3.1 Buildings in regions C or D as defined by AS/NZS 1170.2 *Structural design actions Wind actions* shall comply with the following:

- assume not greater than a terrain category of TC2.5 as defined under clause 4.2.1
- wind speeds factored in accordance with clause 3.4
- in determining internal pressures, assume all unprotected openings are regarded as potential dominant openings unless the building envelope (windows, doors and cladding at heights up to 25m) can be shown to be capable of resisting impact loading from windborne debris determined in accordance with clause 2.5.8. The determination of internal pressures shall be in accordance with clause 5.3
- all cladding, its connections and immediate supporting members and their fixings shall demonstrate performance under the pressure sequences defined in clause 5.4.4, AS 4040.3 *Methods of testing sheet roof and wall cladding-Resistance to wind pressures for cyclone regions* and the NCC, based on the ultimate limit state wind pressure on external and internal surfaces as determined in accordance with this Standard

17.3.2 An opening can be assumed to have adequate protection if shown capable of resisting the impact loading from windborne debris in accordance with clause 2.5.8 of AS/NZS 1170.2.

17.3.3 The parts of the health facility building envelope accommodating patients, e.g. accident and emergency departments and operating theatres shall be designed to resist debris impact by increasing the loads defined above by 25%.

17.3.4 The structural consultant shall prepare a wind load diagram for all elevations of the facility for inclusion in the Project glazing specification. The diagram shall explicitly identify the ultimate positive (acting towards the surface) and negative (suction) wind loads and detail the location and extent of all applicable local pressure zones. For cyclonic regions this diagram shall nominate the windows to be capable of withstanding the impact loads as listed above.

17.4 Earthquake Forces

17.4.1 Facilities shall be designed and constructed to withstand the force assumptions of AS 1170.4 *Structural design actions Earthquake actions in Australia*. Healthcare facilities defined by the FOP as required to comply with clause ”**Disaster or emergency role**” (that is, a facility that is to *withstand natural disasters, or with a strategic post disaster and emergency role*) or clause ”**Continue surgical and/or emergency services during failure**” (that is, a facility that is to *continue to offer invasive surgery or emergency medical services through failure of normal utility services*), shall have in Importance Level of 4 according to the NCC, whereas all other facilities shall attract an Importance level as defined by the NCC.

17.4.2 Particular attention should be given to the design of non-structural elements where loads are likely to be imposed in accordance with AS 1170.4 Section 8 *Design of Parts and Components*. The structural engineer shall define the allowable arrangements for mounting and fastening any non-structural elements on and from the structure. The FRMP shall mitigate against mounting non-structural elements without complying with the structural engineer's requirements.

17.4.3 All seismic joints shall be designed to minimise the passage of fire and/or smoke horizontally and vertically.

17.5 Imposed Actions

17.5.1 The structure shall be designed to be capable of sustaining the design loads listed in the loading code AS/NZS 1170.0 *Structural design actions General principles* and AS/NZS 1170.1 *Structural design actions Permanent, imposed and other actions* unless higher loads are required in the following live loads table. The structural engineer shall determine the actual loads but shall not be less than those nominated in the Live Loads Table below.

17.5.2 Further allowance should be made for access ways, aisles or spaces where heavy equipment loads may be moved or located during construction, installation or commissioning.

17.5.3 Live Loads Table

AREA	ELEMENT	MINIMUM LOADING CONDITION <15 PLANNED LIFE	MINIMUM LOADING CONDITION >15 PLANNED LIFE	CONCENTRATED LOAD
Minimum floor load	Floor	3.0 kPa Uniformly Distributed Load (UDL)	5.0 kPa UDL	4.5kN
Plant rooms, Loading dock, Waste holding areas, Bulk stores, Film repository	Floor	7.5 kPa UDL	7.5 kPa UDL	4.5kN
Loading area, Medical records	Floor	10.0 kPa UDL	10.0 kPa UDL	7.0kN
All other stores, Kitchen, Scullery, Catering, Dirty utility, CSSD	Floor	5.0 kPa UDL	5.0 kPa UDL	4.5kN
Dairy and bulk food cool rooms	Floor	15.0 kPa UDL	15.0 kPa UDL	9.0kN

AREA	ELEMENT	MINIMUM LOADING CONDITION <15 PLANNED LIFE	MINIMUM LOADING CONDITION >15 PLANNED LIFE	CONCENTRATED LOAD
M.R.I.	Floor	Check equipment, allow for equipment transport along access provided.	Check equipment, allow for equipment transport along access provided.	Check equipment load
Medical imaging, Ultrasound unit, Operating theatres	Floor	5.0 kPa UDL	5.0 kPa UDL	4.5kN
Medical imaging, Ultrasound unit	Underside of slab over/ceiling structure.	One moving load of 10kN anywhere on the ceiling structure.	One moving load of 10kN anywhere on the ceiling structure.	
Operating theatres	Underside of slab over/ceiling structure.	Minimum of 8 loads of 5kN each located anywhere in the ceiling.	Minimum of 8 loads of 5kN each located anywhere in the ceiling.	

17.5.4 Areas designed for compactus loadings shall be clearly identified on the drawings. Final locations of these areas shall be determined during the planning of the building.

17.6 Dead Loads and Other Loads

17.6.1 Superimposed dead loads and other loads such as that induced by temperature variations shall be assessed in accordance with the NCC and relevant Australian Standards.

17.6.2 The structural engineer shall determine the actual loads but shall be not less than those nominated in the Dead Loads Table below.

17.6.3 Dead Loads Table

AREA	ELEMENT	MINIMUM LOADING CONDITION <15 PLANNED LIFE	MINIMUM LOADING CONDITION >15 PLANNED LIFE	CONCENTRATED LOAD
Superimposed dead load	Floor	1.0 kPa Uniformly Distributed Load (UDL)	1.5 kPa UDL	
Minimum ceiling load	Ceiling structure	0.5 kPa UDL	1.5 kPa UDL	

17.7 Substructure

17.7.1 The substructure includes the building footings and any basement areas of the building.

17.7.2 Substructure design shall be based upon geotechnical site investigation (refer to chapter "*Engineering Services, Civil*", section "*Site Investigation*").

17.7.3 Substructure shall be designed to transmit the building loads to ground of a suitable bearing capacity, in accordance with the requirements of:

- AS/NZS 1170 (all parts) *Structural design actions*
- AS 3600 *Concrete structures*
- AS 1289 (all parts) *Methods of testing soils for engineering purposes*
- AS 2159 *Piling – Design and installation*
- AS 2870 *Residential slabs and footings*

17.7.4 Sub-structures shall be designed to:

- Tolerate movements in the foundations caused by moisture variations, settlements and the like and comply with the relative differential movement limits as defined in the Geotechnical Report and the relevant Australian Standards, and provide articulation of the superstructure consistent with these limits
- Provide a projected building life at least equal to that of the building structure
- Permit access for the performance of routine maintenance of sub-soil drainage systems and any other services located within this zone
- Require no maintenance
- Control vibration and noise transmission into and throughout the structure (refer to chapter "*General & Environmental Requirements* section "*Acoustic Services Brief* ")
- Prevent ground water and storm water from entering into any parts of the building (refer to chapter "*Engineering Services, Civil*" section "*Drainage*")

17.8 Structure

17.8.1 The structure includes all components which contribute to the function of sustaining and transferring to the foundations all forces and moments arising from vertical and horizontal loadings on the building, e.g. columns, upper floors, roof structures, support beams, staircases, shear walls and structures supporting services and equipment. Design shall comply with, among other things:

- AS/NZS 1170 (all parts) *Structural design actions*
- AS 3600 *Concrete structures*
- AS 4100 *Steel structures*
- AS 1720 (all parts) *Timber structures*
- AS 3700 *Masonry structures*
- AS 2870 *Residential slabs and footings*
- AS/NZS 1664 (all parts) *Aluminium structures*
- AS 3850 (all parts) *Prefabricated concrete elements*

17.8.2 The structure should be designed and suited to the planned life of the building.

17.8.3 Maximum structural deflections shall not exceed the specifications of the Australian Standards and for patient treatment and accommodation areas those of the following table:

17.8.4 Deflection Table

STRUCTURAL ELEMENT	MAXIMUM DEFLECTION
Supporting face brick walls	Span/1000 after construction of partitions
Supporting rendered brick walls	Span/1200 after construction of partitions
Floors not supporting brittle elements	To comply with AS 1170.0
Stud walls under lateral loading	Span/500
Roof members (primary and secondary beams) under:	
a) Dead load (G) +	The lesser of span/360 or 25mm
b) Live load (ψs Q) +	Span/240
c) Wind load (Ws) +	The lesser of span/150 or 10mm

Note: designers should take cognisance of future use of an area.

17.8.5 Notwithstanding compliance with the Australian Standards and the above deflection table, deflections should also be limited to accommodate equipment/services mounting tolerances, e.g. the tracking and position holding of suspended operating lights, gas pendants and radiology equipment should not be adversely affected by building structural deflections.

17.8.6 Control joints shall be constructed to minimise the effects of linear shrinkage of concrete and masonry, temperature effects, movement of the founding soils and prevent structural pounding in an earthquake or cyclone event. Control joints should suit the geometry of the slabs and shall not compromise the performance of the Facility.

17.9 Additions and Alterations to Existing Structures

17.9.1 Existing structures associated with projects involving additions or alterations to the existing structure shall either:

- comply with the requirements of these Guidelines, or
- be shown by structural risk analysis to be safe for the loadings applied and the purpose the altered building will serve

17.10 Demolition

17.10.1 All structural elements should be designed to allow for safe demolition at the end of their useful life.

17.10.2 Any special requirements for safe demolition shall be documented and provided to the Licence Holder/Applicant.

17.11 Fixings and Fastenings

17.11.1 Fixing methods and fastenings to be used in the project shall be to the approval of and endorsed by the project structural engineer.

17.11.2 Any fixture or fitting within reach of patients and potentially used by a patient to try to recover from falling should be capable of supporting the forces potentially applied.

17.11.3 The Licence Holder/Applicant's FRMP shall mitigate against any fixture or fitting or fixing method being applied without complying with a structural engineer's directions.

17.12 Design Checking

17.12.1 For public hospitals structural design should be independently checked to comply with requirements of the structural engineer's commission contract.

17.12.2 For private hospitals structural design shall at least be checked to comply with requirements by an accredited third-party quality management system.

17.13 Construction Supervision

17.13.1 Construction supervision by the structural engineer should include at least:

- 100% review of shop drawings
- 50% inspection of foundations and sub-structures
- 75% inspection of foundations and sub-structures in reactive soils (all classes other than Class A and S as defined in AS 2870)
- 100% inspection of transfer elements
- 75% inspection of suspended slabs and beams
- 50% inspection of stairs connecting suspended floors
- 50% inspection of columns
- 75% inspection of shear and core walls
- 50% inspection of precast and tilt-up panels
- 100% inspection of erected steelwork

17.13.2 The structural engineer's inspection certification reports, including the certification of compliance with design, shall be recorded in the project 'As Constructed' records.

17.14 Vibration

17.14.1 The general vibration criteria are as follows:

ELEMENT	PHENOMENON CONTROLLED	SERVICIBILITY PARAMETER	APPLIED ACTION	ELEMENT RESPONSE
Floor	Vibration	Static midspan deflection	Q=1.0kN	Less than 1 to 2mm

17.14.2 For all potentially movement sensitive equipment, the floor shall be designed using Finite Element Analysis to meet frequency requirements of the specific equipment to be installed in the area, in accordance with the specification details provided by the equipment manufacturer.

17.15 Maintenance

17.15.1 The design of structure should consider installation arrangements such that connections and primary members are accessible and can be visually inspected from accessible areas. This is to ensure inspection and maintenance tasks can be completed efficiently with minimal disruption to facility operations.

18 ENGINEERING SERVICES, VERTICAL TRANSPORTATION

18.1 Vertical Transportation Services Brief

18.1.1 The extent of vertical transportation services shall be defined with a fully detailed description of services to be provided by the Licence Holder/Applicant as part of their submission that supports the safe, secure and reliable clinical and building operational functionality of the health facility served by the vertical transport systems and other transportation arrangements (as necessary).

18.1.2 The performance required to deliver such services shall be not less than as required by the NCC, statutory regulations and these Guidelines.

18.1.3 The Licence Holder/Applicant should deliver a cost effective solution to satisfy the design brief and also demonstrate the inherent future flexibility, expandability, and adaptability to suit the changing needs of the building operational requirements and clinical services delivery over the life of the building.

18.2 Extent of Services

18.2.1 The vertical transportation brief shall consider the need for:

- lifts:
  - bed/passenger lifts
  - passenger lifts
  - goods lifts
  - service lifts
- document and specimen conveyors
- goods conveyors
- hoists and gantries
- automated guided vehicles (AGV's)

18.2.2 The design shall comply with:

- Australian and relevant international standards
- National Construction Code
- Disability Discrimination Act

18.2.3 The project requirements for vertical transportation shall be determined in conjunction with project specific space planning and traffic flow studies.

18.2.4 Lift traffic design and analysis shall be undertaken by a suitably qualified vertical transportation engineer and using specific lift transportation design software.

18.3 Coordination with Other Disciplines

18.3.1 All naming and labelling of electrical supply, cable installation, power quality management and protection coordination of circuit protective devices shall be as defined within the electrical design.

18.3.2 Refer to chapter "*Background*", section "*Definitions*" with clauses that contain a list of terms relating to electrical power supplies as relevant to healthcare facilities referenced within The Guidelines.

18.4 Design Considerations

18.4.1 Lifts should be located to limit transfer distances from any point on a floor plate. Typically this should be less than 50m for all traffic types.

18.4.2 Where there is a requirement for high cross traffic of patients across large floor plates, lift nodes should ideally be within 50 metres travel distance from any point on the floor plate.

18.4.3 Staff, patient, public and goods/service lifts shall be separated wherever possible.

18.4.4 Where the lifts provide access for critical services, redundancy should be provided by grouping at least two lifts together.

18.4.5 Careful consideration should be given before incorporating escalators or moving walks into any healthcare facility; they are generally not suitable for use by disabled, elderly or infirm passengers and a stationary escalator is not appropriate for use as a stairway.

18.5 Vertical Transportation Drawings and Specifications

18.5.1 Project documentation shall at least define:

- the design codes used in the design
- the extent and layout of the services
- the performance and quality of the services
- the capacity of services

18.6 Lifts

18.6.1 Any building of more than one storey that does not have ground level access to all levels shall have adequate lifts to provide safe and reliable vertical transport between levels for all conditions of persons and goods that need to move between levels.

18.6.2 The quantity of lifts and their size, speed and load carrying capacity shall be determined by analysis of their anticipated usage as determined by site-specific design brief to meet the requirements of the FOP (e.g. considering application to public passenger lifts, staff/patient-bed lifts, dedicated or shared passenger /goods lifts & CSSD goods lifts, etc), and likely failure scenario impacts on facility operations.

18.6.3 Passenger and materials lift traffic analysis shall be undertaken to determine number of lifts.

18.7 Lift traffic design

18.7.1 Lift traffic analysis for each lift or group of lifts should consider:

- the number of floors served
- the number of beds per floor
- the number of consulting rooms per floor
- types of departments located on each floor
- inter-floor bed movements
- the location of operating theatres and imaging facilities
- the main entry floor and supplementary entry floors
- the shift patterns and handover times for staff members

- the peak traffic flows for each passenger type served by the lift or lift group (i.e. visitors, staff, beds, goods trolleys etc.)
- the number of visitors and visiting times
- detailed assessment of lift passenger distribution considering the type of facilities and amenities served by the lifts or group of lifts on each floor
- distribution and movement of food, beverages, laundry, medical supplies, waste etc.
- emergency evacuation where lifts are included as part of a vertical evacuation strategy

18.7.2 Lift traffic analyses shall be based on:

- dynamic simulation methodology using a proven simulation tool
- achieving stated design criteria
- stated design populations for various traffic types
- traffic flows developed to reflect the predicted vertical transfers between levels which should be derived from the project functional brief
- maximum lift car loading as stated for each traffic type

18.7.3 Lift Design Criteria

LIFT TYPE	TRAFFIC PROFILE	HANDLING CAPACITY	AVERAGE WAITING TIME	MAXIMUM CAR LOAD
Public Lifts	2 - Way	≥12% visitor population	30-50 seconds	80% Note 1
Car Park Lifts	2 - Way	≥10% car park population	30-50 seconds	80% Note 1
Bed Lifts	Note 3	5% of Bed population /5 minutes	30-50 seconds	1 bed or 1 bed + 4 staff where shared bed/staff lifts are proposed
Staff Lifts	Note 3	≥12% staff population	30-50 seconds	80% by area Note 1
Goods Lifts	Note 3	5% of Bed population /5 minutes	<40 seconds	2 trolleys Note 2

Note 1: Simulations to allow maximum loading of passenger lift cars to 80% of available internal area with an allowance for 0.3 m^2 per passenger.

Note 2: Assumes goods lift car is sized to accommodate 2 trolleys. Maximum to be adjusted to suit lift car and trolley selections.

Note 3: Traffic profile to be simulated based on assessment of the inter-floor movement of each traffic type using a lift or group of lifts.

18.7.4 Design population numbers to be used in lift analyses shall be based on a minimum of the following:

POPULATION TYPE	TRAFFIC PROFILE
Clinical staff	3 staff members per bed
Administration staff	1 person per 12 m^2 of admin office space
Outpatients	1.5 people per 30 minutes per consulting room
Public visitors	2 visitors per bed
Car park users	1.5 people per car park space

18.7.5 Bed Lift car sizes

Bed lift car sizes shall be fit for purpose including consideration of intended lift use and maximum viable size of beds/equipment expected to be transported.

Each lift shall accommodate the largest option available for equipment or patient circumstances requiring transport, e.g. a patient bed with all attachments, attendant trolleys and attendant staff that are needed for worst case safe patient movement.

Clinical planning and Facility operation policies shall define the lift dimensions needed to fulfil this condition.

Typical bed/equipment sizes that may need to use lifts include:

ITEM	WIDTH	LENGTH
Ambulance stretcher	750mm	2200mm
Standard bed	1080mm	2370mm
Critical care bed	1100mm	2400mm
Bariatric bed	1370mm	2540mm
Electric bed tug		Add 580mm

18.7.6 Preferred bed lift car sizes, measured between walls for each case are as follows:

ITEM	CLEAR WIDTH BETWEEN WALLS	CLEAR LENGTH BETWEEN WALLS	MINIMUM ENTRANCES
Ambulance stretcher	1600mm	2400mm	1400mm x 2100mm
Standard bed	1800mm	2700mm	1400mm x 2100mm
Critical care bed	2400mm	3000mm	1600mm x 2100mm
Bariatric bed	2400mm	3000mm[Note 1]	1600mm x 2100mm

Note 1: Increase to 3200mm if bariatric beds are to be moved with an electric tug.

18.7.7 Public Lift Car Sizes

Public/visitor lifts shall consider use by elderly, disabled and users in wheelchairs. Consideration of a wide/shallow car shape with wide entrances should be made to provide optimum passenger transfer times and to intentionally avoid accommodating a bed and deter staff use of these lifts.

18.7.8 The minimum acceptable size for public lifts is Preferred configurations for public lifts are as follows with selection of size subject to lift traffic analysis results:

CAPACITY	CLEAR WIDTH BETWEEN WALLS	CLEAR LENGTH BETWEEN WALLS	MINIMUM ENTRANCES
1275kg /17 Passenger	2000mm	1400mm	1300mm x 2100mm
1600kg /21 Passenger	2100mm	1600mm	1300mm x 2100mm
1800kg /24 Passenger	2350mm	1600mm	1300mm x 2100mm
2000kg /26 Passenger	2350mm	1700mm	1300mm x 2100mm

18.7.9 Goods /Service Lift Car Sizes

Goods and service lifts sizes should consider the need to accommodate trolleys, carts and other implements intended for use for catering, laundry and general goods movements throughout the facility.

Where goods lifts are required for movement of plant and large pieces of medical apparatus (i.e. imaging equipment), then they shall be sized accordingly to accommodate the largest piece of plant or equipment.

Consideration of a longer/narrow car shape with wide entrances should be made to provide capacity for two or more of the largest trolleys/carts where possible.

18.7.10 Preferred configurations for goods and service lifts are as follows with selection of size subject to lift traffic analysis results or assessment of plant and equipment to be accommodated:

CAPACITY	CLEAR WIDTH BETWEEN WALLS	CLEAR LENGTH BETWEEN WALLS	MINIMUM ENTRANCES
1600kg	1400mm	2400mm	1300mm x 2100mm
2000kg	1500mm	2700mm	1300mm x 2100mm
2500kg	1800mm	2700mm	1400mm x 2100mm

18.7.11 Special Operating Controls

Priority/Code Blue Control, Exclusive Service Control and Hazardous Goods Control.

These lift control modes provide staff with control options to effectively cater for various clinical, operational and maintenance requirements.

These modes of control should be planned with all relevant stakeholders to appropriately determine:

- Selection of lifts required to have each method of control
- Method of activation (key switch /access card interfaced with access controls /other)
- Operation in the lift car and at the lift landings
- Audio and visual communication within the lift cars and at the lift landings
- Operation of other lifts not under these modes of control
- Method of return of lifts to normal service on completion of any special operating control mode

18.7.12 Access Control

Provision shall be made within the travelling cables to all lift cars, to allow the installation of access control card readers to each car operating panel.

Where lifts serve clinical functions with differing access limitations (such as mental health, operating theatres, vulnerable cohorts within a general functional building), access control shall be provided via an interface between the lift controls and the electronic access control system that:

- is programmed to the functional and clinical needs of the facility
- prevents access of people to the restricted zone
- avoids people entering a lift from a restricted zone departing into a non-restricted zone unless accompanied or given explicit access rights to that zone
- allow programming changes should the functional requirements change

18.7.13 Machine-room-less (MRL) lifts shall be designed to:

- minimise impact on hospital operations caused by the maintenance access required to lift machinery
- allow management of the working environment where control cabinets are installed (often at landings)
- provide appropriate fire protection
- ensure any additional facilities required to rescue trapped passengers are provided

18.7.14 An additional goods lift shall be considered where any single lift carries a large portion of the hospitals goods traffic.

18.8 Lift Performance and Installation Requirements

18.8.1 Lifts shall:

- comply with the appropriate parts of AS 1735 (various parts) *Lifts, escalators and moving walks*,
- comply with the appropriate parts of EN81 *Safety rules for the construction and installation of lifts*,
- comply with the appropriate parts of AS 1668.1 *The use of ventilation and air conditioning in buildings Fire and smoke control in buildings*
- comply with the requirements of the NCC
- have fire service control in accordance with the NCC
- have levelling accuracy of ≤ ±5mm

18.8.2 Precautions shall be taken to ensure that sound and vibration from hoisting motors, pumps, hydraulic systems and direct drive systems are not transferred into the structure or lift cars.

18.8.3 General-purpose power outlets associated with a lift installation shall be 30 mA residual current device protected and labelled as not suitable for equipment connected to a patient. Lighting and power circuits within common areas of the facility shall not be used on a lift installation.

18.8.4 If a socket outlet in a lift is intended to be used to power equipment connected to a patient it shall be protected by LPD located behind a door within the lift car, in compliance with AS/NZS 3003 *Electrical installations - Patient areas*.

18.8.5 Lifts should be connected to the vital electricity supply (where such supply is provided to the facility). Where not all lifts can operate on the vital supply available, then:

- at least one lift in each grouping of fire zones shall operate
- at the beginning of emergency supply all lifts shall home to the egress floor at rated speed, open its doors to allow any passengers to alight and shut down with doors open. The homing process shall be controlled in a sequence that will not overload the emergency electricity supply
- during the homing process all lifts shall, by audible message and visual signage, advise passengers they are returning to the main entry floor
- once homed, lifts shall, by audible message and visual signage, advise any person entering the car of the lift status, e.g. “out of service”, or “emergency power starting please wait”
- in the case of multiple lifts in a fire zone grouping if the lift selected to operate on vital electricity is out of operation or fails to operate the duty shall automatically pass to the next lift in the group
- any lift not connected to a vital supply source shall incorporate an emergency rescue system.

18.8.6 The lift and lift well design shall consider the risk of lift well temperatures exceeding 40°C and where this risk exists, take steps to ensure lifts will not be shut down, either through a preventative parking sequence triggered by high temperatures or through component failure due to overheating.

Such steps may consider an alternative solution to the NCC Deemed to Satisfy requirement with components designed and warranted to operate at higher than 40°C or lift shaft cooling/ventilation.

18.8.7 Lift car doors shall be:

- horizontal opening power operated type with operators having adjustable speed and torque
- provided with a passenger protection device of the solid state modulated multi-beam infra-red type with extended convergence zone protection into the hallway for greater passenger protection and to reduce the doors being damaged by trolleys and beds

18.8.8 Lighting in lift cars shall:

- where used for patient transfer or clinical observation shall comply with AS/NZS 1680.2.5 *Interior and workplace lighting - Hospital and medical tasks*; refer also section regarding lighting for clinical observation in chapter “*Engineering Services, Electrica*l”
- include two self-contained battery/inverter emergency lights installed in each lift car and one on top of each lift car. Luminaires shall be compliant with AS/NZS 2293 *Emergency lighting and exit signs for buildings* to match the building emergency lighting system and provide a minimum illuminance level of 50 lux at the floor. The battery pack for each luminaire should be located on the car roof and be accessible from inside the car

18.8.9 Traction lifts power and drive systems shall:

- be of the direct drive solid state type with efficient filtering and electrically isolated from the main supply system
- comply with the Australian EMC framework for radio frequency applications
- comply with AS/NZS CISPR 14.1 1 *Electromagnetic compatibility - Requirements for household appliances, electric tools and similar apparatus* and AS/NZS 61000 (various parts) *Electromagnetic compatibility (EMC)*
- have variable voltage, variable frequency (VVVF) alternating current type drives and the drive should be regenerative

18.8.10 Traction lifts power and drive systems should be equipped with a UPS powered emergency lowering and release system to provide automatic lowering of the lift car to the next floor and open the doors in the event of a power failure.

18.8.11 Electro-hydraulic lifts should be:

- considered only for low rise installations with less than 45 starts per hour (Up call) and speed less than 0.8 m/s
- fitted with oil coolers ventilated to the outside of the lift motor room
- fitted with silencers
- connected to the vital power system (where such supply is provided to the facility)
- equipped with a UPS powered emergency lowering and release system to provide automatic lowering of the lift car to the next floor and open the doors in the event of a power failure

18.8.12 Provision for persons with disabilities shall include:

- requirements of AS 1735 Part 12, *Lifts, escalators and moving walks - Facilities for Persons with Disabilities* and the *National Construction Code*
- auxiliary car operating panel
- a hands free two way emergency voice communication system provided from each lift car to an emergency 24 hour answering service
- a digital car position indicator which shall be selected for colour, letter type and size to provide easy effective reading installed in each lift car operating panel
- on lift services over two levels, direction of travel lanterns at each landing
- the clearance between car sill and landing sill (running clearance) shall not exceed 30mm

18.8.13 Additional lift features should include:

- digital car position indicator on each entrance landing
- permanently illuminated alarm button
- speech announcement systems in each lift car to advise car direction, floor served and emergency messages
- hearing induction loop in each lift car
- permanent floor numbers installed on the sight guard and to the rear of each set of landing doors, where the landing door sight guards are not suitable for fixing floor numerals (e.g. on newer door types) provide numbering to the requirements of AS 1735.12
- pre-recorded identification message on emergency phone systems that identify the lift location to the answering party

18.8.14 Floor finishes and wall and ceiling linings shall meet relevant fire resistance properties in accordance with NCC and AS 1735.1.2.

18.8.15 Lifts shall be provided with fault and maintenance diagnostic facilities necessary for efficient and effective long-term maintenance and performance management.

18.8.16 Comply with ISO 8102-20:2022 (and any later update or amendment) to warrant cybersecurity of electrical systems in lifts and provide a cybersecurity risk assessment for any digitally connected features and integrations of the lift system including and not limited to Ethernet, TCP/IP connectivity, GSM or cellular connectivity, ModBUS, or BACnet.

18.9 Document and Specimen Conveyors

18.9.1 Any conveyor shall:

- transport specimens without acceleration or impact causing damage to the specimen
- be connected to the vital electricity supply
- comply with noise limits of subsection "*Acoustic Services Brief*"
- have provision for directing incorrectly addressed carriers to an attended station

18.10 Hoists

18.10.1 A hoist should be used for lifting plant to a machine room. Note: this clause does not refer to a patient hoist (which is covered separately under subsection "*Equipment*").

18.10.2 Hoists shall:

- be labelled with safe working loads
- comply with relevant design codes

18.11 Automated Guided Vehicle Systems (AGVs)

18.11.1 Automated guided vehicles (AGVs) are used for handling material in large healthcare facilities to transport supplies, medication, linens, meals, and waste streams throughout a facility. The AGVs navigate defined paths using embedded guide wires or laser guidance systems.

18.11.2 Autonomous mobile robots (AMRs) are also used for handling material, do not require embedded infrastructure and are suitable in new and existing facilities that have restricted corridors or multiple levels (or both).

18.11.3 Provision of such systems shall be based on Licence Holder/Applicant assessment with input from specialist designer. Analysis and design shall be undertaken by a suitably qualified integrated transportation professional and using recognised appropriate design software.

18.11.4 The use of AGVs can be appropriate to reduce staffing demand in the supply chain process for containerised transport of general goods, linen, meals and rubbish. Such systems can provide an automated container transfer service for scheduled transport needs and for specific demands as they arise.

18.11.5 Spatial and services interface should be coordinated, including consideration of:

- environment – such as internal use only
- corridor and walkway width suitable for both pedestrians and AGVs
- corridor and walkway floor covering, gradient, level changes

18.11.6 AMRs typically handle smaller volumes and tend to be more suited where an embedded guided vehicle system is not practical. Increasingly these may be used for:

- document courier

- environmental data collection and monitoring
- food and beverage distribution
- linen supply and collection
- laboratory specimen handling
- pharmacy supplies.

18.11.7 Design considerations should include the following when assessing the suitability and application of AGV and AMR installations:

- AGV parking, storage, recharge area
- electrical supply source, charging should be connected to the vital electricity supply and controls connected to instantaneous supply
- communications and security services interface
- lift services interface
- automated door interface

18.12 Testing and Commissioning

18.12.1 Lifts shall be tested and commissioned as required by AS 1735, EN 81, AS/NZS 3000, and relevant Statutory Authorities.

18.13 Maintenance

18.13.1 All lifts and vertical transportation equipment shall be procured with fully comprehensive maintenance, with a scope of service that ensures lifts are maintained in a safe and reliable condition in accordance with WH&S legislation.

18.13.2 All lifts shall incorporate equipment that provides access clearances in accordance with AS 1735.1.2.

18.13.3 The location and design of maintenance service panels for MRL lifts, that need to be accessed from a landing should be subject to coordination and approval of the architect and client design team.

19 EQUIPMENT

19.1 Equipment Brief

19.1.1 The Licence Holder/Applicant shall define the extent of equipment to be provided and the performance required from each item, which shall be not less than as required by statutory regulations and these Guidelines.

19.1.2 The availability (i.e. % of the time available) the Licence Holder/Applicant requires from the equipment should also be specified; this will allow an assessment to be made of the need for special maintenance arrangements or redundancy in equipment numbers to cover down time for maintenance.

19.1.3 Equipment should be supported in Australia and parts available for a minimum of ten years from date of purchase.

19.2 Equipment Specifications

19.2.1 Equipment specifications shall at least define:

- the design codes to be complied with
- the site conditions to apply
- the performance and quality of the service to be delivered

19.3 Equipment, General

19.3.1 It is not intended that these Guidelines describe requirements for every item of equipment used in facilities but to specify general standards, requirements and principles and draw attention to particular equipment issues sometimes overlooked.

19.3.2 Equipment shall:

- if fixed to the project structure or superstructure have supports and fixings to comply with
  - AS 1170.4 *Structural design actions Earthquake actions in Australia Section 5 Requirements for Non-structural Components* and
  - chapter "*Engineering Services, Structural*"
- if standing on a suspended floor, not impose floor loading in excess of design loadings advised by the project structural engineer
- have operating noise and vibration levels complying with subsection "*Acoustic Services Brief*"
- not cause radio or electromagnetic interference with any other equipment or processes in the facility
- if electrically powered by other than extra low voltage electricity be:
  - inspected for electrical safety before being placed in service
  - inspected for electrical safety at intervals determined by Licence Holder/Applicant's duty of care
  - display a safety inspection label showing the date the next inspection is due
- if handling any hazardous material be labelled with appropriate safety warnings

19.3.3 Wheeled equipment shall be fitted with:

- buffers to minimise damage to the equipment and the surfaces it contacts in transit
- wheels or castors that will not mark floor finishes or be trapped in joints or lift threshold gaps across which it will pass

- brakes to prevent it moving unintentionally or getting out of control

19.3.4 The quantity of equipment of each type provided, shall allow for the Licence Holder/Applicant's defined required availability of capacity, and the required down times for maintenance, testing and cleaning.

19.3.5 Storage facilities should be provided for portable equipment that:

- protects the equipment from interference
- makes it appropriately accessible for use
- prevents it obstructing egress routes or access to other equipment or services

19.3.6 Power operated equipment used to lift or transport patients should have manual means of restoring them to normal mobility if the powered motion fails.

19.4 Medical Electrical Equipment

19.4.1 Medical electrical equipment shall comply with all the appropriate parts of AS/NZS 3200 (various parts) *Medical electrical equipment*.

19.5 Flammable Liquid Storage

19.5.1 Flammable liquids shall:

- be managed so that quantities within any building are within limits specified in AS 1940 *The storage and handling of flammable and combustible liquids*
- have liquids not in use stored in ventilated flammable liquid cabinets

19.6 Chemical Storage

19.6.1 Arrangements for the storage of chemicals shall comply with AS/NZS 2243.10 *Safety in laboratories - Storage of chemicals*.

19.7 Cleaning Equipment

19.7.1 Vacuum cleaners (that recirculate air to the space cleaned) used for cleaning patient areas shall be fitted with HEPA filters.

19.7.2 Portable electric powered cleaning equipment shall have electric cable lengths limited to 15 metres.

19.8 Cool Rooms and Freezer Rooms

19.8.1 Any refrigerated or cooling chamber, or the like which is of sufficient size for a person to enter shall:

- have adequate means of communicating or alerting other occupants in the building in case of an emergency
- have a door which is of adequate dimensions to allow occupants to readily escape and openable from inside without a key at all times

19.8.2 Cool and freezer rooms in which people are required to work with doors closed shall be provided with forced ventilation at a rate to maintain oxygen levels and appropriately dilute any air contamination.

19.8.3 Cool and freezer rooms shall be insulated or insulated and fitted with anti-condensation heaters to prevent condensation on external surfaces.

19.8.4 Cool and freezer rooms shall be fitted with entrapment alarms immediately outside and connected to the BMCS (where available or other readily recognisable location where connection to BMCS is not available).

19.9 Cryogenic Storage

19.9.1 There is an inherent risk associated with storage and handling of cryogenic material; storage and handling shall be provided with due consideration and appropriate measures to avoid unsafe conditions for people in the facility or damage/loss of stored product.

19.9.2 Storage of products in cryogenic material shall be undertaken with detailed consideration of risk issues and management of those issues.

19.9.3 Compliance with requirements of AS 1894 *The storage and handling of non-flammable cryogenic and refrigerated liquids* shall be achieved.

19.9.4 Alarms associated with cryogenic storage facilities shall be connected to the BMCS in addition to local annunciation.

19.10 Laboratory Equipment

19.10.1 Fume cupboards shall comply with AS/NZS 2243.8 *Safety in laboratories – fume cupboards*.

19.10.2 Fume cupboards (and fume hoods) shall have fault alarms (i.e. fan failure alarms) and be interfaced to the BMCS.

19.10.3 Biological safety cabinets shall, as appropriate to the application, comply with:

- AS 2252.1 *Biological safety cabinets Biological safety cabinets (Class I) for personnel and environment protection* (withdrawn but maintained for reference)
- AS 2252.2 *Controlled environments Biological safety cabinets - Class II – design*
- AS 2252.3 *Controlled environments Biological safety cabinets - Class III – design*
- AS 2252.4 *Controlled environments Biological safety cabinets Classes I and II - installation and use*
- AS 2252.5 *Controlled environments Cytotoxic drug safety cabinets (CDSC) – design, construction, installation, testing and use*
- AS 2252.6 *Controlled environments Clean workstations - design, installation and use*

19.10.4 Cabinets that require decontamination before access for maintenance shall be provided with means of safely venting any gases or vapours involved in the decontamination process.

19.11 Sterilisation Equipment

19.11.1 Sterilisers shall comply with:

- AS 1410 *Sterilisers – Steam - Pre-Vacuum*
- AS 2182 *Sterilisers – Steam - Bench top*
- AS 2192 *Sterilisers – Steam - Downward displacement*
- AS 2487 *Dry heat sterilisers*
- AS/NZS 5369 *Reprocessing of reusable medical devices and other devices in health and non-health related facilities*

19.11.2 Washer/disinfectors shall comply with:

- AS 2945 *Batch-type washer/disinfectors for healthcare facilities* (withdrawn but maintained for reference)
- AS 3836 *Rack conveyor washers for healthcare facilities*

- AS/NZS 5369 *Reprocessing of reusable medical devices and other devices in health and non-health related facilities*

19.11.3 Ultrasonic cleaners shall comply with:

- AS 2773 *Ultrasonic cleaners for health service organisations*
- AS/NZS 5369 *Reprocessing of reusable medical devices and other devices in health and non-health related facilities*

19.11.4 Heat and vapour from sterilisation equipment should be collected and exhausted without effecting the occupied environment.

19.11.5 Sterilisation equipment enclosures shall be maintained at temperatures that do not compromise equipment reliability.

19.11.6 Sterilisation equipment shall pass commissioning tests specified in the standards.

19.12 Catering Equipment

19.12.1 Catering departments shall be equipped to maintain food services through any emergency and post disaster conditions the Facilities are required to continue to operate.

19.13 Laundry Equipment

Facilities with outsourced laundry services, where the Facility is required to continue to function though emergencies and post disaster conditions, should consider whether they require some on site laundry capacity to cover break down of normal supplies.

19.14 Ward Equipment

19.14.1 Pan flusher sanitisers shall comply with AS 2437 *Flusher/sanitisers for bedpans and urine bottles* (withdrawn but maintained for reference).

19.14.2 Macerators if used for bedpan and bottle disposal shall be installed to Water Statutory Authority approval.

19.15 Film Processing Equipment

19.15.1 Film processing equipment and connections to drains shall be fitted with means to prevent chemical emissions exceeding statutory limits.

19.15.2 Effluent shall be treated to limit silver discharge to comply with Statutory Authority regulations.

20 FACILITY MANAGEMENT

20.1 Facility Manager

20.1.1 There shall be a competent Facility Manager experienced in healthcare operation and maintenance appointed by the Licence Holder/Applicant to manage the Facility and implement the Facility's operating, maintenance and risk management plans. The Facility Manager may be a nominated staff member representing an organisation engaged by the Licence Holder/Applicant with experience and competency to manage the Facility.

20.1.2 The Facility Manager shall have a performance agreement with the Licence Holder/Applicant that:

- defines the purpose of the performance agreement
- requires the facility to be managed to comply with these Guidelines
- requires the manager to report, in writing to the Licence Holder/Applicant, any deficiencies that are beyond the facilities manager's level of authority to keep within compliance standards
- identifies key performance indicators (KPI's)
- scope of service and response times
- defines the Facility risk management plan (FRMP)
- defines the Facility operating plan (FOP) and Business continuity plan (BCP)
- defines the Facility asset management plan (FAMP)
- defines the Facility maintenance plan (FMP)
- ensures the facility building services and equipment are managed, operated and maintained in accordance with the NCC, Australian Standards, legislation, manufacturers recommendations, systems design and organisational policies

20.1.3 Persons or organisations employed to operate, maintain or develop facilities shall:

- have history of experience and competence in facility management in healthcare or equivalent environments or demonstrated experience in the facility management of a large complex building/s containing systems provided in the Facility
- have the ability to effectively manage and maintain a computerised works management system incorporating asset and maintenance history
- have direction to supply any information needed to keep the records updated to record any changes arising from the work done
- be eligible for full membership of the Institute of Healthcare Engineering Australia
- be fully available to attend the requirements of the Facility

21 FACILITY OPERATION

21.1 Facility Operating Plan

21.1.1 There shall be a written Facility Operating Plan (FOP).

21.1.2 The FOP shall address all operating objectives and risks.

21.1.3 The FOP shall include requirements for testing of all engineering services emergency preparedness scenarios including rehearsing changeover to alternative supplies service.

21.1.4 The FOP shall be reviewed annually to ensure alignment with changes in Standards and Guidelines. Any changes to the FOP shall be actioned within agreed timeframe.

21.1.5 The FOP shall be developed to ensure safe and reliable operation of services by Facility operators.

21.2 Specific Requirements of the Facility Operating Plan

21.2.1 Any standby electrical plant (such as generators, UPS, batteries) emergency electricity generators shall be maintained and tested along with records of operation and maintenance in accordance with AS 3009.

21.2.2 All fire protection services (wet and dry) shall be maintained and tested in accordance with AS 1851.

21.2.3 Develop and implement a Water Quality Risk Management Plan in accordance with HDWA "*Guidelines for Microbial assessment of Water*".

21.2.4 Microbial control of cooling water systems shall be maintained and tested in accordance with AS 3666.3.

21.2.5 Any ventilation system providing cross infection control flow or pressure gradients shall be tested for air balance and integrity of flow direction during heating and cooling modes at least once each year, e.g. once during the heating season and once during the cooling season.

Ductwork cleaning and filter replacement schedules for HVAC ductwork serving clinical areas, as a minimum shall be determined by the Facility Management team and included in the FOP.

21.2.6 Switchgear on main and submain switchboards shall be operated not less than once per year.

21.2.7 Valves on piped services mains and submains and standby fans shall be operated not less than once per year in order to avoid seizure. Pumps and fans operating as a "+1" for resiliency purposes shall be part of a scheduled duty-sharing protocol as part of the BMCS programming.

21.2.8 All facilities shall be inspected, not less than once per year, by persons appointed by the Licence Holder/Applicant and competent to assess details of facility condition, any changed risk status and action required to keep them within Guideline performance requirements. Inspection reports shall be provided to the Licence Holder/Applicant who shall act on the reports with appropriate duty of care.

21.3 Facility Operating Policies

21.3.1 The FOP shall define the Licence Holder/Applicant's Operating Policies for the facilities and facility services. The operating policies shall cover:

- who is authorised to operate
- the conditions under which they can be operated

- the hours during which they are operated
- the equipment operating and performance parameters to be maintained for safe reliable cost effective operation
- emergency modes of operation and the circumstances that apply to changing to emergency operating configurations and changing back to normal operating modes
- testing and quality assurance requirements to keep facilities in safe reliable order and rehearsal requirements to keep operators and users able to deal with foreseeable contingencies
- reporting on asset and asset management performance

21.3.2 Note: Facilities operating policies form a subset of all operating policies for the functions performed at the facility.

21.4 Operator Training

21.4.1 The Licence Holder/Applicant (including an organisation supplying Facility Management services) shall provide and support adequate and ongoing training and instruction to facility operators and in accordance with regulatory requirements where applicable.

21.4.2 Instructions shall be available in writing for reference by operators.

21.5 Operator Competence

21.5.1 The Licence Holder/Applicant shall assess operator competence and only allow competent operation.

21.6 Operating Records

21.6.1 There shall be records of:

- operating policies
- operating instructions
- operating competence assessment
- emergency procedures testing and rehearsal
- audits and inspections of facilities, plant and equipment
- commissioning, testing and certificates of compliance for all facilities plant and equipment

22 FACILITY MAINTENANCE

22.1 Facility Maintenance Plan

22.1.1 There shall be a written Facility Maintenance Plan (FMP) which, as a minimum, shall:

- provide for maintenance and component replacement of the facilities or equipment to improve efficiency and maximise economic life while minimising operational costs over the planned life of the facility
- maintain the Facility to deliver duty of care facility risk management and provision of an appropriate healthcare environment
- demonstrate that the facility, plant and equipment are maintained and that maintenance activities are documented
- be monitored and managed by the Licence Holder/Applicant and reviewed at a minimum of intervals not exceeding two years

22.1.2 Where activities of the FMP require involvement of an external contracting body there shall be clearly documented procedures that identify the skills, competency and experience necessary to successfully complete the work in an operating healthcare environment. This shall be documented for both the contracting entity and the individuals involved in the work.

22.2 Maintenance Training

22.2.1 The Licence Holder/Applicant shall provide training and instruction to facility maintainers.

22.2.2 Maintenance instructions shall be:

- available in writing for reference by maintainers
- of a standard where any competent person unfamiliar with the Facility is able to readily determine the extent and details of the system and safely execute the maintenance required

22.3 Maintenance Competence

22.3.1 The Licence Holder/Applicant shall assess, or employ a competent person to assess, the competence of each maintainer and only allow competent maintainers access to the Facility.

22.3.2 There should be records of:

- the As Constructed details of the Facility
- maintenance instructions used
- maintainer competence assessment
- each maintenance task completed
- materials used
- who provided the maintenance
- dates and times the maintenance was provided

22.3.3 Maintenance records should be kept for the life of the item maintained.

22.3.4 When alterations to facilities are carried out the Licence Holder/Applicant should ensure that the “As Constructed drawings” of the Facility are updated rather than recording the alterations on separate sheets.

If this is not done, as time elapses and alterations increase, it gets increasingly difficult to identify the true 'as constructed' status of the facility.

The requirement for new in-ground services to be surveyed and photographed before being covered up should also be considered.

22.3.5 The records (including all updates) shall be held in an accessible location at the healthcare facility for reference by maintenance personnel, fire authorities and other parties having need to reference this information.

22.3.6 A copy of the records and updates should be made and be maintained at a separate location as a precaution against the working record being destroyed.

22.3.7 Where records are stored electronically all files should be kept in a universally accessible format, fully accessible without need for password and not subject to expiry.

22.4 Facility Asset Management Plan (FAMP)

22.4.1 All facilities shall have a FAMP.

22.4.2 The purpose of the FAMP is to plan the life of the asset from date of purchase to date of disposal.

22.4.3 The FAMP shall provide clear guidelines to ensure that the assets are maintained to maximise economic life for financial, liability and insurance purposes.

22.4.4 All new assets purchased that require planned preventative maintenance shall be added to the FAMP.

22.4.5 As a minimum the FAMP shall:

- comply with these Guidelines
- uniquely identify each major asset
- provide a safe environment
- maintain business continuity
- be reviewed annually
- update preventative/predictive maintenance strategies for new assets
- record disposal of assets no longer required

22.4.6 All major assets should be identified within the FAMP with the following:

- asset number
- asset name/description
- location
- date of purchase or installation
- anticipated end- of-life date

22.4.7 The Licence Holder/Applicant should consider electronic storage of the FAMP along with FRMP, FOP and FMP and keep copies both on-site and off-site, with documents readily accessible without need for special access requirements.

22.5 Fire Systems Inspection and Testing

22.5.1 All routine servicing of fire services (passive and active) shall be undertaken in accordance with:

- statutory and regulatory requirements
- requirements of the FER

- relevant Australian Standards including but not limited to AS 1851, AS 2293.2 and others.
- manufacturers recommendations

22.5.2 Planning of all required activities shall be kept as a part of the FAMP and record of all maintenance actions shall include:

- copy of all fire and safety related services certifications
- system/equipment identification and location
- baseline data associated with essential fire systems including active and passive fire safety measures
- schedule of routine inspections for each system
- date and frequency of service performed
- record of inspections (routine and non-scheduled), with sign-off by the responsible party
- details of each activity performed, including recorded results where necessary, and record of outcomes as “pass” or “fail” as appropriate.
- details of each non-conformance or defect including its classification, location and any rectification completed
- details of the service provider and responsible service person

22.5.3 All defects shall be confirmed in writing:

- listed with necessary rectification options and timeline for re-inspection
- critical items recorded as soon as practicable but no later than 24 hours from identification of the defect and reconfirmed each time the defect is identified
- non-critical defects, non-conformances and out of tolerance items recorded as soon as practicable but no later than one week
- recommendations for future activities

23 PROJECT COMMISSIONING CERTIFICATES

23.1 Information to be provided

23.1.1 When presenting a project for Approval to Occupy and in the case of private facilities issue of a licence to operate, the Licence Holder/Applicant shall provide the following signed certificates that certify:

- the project complies with The Guidelines that were current at the date of Approval in Principle
- the project quality and performance at least complies with the documentation that was the basis for the project being granted Approval to Construct status
- tests described in The Guidelines have been performed, passed and there are records to prove it
- there is a FRMP and mitigation has been or is ready to be implemented (refer chapter "*Facility Risk Management Plan*")
- there is a Facility Operating Plan and operators are trained ready to implement it and have access to written operating instructions
- there is a Facility Maintenance Plan and arrangements have been made for it to be implemented and maintainers have access to written maintenance instructions (refer chapter "*Facility Maintenance*")
- there is a Facility Asset Management Plan and arrangements have been made for it to be updated for all new and disposed assets (refer chapter "*Facility Maintenance*")
- the Facility Manager, or their competent delegate, has witnessed all commissioning of services to ensure they meet the requirements of The Guidelines
- the Facility Manager has received all "As Constructed" documentation comprising at least one hard copy and one electronic copy
- the Facility has been subject to a full project completion builders clean and tidy, and where relevant, a clinical clean has been carried out with swab test results available to demonstrate suitable level of cleanliness
- all essential systems for the proper functioning of the facility are operational, and all relevant system interfaces are in place and have been demonstrated as fully integrated and functional

23.1.2 Access to test reports and listed plans may be required as part of the Approval to Occupy assessment process.

24 APPENDIX – APPROVAL TO OCCUPY (ATO) INSPECTION

List of items for consideration prior to Approval to Occupy inspection.

Note: this is provided as a guide of the minimum/typical matters to be addressed by the Licence Holder/Applicant's design and construction teams prior to seeking ATO. It is not and is never intended to represent a complete or comprehensive list. The Licence Holder/Applicant is required to take responsibility for full compliance and shall ensure their contractors/consultants/designers fully comply with the requirements of the WAHFG including all matters established or implied through the AIP and ATC process.

1. General

The Approval to Occupy (ATO) Inspection as carried out by the Licensing and Accreditation Regulatory Unit (LARU) of the Government of Western Australia Department of Health is a random audit of the facility/area. It is the responsibility of the Licence Holder and/or their representatives to undertake 'due diligence' to ensure that the facility/area complies with Western Australia Health Facility Guidelines for Engineering Services, National Construction Code of Australia and all relevant Australian Standards and is fit for intended function/use.

Practical completion (PC) shall have been granted and a certificate of PC presented to LARU prior to the ATO inspection.

At the time of undertaking an ATO inspection all relevant certification and approvals documents shall be available, including: poisons license, Radiation Council certificate, food handling HACCP certification, all Regulatory Authority approvals and certification.

All approval and certification documents shall be presented with a wet signature except where an alternative form of signing has been agreed with LARU.

A list of definitions and abbreviations is provided in Section "*Background*".

The following issues as a minimum shall be addressed prior to the Government of Western Australia Department of Health Approval to Occupy inspection.

1.1. An Approval to Occupy Inspection will not be conducted by LARU until all components of the works have been certified as having reached Practical Completion and the facility/area is completed in accordance with documentation and plans approved by LARU at Approval in Principle and Approval to Construct.

The certifications shall be completed by the Clinical Leads, Architect and all Engineering Consultants and Contractors, and full services commissioning and certification data, as specified herein, shall be available on site on the day of inspection and retained on site whilst the facility is licenced.

1.2. The facility/area shall, prior to the Approval to Occupy Inspection, be fully commissioned and compliant with all relevant standards for patients, staff or intended function.

Clinical commissioning – includes all furniture and equipment in situ:

- Consumables (medical and non-medical)
- Cleaning and environmental testing of sterile critical areas
- Staff training in emergency responses and use of medical equipment to be completed

1.3. The '*Declaration for Approval to Occupy Inspection*' form shall be completed and returned to LARU two (2) weeks prior to the ATO inspection.

2. Practical Completion

2.1 The works shall have reached "*Practical Completion*" and shall have been certified as such by the Architect, Building Surveyor and Engineering Consultants**.**

Note: The date of Practical Completion is not the same as, and will always precede, the "*Date of Occupation*".

2.2 "As Constructed" documents, including commissioning results, record of all testing and staff training, signed certificates of completion, and Operation and Maintenance (O&M) Manuals shall be fully complete and provided prior to granting Practical Completion.

Note: ATO inspection cannot be undertaken unless As Constructed and O&M documentation is fully completed and available for review during the inspection.

2.3 The Architects and Engineers certification of practical completion and the registered Building Surveyor's Certificate of construction compliance (BA17) or the Certificate of building compliance (BA18) as required by the West Australian Building Act 2011 shall be submitted and made available at the Approval to Occupy inspection.

2.4 The certifying statement(s) shall confirm that the design and completed works have been completed and comply (in the professional opinion of the certifier) with the statutory requirements of the various Government controlling agencies, with the Western Australia Health Facility Guidelines for Engineering Services, relevant National Construction Code and Australian Standards, any relevant Fire Engineering Report, and with the mandatory items that were identified with the issue of Approval in Principle and Approval to Construct.

2.5 A list of defects, omissions and outstanding items shall be available at the ATO inspection, and these items shall be made evident during the inspection.

2.6 Prior to granting practical completion, all Facility staff responsible for the operation and maintenance of all engineering and services aspects of the facility shall be fully inducted and trained in the specific features of the installations at the Facility. Records of such induction and training shall be included in the project completion pack.

3. Operational Commissioning

3.1 The facility/area shall have been commissioned for clinical operation and made ready for patient, staff or intended function prior to the ATO Inspection.

3.2 All medical consumables, equipment and furniture shall have been installed.

3.3 A hospital clean shall have been carried out for the area(s) to be inspected.

3.4 Staff fire evacuation and emergency training shall have been completed.

3.5 All operational and clinical policies and rosters for the facility/area shall have been completed and be available on site.

3.6 Cleaning and environmental testing of operating suites, operating rooms, procedure rooms, CSD areas and similar shall be completed and results made available on site.

3.7 Staff orientation and equipment training to the facility/area shall be completed.

3.8 Clinical commissioning shall ensure that all builders' materials, hoardings, security fencing and site facilities etc. have been removed from the site.

For operating and procedure rooms the Licence Holder/Applicant shall submit prior to the Approval to Occupy Inspection:

3.9 A statement of the procedures to be performed in each operating and procedure room.

3.10 Documentation that specifies the Operational Procedures for cleaning and environmental testing of each operating and procedure room.

In addition to the above, the following shall be made available at the ATO Inspection:

3.11 The statement of function for the facility/area to be inspected.

3.12 Any infection control audits or report that may have been carried out for the facility/area.

3.13 Any occupational health and safety audits or reports that may have been carried out for the facility/area.

4. System Testing

All building systems (fire, mechanical, electrical, hydraulic, security, etc.) and their respective systems interfaces shall have been fully tested and be working as designed/documented.

5. Structural and Civil Certification

Refer to Consultant's Certification Template (attachment A to this Appendix) to be provided at ATO.

A statement by the design structural engineer that certifies that the building has been built in compliance with chapter "*Engineering Services, Structural*" of the Guidelines.

The civil engineer shall similarly submit a statement that the building complies with chapter "*Engineering Services, Civil*".

Similar certifications shall also be provided by independent Structural and Civil reviewers of the submitted design(s).

Refer also to Appendix "*Declaration of Conformance"* to be provided at all stages of AIP, ATC and ATO.

6. Services Engineering Design Certification

Refer to Consultant's Certification Template (attachment A to this Appendix) to be provided at ATO.

Certified statements shall be provided to HDWA which confirm that the designed, documented and witnessed mechanical, electrical, hydraulic, fire and vertical transportation engineering systems (including all services subsystems and system interfaces) comply (in the professional opinion of the Certifier) with the statutory requirements of the various Government controlling agencies (including HDWA).

The statement shall be prepared by the engineer/designer responsible for each engineering discipline – refer to chapter "*Background*", section "*Definitions*" with description of roles and definitions for personnel titles used in The Guidelines.

The relevant engineer/designer shall certify the design and all commissioning and test data complies with WAHFG ES, relevant Australian Standards and Fire Engineering Report(s), and the mandatory items that were established or implied with the issue of the 'Approval in Principle' and 'Approval to Construct', the HDWA Guidelines and all other statutory requirements.

Refer also to the "*Declaration of Conformance"* appendix to be provided at all stages of AIP, ATC and ATO.

7. Engineering Installation Certification

Refer to Installer's Certification Template (attachment B to this Appendix) to be provided at ATO.

The installing contractors and specialist subcontractors for the mechanical, medical gas, electrical, communications, security, fire, hydraulic and vertical transportation services shall certify that the installation and construction complies with HDWA West Australian Health Facility Guidelines for Engineering Services, relevant Australian Standards, relevant Fire Engineering Report(s), and mandatory items that were established or implied with the issue of the "approval to construct". Certification of compliance with the other controlling Statutory Authorities (LGIRS, Western Power, Water Corporation, WorkSafe WA, etc.) shall also be provided.

Engineering Scope

The engineering services mentioned in clauses "*System Testing*", "*Engineering Design Certification*" and "*Engineering Installation Certification*" above include, but are not limited to, the following:

7.1 Mechanical systems:

7.1.1 Air conditioning

7.1.2 Heating

7.1.3 Ventilation

7.1.4 Exhaust

7.1.5 Special exhaust

7.1.6 Chilled and heating hot water

7.1.7 Medical gases and medical vacuum (including alarm systems)

7.1.8 Air filtration

7.1.9 Air pressure differentials

7.1.10 Sterilisers

7.1.11 Steam generators (or similar systems)

7.1.12 Mechanical switchboards

7.1.13 Controls

7.1.14 Acoustic attenuation

Note that where evaporative coolers are used, a statement is required certifying that a system for sanitation for Legionella control has been tested and is operational. The procedure should be described in the Operation and Maintenance Manual.

Commissioning of medical gases and suction services shall be in strict accordance with the procedures outlined in AS 2896 *Medical gas systems - Installation and testing of non-flammable medical gas pipeline systems*. This testing shall be witnessed and certified by the Mechanical Engineer and witnessed by a senior hospital representative, usually a qualified anaesthetist.

7.2 Electrical and communication systems:

7.2.1 High voltage installation

7.2.2 Vital & Instantaneous power supplies

7.2.3 Earthing

7.2.4 Switchboards

7.2.5 Discrimination and cascading

7.2.6 Submains and subcircuit cabling

7.2.7 Internal and external lighting and lighting control systems

7.2.8 Lighting for clinical observation and clinical functions

7.2.9 Emergency evacuation lighting

7.2.10 RCD & LPD protection

7.2.11 Body and cardiac protection

7.2.12 Lightning protection systems

7.2.13 Structured cabling installation

7.2.14 Messaging Systems

7.2.15 Assistance call systems and patient entertainment systems

7.2.16 Fire detection and alarm systems

7.2.17 Security systems

7.2.18 Solar PV and battery systems

7.2.19 EV charging

7.2.20 EMI & RFI disturbance mitigation

7.2.21 Vertical transportation systems

7.2.22 Other miscellaneous electrical/electronic systems

7.3 Hydraulic systems:

7.3.1 Fire hydrants, hose reels and sprinklers systems

7.3.2 Drinking and non-drinking cold and hot water reticulation systems

7.3.3 Backflow prevention systems

7.3.4 Water Softening and Reverse Osmosis Water Systems

7.3.5 Natural or LP gas systems

7.3.6 Sanitary Fixtures and Tapware

7.3.7 Hospital appliances such as flushing rim sinks, washer/disinfector, macerator, etc

7.3.8 Siphonic or gravity stormwater systems

7.3.9 Gravity or pump sewer systems

7.3.10 Industrial waste and drainage systems

7.4 All engineering disciplines:

All associated works, including:

7.4.1 Make good to penetrations through fire rated barriers, acoustically rated division, areas with pressure management regime

7.4.2 Electronic control, management and monitoring systems

7.4.3 Weather tightness

7.4.5 Sustainability items

7.4.6 Signage and labelling

8. Mechanical Ventilation and Air Conditioning Systems

Specific written data shall be provided in tabulated form confirming commissioning figures for toilet and general exhaust, ventilation rates (supply and return air), supply air and outside air quantities, presented in the following presentation style.

Measurement Location	Code Requirement	Design	Actual	% of Design
e.g.: Shared resident toilet and shower	10L/s/m^2	45 L/s	47 L/s	104

The method of determination and calibration data shall also be provided to enable assessment of the appropriateness of measurement.

Cold DOP testing of absolute (HEPA) filters shall be conducted in accordance with AS 1132.9. HEPA filters shall also be certified in accordance with AS 1807 *Separative devices – Biological and cytotoxic drug safety cabinets, clean workstations and pharmaceutical isolators – Methods of test*as appropriate, after initial installation.

Air flow patterns within, to and from Operating, Set-Up, Cytotoxic and Isolation Rooms, and other critical infection control areas served by absolute filters, shall be verified by air flow tests. Air flow diagrams showing the direction of flow to and from these areas shall be provided.

9. Medical Gas Services

The specialist Medical Gases installation contractor *shall* certify in writing that they are experienced, and competent installers as required by AS 2896 *Medical gas systems - Installation and testing of non-flammable medical gas pipeline systems* and WAHFG.

Commissioning of gas and suction services *shall* be in strict accordance with the procedures outlined in the Australian Standard AS 2896. Tests shall be witnessed by the Mechanical Engineer and the appropriate health facility representative (HFR) in accordance with the requirements of Australian and New Zealand College of Anaesthetists. The role of the HFR shall comply with PG66(A) *Guideline on the role of the anaesthetist in commissioning medical gas pipelines*.

Flow test results of all installed gases including oxygen, nitrous oxide, medical air, surgical tool air and suction services *shall* be provided. Cross connection and purity tests *shall* be provided for each outlet. All test results *shall* be submitted in AS 2896 and PG66(A) format. Procedures for regular reliable ongoing replenishment and service of all systems and equipment shall be verified as appropriate.

10. Electrical Systems

Specific written test data shall be provided for the entire electrical installation including the following:

- Routine testing to AS/NZS 61439 of all switchboards
- Compliance with AS/NZS 3000 (such as earthing, RCD’s and the like) and functional operation of the system
- Routine testing to AS/NZS 3003 of all electromedical installations
- Where the electrical system incorporates a customer owned HV supply, all testing and commissioning data shall be provided to the Australian Standards, Statutory Authorities requirements and any other regulatory requirements for the HV system

The O&M manuals shall include (as a minimum) the following:

- Certifications of compliance to AS/NZS 3000 and all other mandatory standards
- All electrical test result required for compliance to AS/NZS 3000
- Supply Authority tickets
- A copy of all circuit schedules
- Shop drawings for all switchboards, generators, transfer switches, UPS etc.
- Shop drawings for non-proprietary luminaires and surgical and examination lights
- Lighting control network connections and input and output data files
- A copy of all single line diagrams (As Constructed)
- A copy of all electrical drawings (As Constructed)
- Software for all data driven or electronic systems, including metering, power supplies, emergency lighting, lighting control, vital and instantaneous power supplies, solar PV, EV charging, AV systems, EMS and BMCS and any other similar system in the facility plus a copy of all specific point register settings and all as commissioned calibrations
- Instructions for other miscellaneous systems where provided, such as solar PV systems, EV charging, battery storage, EMI shielding, power quality management (e.g. harmonic filtration)

Where the electrical system incorporates a customer owned HV supply, an approved HV Safety Management Plan, including maintenance templates shall be provided as a separate part of the O&M documentation.

11. Emergency Lighting Systems

Emergency lighting systems shall be tested in accordance with AS/NZS 2293 and full test results in “logbook” format shall be provided for systems without central computer monitoring. Evidence shall be provided proving satisfactory test results being recorded for monitored emergency lighting.

Certifications shall be provided of compliance to AS/NZS 2293 and the NCC.

12. Vital & Instantaneous Power Supplies

Provide functional testing of alternative power supply systems under all modes of operation (including single/parallel connection, back-up with redundant equipment, black start and no-break transfer systems).

Full commissioning data shall be provided for emergency diesel, UPS and any other back up and support power supplies. Full discharge and subsequent recharge test results shall be provided for all battery systems.

Certifications shall be provided that the whole of the installation complies with AS/NZS 3009 and the project brief.

13. Electromedical Areas

All electromedical areas shall be tested by an approved testing and commissioning company qualified to undertake testing to AS/NZS 3003.

Full test results to AS/NZS 3003 shall be provided including a complete and certified checklist.

Include test results from a registered specialist for electromagnetic (EM) and radio frequency (RF) interference of mitigation measures provided for any location that could be subject to equipment interference/malfunction.

Certifications shall be provided that the whole of the installation complies with AS/NZS 3003 and relevant part of AS/NZS 61000.

14. Assistance Call Systems

Functional test results shall be provided for the patient and emergency assistance call systems including duress, wireless communications and interface to other systems.

A checklist for each point shall be provided indicating the operating status of every call point and indicator/annunciator at the time of testing.

Demonstrate operation of all patient entertainment systems and AV systems.

15. Fire Detection and Alarm Systems

Fire Detection and Alarm Systems shall be tested in accordance with the Australian Standards and statutory requirements, and any Fire Engineering Reports (if applicable). Full function and system interface test results shall be provided.

Certifications shall be provided that the entire installation complies with AS 1670.

16. Domestic Hot Water System and Temperature

Hot water installation systems shall be tested in accordance with the Australian Standards and statutory requirements. Full pressure test results shall be provided.

Specific written data shall be provided in tabulated form confirming commissioning figures for all tempered water outlets and hot water heaters to confirm commissioned exact water temperatures, presented in the following presentation style.

Measurement Location	Design	Actual
e.g.: Level 1: Hand basin in room 1.02	38 °C	38.6 °C

A confirmation test certificate shall be provided including laboratory test result to prove that the hot water system is free of Legionella and within the limitations of the Australian Drinking Water Guideline. The procedure shall be described in the Operation and Maintenance Manual.

The testing requirements and sanitation procedures shall be covered in the Operation and Maintenance Manuals.

17. Cold Water System

Cold water installation systems shall be tested in accordance with the Australian Standards and statutory requirements. Full pressure test results shall be provided.

A confirmation test certificate shall be provided including laboratory test results to prove that the cold-water system is free of Legionella and within the limitations of the Australian Drinking water guideline. The procedure shall be described in the Operation and Maintenance Manual.

18. Reverse Osmosis (RO) Water Systems

Site acceptance testing (SAT) shall be carried out and commissioning data shall be supplied to confirm that the system is fully operational and the provided RO water quality complies with AS/NZS 5369.

19. All Other Hydraulic Systems (including Wet Fire Services)

All systems shall be tested in accordance with the relevant Australian Standards and statutory requirements. Full test results shall be provided.

20. Environmental Tests

The cleanliness of Operating Suites, including Operating Rooms, Set-up Rooms, Sterile Stores, Angiography and Cardiac Catheterisation Rooms, any other room(s) in which such sterile procedures will be completed, and Central Sterile Department/Units (CSD) shall be verified by air flow checks and bacterial sampling conducted by an appropriately NATA certified professional. Before testing, the following are required:

- All building and engineering works have been completed.
- The ducting has been cleaned, absolute filters installed, Cold Dispersed Oil Particulate (DOP) tests satisfactorily completed and air flows verified.
- The operating suite and sterile room/s have been thoroughly two-step clinically cleaned to eliminate all surface contamination.
- Plant has been running under normal operating conditions for 24 hrs prior to test.
- There is no activity in the operating room/s/unit.
- The room(s) shall be tested by:
    - Noting the direction of air movement using a smoke test.
    - Performing counts of microbiological and bacterial colony forming units from adequate air sampling.
    - Microbiological testing and sampling regime to an agreed standard

This is to be repeated once to confirm that duplication of results is possible.

If the room(s) fails the tests, the Engineer (mechanical) shall be consulted to confirm air velocities and filter integrity. The tests shall be repeated once the criteria are met.

21. Steriliser Tests

The results of commissioning and appropriate testing data shall be provided in accordance with AS/NZS 5369 *Reprocessing of reusable medical devices and other devices in health and non-health related facilities*. These include:

- Validation program is performed to evaluate the reliability of a sterilisation process.
- Validation shall demonstrate that a given sterilisation cycle in an identified steriliser will render a specified load sterile.
- Verification of satisfactory cycle check tests and daily leak rate tests.
- Bowie-Dick type test (conforms to BS7720) where applicable.
- Access to supplier’s tests.
- Calibration of gauges.

22. Washer/Disinfector Tests

Washer/disinfector machines, including pan washers, instrument washers and anaesthetic tubing washers shall pass appropriate cycle and challenge tests for mechanical action and disinfecting activity where applicable, also artificial soil tests and thermocouple tests post installation where indicated. Foil and graphite tests for ultrasonic cleaners. The results of the validation tests shall be provided.

23. Anaesthetic Equipment Tests

Certification is required from a specialist anaesthetist that the facilities and equipment are in accordance with the safe anaesthetic practice requirements of the Australian and New Zealand College of Anaesthetists and the Royal Australasian College of Surgeons.

24. Fire Safety

In addition to the fire alarm and detection system, emergency and exit lighting, and the firefighting (hydraulic) services mentioned prior, certification of the following (where appropriate) shall be provided:

24.1 Integrity and completeness of fire and smoke barriers, i.e. full compartment/isolated space separation as required, with penetrations fully sealed with a material capable of maintaining the fire/smoke resistance of the barrier or protected by an approved device designed for the purpose. Fire and smoke barriers shall extend from true floor to the underside of the roof/slab over, and a fire wall shall be able to maintain its structural integrity in the event of a wall and roof collapse on one side. Appropriate fire-resistant packing between the top of a firewall and roof cladding shall be installed to provide a continuous seal.

24.2 Fire dampers (in mechanical ductwork) tested and operational.

24.3 Door closers (hydraulic or electromagnetic) on all fire and smoke doors being fully operational and closing speed adjusted for safe operation.

24.4 Door sequence closing devices operational (where fire/smoke doors are fitted).

24.5 Fire door certification plates fitted to all fire doors and frames which comply with AS 1905.1 *Components for the protection of openings in fire-resistant walls*.

24.6 Appropriate and permanent smoke seals fitted to all smoke doors.

24.7 Appropriate fire extinguishers and fire blankets installed.

24.8 Appropriate signposting installed in accordance with the relevant codes.

24.9 Special fire suppression systems tested and operational.

24.10 Use of fire resistance rated plasterboard to a tested system (Fyrchek, Boral, etc.) for the construction of fire barriers.

24.11 Appropriate and unobstructed means of egress.

24.12 The installed floor coverings, window treatments and bed screen curtains in compliance with Specification 7, *Fire hazard properties*, of the NCC.

24.13 The installation, completeness and operation of the early warning fire system and its integration with all other associated systems.

24.14 Integrated systems testing, in line with AS 1851, to be completed once all individual systems have been tested and commissioned and demonstrated to be fully functioning in a standalone manner.

25. Fire Brigade Facilities

Confirmation of the successful outcome of the following fire systems tests shall be forwarded to LARU:

25.1 Testing of heating, ventilation and air conditioning (HVAC) systems in relation to smoke control to ensure compliance with Part E2 *Smoke hazard management* of the National Construction Code. These tests shall involve the

use of artificial smoke to assess the movement of smoke and gases produced by a fire, to the greatest extent possible, particularly as to:

- means of egress
- exit passageways or other similar areas
- operating suite
- nurseries, birthing suites, etc
- time taken to activate alarms, fire and smoke doors to close, and for smoke evacuation.

25.2 Testing of hydrant flow and pressure in accordance with AS 2419.1. Test results shall be provided.

25.3 Testing of hydrant hose reel flow and pressure in accordance with AS 2441.

25.4 Provision of appropriate access routes and hardstanding for fire trucks. Earlier discussions and agreement with the fire brigade as a requirement at the design stage is assumed.

Where a Direct Brigade Alarm (DBA) connection is required, the connection shall be approved by the fire brigade and operational at the time of the ATO.

Where a DBA connection is not implemented at the time of the ATO, details shall be provided of the measures or works required that will be implemented to address this issue. These measures or works required shall be implemented prior to ATO.

26. Security

A certified statement shall be provided that confirms successful testing of all electronic security systems, CCTV and duress call.

27. Furniture and Equipment

All furniture and equipment should be installed prior to ATO Inspection so that evaluation can take place during the inspection. Where this is not possible, a written description of the type and quantity of loose furniture and equipment, including size and spatial requirements, to be installed including its location shall be provided.

28. Other Certification Issues

Certification of successful testing of any other items or systems that have been installed AND which have not had HDWA approval, along with a description of the system, what is replaced, and why, shall be provided.

29. “As Constructed” Drawings

A full set of ‘As Constructed’ drawings (architectural, structural, and building services) shall be available for perusal as required during the Approval to Occupy Inspection.

All documentation that is required shall be labelled, sorted and placed into appropriate sections in folders to allow LARU Consultants to readily access relevant information.

Documents stored electronically should be arranged in folders and subfolders to be easily perused with hyperlinks to every subsection from a detailed table of contents and cross references within the document.

All of the above documentation shall be kept at the facility for future reference. Hard copy documentation should be stored in a safe position with ready access. Electronic copies shall be presented in native file format that allows future

modifications to be incorporated, plus pdf printed version. Soft copies should be backed up with copies held both off-site and on-site.

If there have been any changes to documentation after the ATC approved set, a separate set of documents that have changes clearly identified in contrasting colour shall be available on the day of the inspection and these changes shall be made evident to the LARU inspection team at the start of the inspection.

Six A3 floor plans (needn't be to scale, but clear and legible) highlighting the areas to be inspected, and with all rooms correctly labelled in accordance with installed signposting, shall be available for LARU use during the inspection.

30. NCC Compliance Report and Fire Engineering Report

The Final NCC Compliance Report and Final Fire Engineering Report, and where provided, content relating to the fire safety handbook, shall be available for perusal as required during the Approval to Occupy Inspection. These documents shall also be kept on site at all times.

31. Consultant Availability

The project architect, engineering design consultants, specialist sub-consultants, and/or appropriately skilled contract personnel, shall be available during the Approval to Occupy inspection to answer technical questions and assist HDWA officers in the systems checking process.

If there have been any changes to the professional consultants that were listed in the contact list at the time of the AIP submission, LARU shall be notified in writing of this change together with a brief reason for the change prior to the ATO inspection. The qualifications and experience of the new staff members shall meet the requirements of the WAHFG – refer to clauses with "*personnel definitions*" in chapter "*Background*", section "*Definitions"*.

32. Hospital Personnel Availability

The hospital/facility/area personnel who have been involved in the design, planning and commissioning of the hospital/facility/area and the senior staff who will be responsible for the day-to-day operations of the hospital/facility/area shall be available during the Approval to Occupy Inspection to answer technical questions and assist LARU in the systems checking process.

All hospital staff in attendance during the inspection shall be fully trained and competent in the management, operation and maintenance of all applicable systems and subsystems of the new Facility.

33. Operation and Maintenance Manual

Proof shall be provided that a manual exists which instructs the Licence Holder/Applicant on the maintenance requirements of the engineering systems and all equipment (including air conditioning plant, autoclaves, sterilisers and washer disinfectors, catering equipment, other plant, etc.).

Availability of equipment manuals for operators and maintenance staff shall be demonstrated.

34. Typical Consultant's Certification (Attachment A)

Typical consultant's certification letter – text template

to be provided on company letterhead

Include all services or sub-services as relevant to the project so that certification is provided for the entire facility.

Provide individual sign off per discipline

Re: **ANYWHERE PRIVATE HOSPITAL**

Civil/Communications/Electrical/Fire Engineering/Fire Protection/Hydraulic/Mechanical/Medical Gases/Security/Structural/Vertical Transportation Services

We advise that the [*Insert Relevant Service*] services, documented for the… *[insert name of particular project portion/section/stage]*, have been effectively completed.

All engineering services have been tested and found to be working as designed.

To our knowledge the [*Insert Relevant Service*] services installation, testing and commissioning complies with the contract documents and the Government of Western Australia Department of Health *Western Australia Health Facility Guidelines for Engineering Services*, NCC, Australian Standards and the mandatory items that were established or implied with the issue of the 'Approval in Principle' and 'Approval to Construct'.

* Medical Gases cross connection and purity tests for each outlet have been witnessed by a senior hospital medical representative (include in medical gases only).

Signed:

[Name and signature of responsible engineer]

[Engineer NER reference]

[Date]

35. Typical Installers Certification (Attachment B)

Typical installers certification letter – text template

to be provided on company letterhead

Certification is required for every relevant service and sub-service installed at the facility.

Re: **ANYWHERE PRIVATE HOSPITAL**

Civil/Communications/Electrical/Electromedical/Equipment/Fire – Wet & Dry/Hydraulic/Mechanical/Medical Gases/Security/Structure/Vertical Transportation Services

We advise that the [*Insert Relevant Service*] services installation for the… *[insert name of particular project portion/section/stage]*, have been effectively completed.

All engineering services have been tested and found to be working as designed. A fully complete set of As Constructed documents and Operation and Maintenance manuals, including certificates, testing and commissioning results have been provided to the Licence Holder/Applicant.

To our knowledge the [*Insert Relevant Service*] services installation, testing and commissioning complies with the contract documents and the Government of Western Australia Department of Health *Western Australia Health Facility Guidelines for Engineering Services*, NCC, Australian Standards and the mandatory items that were established or implied with the issue of the 'Approval in Principle' and 'Approval to Construct'.

Signed:

[Name of contractor]

[Name and signature of representative responsible for the certified work]

[Date]

25 APPENDIX – MECHANICAL DESIGN PARAMETERS

25.1.1 Appendix - Mechanical Design Parameters

Function of Space	Pressure Relationship to Adjacent Areas (d)	Minimum Outdoor A/C/hr	Minimum Total A/C/hr	All Room air Exhausted Directly to Outdoors	Air Recirculated by Means of Room Units (a)	Design Relative Humidity (k) %	Design Temperature (l), (ad)	Internal Noise from engineering services RC (ac)	Air Filtration Grade Primary /Secondary /Final (y) (z) (ae) (ak)	Directional Airflow Guidance (subject to IP&C Team approval per project) (j)	Main purpose of A/C System
SURGERY AND CRITICAL CARE											
Critical and intensive care (infectious)	Negative	3	6	Yes	No	30-60	19-24 (l)	35	Type 1, Class A or B, G4 Prefilter and F8 Main Filter to AS 1324.1 or ISO/AS 16890 equivalent and H13 on Exhaust	Inward to room from adjacent spaces. Create cleaner "upstream" zone for staff (and visitors) by taking exhaust/return from patient bedhead zone.	Infection Control
Critical and intensive care (non-infectious)	Positive	3	6	no restriction	No	30-60	19-24 (l)	35	Type 1, Class A or B, G4 Prefilter and F8 Main Filter to AS 1324.1 or ISO/AS 16890 equivalent. Separately confirm HEPA filter needs with Dept Lead and IP&C Team.	Spill from room to adjacent zones. Protect patient with supply over bedhead and outwards cascade away from patient to visitor/nursing zones.	Air Conditioning
Delivery room; Caesarean (m), (o), (ai)	Positive	5	20	no restriction	No	30-60	19-24 (l)	40	Type 1, Class A or B, G4 Prefilter and F8 Main Filter to AS 1324.1 or ISO/AS 16890 equivalent	Spill from room to adjacent zones. Protect patient with supply over delivery zone and outwards cascade away from patient to visitor/nursing zones.	Air Conditioning
Emergency Department Decontamination Room	Negative	3	12	Yes + HEPA/Charcoal filter discharge	No	(t)	un-controlled	45	Type 1, Class A or B, G4 Prefilter and F6 Main Filter to AS 1324.1 or ISO/AS 16890 equivalent	Inward to room from adjacent spaces.	Containment
Emergency Department Exam /Treatment Room (p)	Negative	2	6	no restriction	No	(t)	21-25	35	Type 1, Class A or B, G4 Prefilter and F8 Main Filter to AS 1324.1 or ISO/AS 16890 equivalent	Inward to room from adjacent spaces. Create cleaner "upstream" zone for staff (and visitors) by taking exhaust/return from patient zone.	Air Conditioning
Emergency Department Public Waiting Area	Negative	3	12	Yes (q)	No	(t)	21-25	40	Type 1, Class A or B, G4 Prefilter and F8 Main Filter to AS 1324.1 or ISO/AS 16890 equivalent	Exhaust/return over seating areas. Do not mix with or spill into ED Staff/admin zones. Separate AHU if possible.	Infection Control
General Clinical	Neutral	2	6	no restriction	no restriction	(t)	21-25	40	Type 1, Class A or B, G4 Prefilter and F8 Main Filter to AS 1324.1 or ISO/AS 16890 equivalent	General airflow from corridors to bedrooms and from bedrooms to ensuites and provide cross ventilation of the bedroom; however review with IP&C team on a project by project basis.	Air Conditioning
Laser Eye Room	Positive	3	12	no restriction	No	(t)	21-25	35	Type 1, Class A or B, G4 Prefilter and F8 Main Filter to AS 1324.1 or ISO/AS 16890 equivalent	Spill from room to adjacent zones. Protect patient with supply over delivery zone and outwards cascade away from patient to visitor/nursing zones.	Air Conditioning
Medical /Anaesthesia Gas Storage	Negative	6	8	Yes	No	un-controlled	un-controlled	45	Type 1, Class A or B, G4 Prefilter and F6 Main Filter to AS 1324.1 or ISO/AS 16890 equivalent	Inward to room from adjacent spaces.	Containment
Newborn Intensive Care (ab)	Positive	2	6	no restriction	No	(t)	22-26 (l)	35	Type 1, Class A or B, G4 Prefilter and F8 Main Filter to AS 1324.1 or ISO/AS 16890 equivalent	Spill from room to adjacent zones. Protect patient with supply over delivery zone and outwards cascade away from patient to visitor/nursing zones. Maintain low velocities/stable air temperature over Newborn.	Air Conditioning
Operating Room (m), (o), (d), (ai)	Positive (g)	10	25	Low Level exhausts to be separately discharged	No	30-60	18-26 (l) (aj)	40 (c)	G4/F8/H14 HEPA (ae)	Spill into OR from Sterile/Prep Zone and spill out of OR into exit bay/corridor. HEPA Supply air/laminar flow hood over operating table and cascade air towards 4 corners of OR to low and mid-level returns/exhausts. Maintain low velocities over table and uniform face velocities at HEPA filters.	Infection Control

Function of Space	Pressure Relationship to Adjacent Areas (d)	Minimum Outdoor A/C/hr	Minimum Total A/C/hr	All Room air Exhausted Directly to Outdoors	Air Recirculated by Means of Room Units (a)	Design Relative Humidity (k) %	Design Temperature (l), (ad)	Internal Noise from engineering services RC (ac)	Air Filtration Grade Primary /Secondary /Final (y) (z) (ae) (ak)	Directional Airflow Guidance (subject to IP&C Team approval per project) (j)	Main purpose of A/C System
Cardiac OR (m), (o), (d) , (ai)	Positive (g)	10	25	Low Level exhausts to be separately discharged	No	30-60	18-26 (l)	40 (c)	G4/F8/H14 HEPA (ae)	Spill into OR from Sterile/Prep Zone and spill out of OR into exit bay/corridor. Supply air over operating table and cascade towards 4 corners of OR to low and mid-level returns/exhausts. Co-ordinate HEPA locations with overhead gantries. Maintain low velocities over table and uniform face velocities at HEPA filters.	Infection Control
Operating Room Burns /Plastics (m), (o), (d) , (ai)	Positive (g)	10	25	Low Level exhausts to be separately discharged	No	50-90	18-32 (l) (af)	40 (c)	G4/F8/H14 HEPA (ae)	As per main OR above, but with wider temperature and humidity control bands. Avoid dry and fast/turbulent air over Burns patient.	Infection Control
Intraoperative MRI Theatre (i), (m), (o), (d) , (ai)	Positive (g)	10	25	Low Level exhausts to be separately discharged	No	30-60	18-26 (l)	40 (c)	G4/F8/H14 HEPA (ae)	Spill into OR from Sterile/Prep Zone and spill out of OR into exit bay/corridor. Supply air over operating table and cascade towards 4 corners of OR to low and mid-level returns/exhausts. Co-ordinate HEPA locations with overhead gantries. Maintain low velocities over table and uniform face velocities at HEPA filters.	Infection Control
Hybrid Operating Room (m), (o), (d) , (ai)	Positive (g)	10	25	Low Level exhausts to be separately discharged	No	30-60	18-26 (l)	40	G4/F8/H14 HEPA (ae)	Spill into OR from Sterile/Prep Zone and spill out of OR into exit bay/corridor. Supply air over operating table and cascade towards 4 corners of OR to low and mid-level returns/exhausts. Co-ordinate HEPA locations with overhead gantries. Maintain low velocities over table and uniform face velocities at HEPA filters.	Infection Control
Operating /surgical Cystoscopy Rooms (m), (o), (d) , (ai)	Positive (g)	10	25	Low Level exhausts to be separately discharged	No	30-60	18-26 (l)	40	G4/F8/H14 HEPA (ae)	As per Main OR details above.	Infection Control
Peri-operative circulation space /corridor	Negative to ORs	2	As required for overall balance	no restriction	No	(t)	Target 24DegC - Resultant temp from theatre spill	40	Type 1, Class A or B, G4 Prefilter and F8 Main Filter to AS 1324.1 or ISO/AS 16890 equivalent	Centrally collect spill air from theatres. Supply air local to heat gain sources (equipment, reception etc.)	Air Conditioning
Cardiac Catheterisation laboratory (m), (o), (d)	Positive (g)	10	25	Low Level exhausts to be separately discharged	No	30-60	18-26 (l)	40	G4/F8/H14 HEPA (ae)	Spill into OR from Sterile/Prep Zone and spill out of OR into exit bay/corridor. Supply air over operating table and cascade towards 4 corners of OR to low and mid-level returns/exhausts. Co-ordinate HEPA locations with overhead gantries. Maintain low velocities over table and uniform face velocities at HEPA filters.	Infection Control
Minor/Procedure Room (m), (o), (d), (ai)	Positive, Negative to Sterile Prep	7.5	15	no restriction	No	(t)	19-24 (l)	40	G4/F8/H14 HEPA (ae)	As per Main OR details above. Low Level Exhausts where anaesthetic gases provided.	Infection Control
Radiology Waiting Rooms	Negative	3	12	Yes (q), (u)	no restriction	(t)	21-25	40	Type 1, Class A or B, G4 Prefilter and F8 Main Filter to AS 1324.1 or ISO/AS 16890 equivalent	Exhaust/return over seating areas. Avoid mixing with or spill into admin zones where possible.	Infection Control
Recovery Room (ai)	Neutral	3	10	no restriction	No	(t)	19-25 (l)	40	Type 1, Class A or B, G4 Prefilter and F8 Main Filter to AS 1324.1 or ISO/AS 16890 equivalent	Low level exhausts at bedhead to collect expired anaesthetic gases. Supply over bedhead to protect patient post-Op.	Air Conditioning

Function of Space	Pressure Relationship to Adjacent Areas (d)	Minimum Outdoor A/C/hr	Minimum Total A/C/hr	All Room air Exhausted Directly to Outdoors	Air Recirculated by Means of Room Units (a)	Design Relative Humidity (k) %	Design Temperature (l), (ad)	Internal Noise from engineering services RC (ac)	Air Filtration Grade Primary /Secondary /Final (y) (z) (ae) (ak)	Directional Airflow Guidance (subject to IP&C Team approval per project) (j)	Main purpose of A/C System
Sub sterile Service Area	Neutral	2	6	no restriction	No	(t)	un-controlled	50	Type 1, Class A or B, G4 Prefilter and F7 Main Filter to AS 1324.1 or ISO/AS 16890 equivalent	Exhaust directly over/connect to equipment	Heat/Moisture Rejection
Resuscitation. /Trauma Room /Crisis Hubs	Positive	4	15	no restriction	No	(t)	21-25	35	Type 1, Class A or B, G4 Prefilter and F8 Main Filter to AS 1324.1 or ISO/AS 16890 equivalent	As per Main OR details above. Low Level Exhausts where anaesthetic gases provided.	Air Conditioning
Treatment Room (p) (ai)	Positive	2	6	no restriction	no restriction	(t)	21-25	35	Type 1, Class A or B, G4 Prefilter and F8 Main Filter to AS 1324.1 or ISO/AS 16890 equivalent	Patient or Staff protection bias subject to project specific IP&C Team input.	Air Conditioning
Triage	Negative	3	12	Yes (q)	no restriction	(t)	21-25	40	Type 1, Class A or B, G4 Prefilter and F8 Main Filter to AS 1324.1 or ISO/AS 16890 equivalent	Exhaust/return over seating areas. Do not mix with or spill into ED Staff/admin zones. Separate AHU, if possible, especially if set up to deal with Infectious Like Illness (ILI) pathways.	Air Conditioning
Wound Intensive Care, Burns Unit	Positive	3	10	no restriction	No	(t)	21-25 (Wound), 18-32 (Burns) (l) (af)	40	Type 1, Class A or B, G4 Prefilter and F8 Main Filter to AS 1324.1 or ISO/AS 16890 equivalent	As per main OR above, but with wider temperature and humidity control bands. Avoid dry and fast/turbulent air over Burns patient.	Infection Control
OR Set-up/Sterile Prep	Positive to OR	6	15	no restriction	No	(t), and where required by AS/NZS 5369	19-24, or as driven by associated theatre controller (l)	40	G4/F8/H14 HEPA (ae)	Highest pressure/most clean zone in OR Suite. Spill air into OR.	Infection Control
Anaesthetic Induction	Negative to OR - Positive to Corridor/Exit Bay	5	10	no restriction	No	(t)	19-24, or as driven by associated theatre controller (l)	40	G4/F8/H14 HEPA (ae)	Balanced Air with spill from OR and into Exit Bay/Corridor. Low level exhaust in min 2 corners.	Infection Control
Perfusion Room	Neutral to OR - Positive to Corridor/Exit Bay	5	10	no restriction	No	30-60	19-24 (l)	40	G4/F8/H14 HEPA (ae)	Balanced Air with spill from OR and into Exit Bay/Corridor. Low level exhaust in min 2 corners.	Infection Control
Pathology Bay /Sample Storage	Positive to Corridor	3	6	no restriction	No	(t)	21-25	40	Type 1, Class A or B, G4 Prefilter and F8 Main Filter to AS 1324.1 or ISO/AS 16890 equivalent	Supply air to bay, usually open to circulation space	Air Conditioning
INPATIENT NURSING											
Class N Anteroom (r), (s)	Negative (e)	Min 6 A/c/hr and to suit pressure regime.	10	Yes (+HEPA)	No	(t)	un-controlled	40	Type 1, Class A or B, G4 Prefilter, F8 Main Filter in AHU to AS 1324.1 or ISO/AS 16890 equivalent plus terminal H14 on exhaust in room or at discharge point (where necessary)	Fans sized to allow for room air leakage while still maintaining required air changes.	Infection Control
Class N - Isolation Room (r), (s)	Negative (e)	Min 6 A/c/hr and to suit pressure regime.	12	Yes (+HEPA)	No	(t)	19-25 (l)	40	Type 1, Class A or B, G4 Prefilter, F8 Main Filter in AHU to AS 1324.1 or ISO/AS 16890 equivalent plus terminal H14 on exhaust in room or at discharge point (where necessary)	Fans sized to allow for room air leakage while still maintaining required air changes. Exhaust over patient bedhead to create cleaner upstream zone for staff where possible.	Infection Control
Class N - Ensuite	Negative (e)	AS 1668.2	Greater of 10 or AS 1668.2	Yes (+HEPA)	No	(t)	un-controlled	40	Supply - N/A. HEPA on exhaust.	Inward make-up air flow from bedroom	
Class P Anteroom (r)	Positive (e)	10	10	no restriction	No	(t)	un-controlled	40	Type 1, Class A or B, G4 Prefilter, F8 Main Filter in AHU to AS 1324.1or ISO/AS 16890 equivalent plus terminal H14 in room	Fans sized to allow for room air leakage while still maintaining required air changes.	Infection Control

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Class P - Protective Environment Room (r)	Positive (e)	12	12	no restriction	No	(t)	19-25 (l)	40	Type 1, Class A or B, G4 Prefilter, F8 Main Filter in AHU to AS 1324.1 or ISO/AS 16890 equivalent plus terminal H14 in room	Fans sized to allow for room air leakage while still maintaining required air changes. Supply over patient bedhead to create cleaner patient zone/protection from staff/visitors where possible.	Infection Control
Class P - Ensuite	Negative (e)	AS 1668.2	Greater of 10 or AS 1668.2	Yes (+HEPA)	No	(t)	un-controlled	40	Supply - N/A.	Inward make-up air flow from bedroom	
Class Q Anteroom (r), (s)	Negative (e)	Min 6 A/c/hr and to suit pressure regime.	10	Yes (+HEPA)	No	(t)	un-controlled	40	Type 1, Class A or B, G4 Prefilter, F8 Main Filter in AHU to AS 1324.1 or ISO/AS 16890 equivalent plus terminal H14 on exhaust in room or at discharge point	Fans sized to allow for room air leakage while still maintaining required air changes.	Infection Control
Class Q - Isolation Room (r), (s)	Negative (e)	Min 6 A/c/hr and to suit pressure regime.	12	Yes (+HEPA)	No	(t)	19-25 (l)	40	Type 1, Class A or B, G4 Prefilter, F8 Main Filter in AHU to AS 1324.1 or ISO/AS 16890 equivalent plus terminal H14 on exhaust in room or at discharge point	Fans sized to allow for room air leakage while still maintaining required air changes. Exhaust over patient bedhead to create cleaner upstream zone for staff where possible.	Infection Control
Class Q - Ensuite	Negative (e)	AS 1668.2	Greater of 10 or AS 1668.2	Yes (+HEPA)	No	(t)	un-controlled	40	Supply - N/A. HEPA on exhaust.	Inward make-up air flow from bedroom	
Class P+N Combination Anteroom (r)	Negative (e)	Min 6 A/c/hr and to suit pressure regime.	10	no restriction	No	(t)	un-controlled	40	Type 1, Class A or B, G4 Prefilter, F8 Main Filter in AHU to AS 1324.1 or ISO/AS 16890 equivalent plus terminal H14 in room	Fans sized to allow for room air leakage while still maintaining required air changes.	Infection Control
Class P+N Patient's Room (r)	Positive (e)	Min 6 A/c/hr and to suit pressure regime.	12	no restriction	No	(t)	19-25 (l)	40	Type 1, Class A or B, G4 Prefilter, F8 Main Filter in AHU to AS 1324.1 or ISO/AS 16890 equivalent plus terminal H14 in room	Fans sized to allow for room air leakage while still maintaining required air changes. Supply over patient bedhead to create cleaner patient zone/protection from staff/visitors where possible.	Infection Control
Class P+N Ensuite	Negative (e)	AS 1668.2	Greater of 10 or AS 1668.2	Yes	No	un-controlled	un-controlled	40	Supply - N/A.	Fans sized to allow for room air leakage while still maintaining required air changes.	Air Conditioning
Continued Care Nursery	Neutral	2	6	no restriction	No	(t)	22-26 (l)	35	Type 1, Class A or B, G4 Prefilter and F8 Main Filter to AS 1324.1 or ISO/AS 16890 equivalent	Protect patient with supply over patient zones and outwards cascade away from patient to visitor/nursing zones. Maintain low velocities/stable air temperature over Newborn/Infants.	Air Conditioning
Labour /Delivery /Recovery /Postpartum (LDRP) Room (ai)	Neutral	2	6	no restriction	no restriction	(t)	21-24 (l)	40	Type 1, Class A or B, G4 Prefilter and F8 Main Filter to AS 1324.1 or ISO/AS 16890 equivalent	Protect patient with supply over patient zones and outwards cascade away from patient to visitor/nursing zones.	Air Conditioning
Newborn Nursery Suite	Neutral	2	6	no restriction	No	(t)	22-28 (l)	35	Type 1, Class A or B, G4 Prefilter and F8 Main Filter to AS 1324.1 or ISO/AS 16890 equivalent	Protect patient with supply over patient zones and outwards cascade away from patient to visitor/nursing zones. Maintain low velocities/stable air temperature over Newborn/Infants.	Air Conditioning
Tea Room /Beverage Bay	Negative	no restriction	6	Yes	no restriction	un-controlled	un-controlled	40	Type 1, Class A or B, G4 Prefilter and F6 Main Filter to AS 1324.1 or ISO/AS 16890 equivalent	Inward flow from adjacent areas - usually exhaust only and balanced from adjacent space	Odour Control

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Patient Corridor	Neutral/As required for overall balance	5 lit/sec/m2	6	no restriction	no restriction	un-controlled	un-controlled	40	Type 1, Class A or B, G4 Prefilter and F8 Main Filter to AS 1324.1 or ISO/AS 16890 equivalent	Minimise risk of cross flow between patient rooms from common corridor.	Air Conditioning
Immuno-compromised Patient areas	Positive	2	6	no restriction	No	(t)	21-24 (l)	35	Type 1, Class A or B, G4 Prefilter, F8 Main Filter in AHU to AS 1324.1 or ISO/AS 16890 equivalent plus terminal H14 in room	Spill from room to adjacent zones. Protect patient with supply over delivery zone and outwards cascade away from patient to visitor/nursing zones.	Infection Control
Standard Class S Patient Bedroom	Negative (j)	2	6 (w)	no restriction	no restriction	(t)	21-25	35	Type 1, Class A or B, G4 Prefilter and F8 Main Filter to AS 1324.1 or ISO/AS 16890 equivalent	Ventilation air movement in patient room should normally achieve a positive inward airflow from corridors to bedrooms and from bedrooms to ensuites (may be reversed subject to patient cohort and IP&C endorsement).	Infection Control
Single patient en-suite	Negative	AS 1668.2	Greater of 10 or AS 1668.2	Yes	-	un-controlled	un-controlled	45	Inward make-up air flow from bedroom	Inward flow from adjacent areas - usually exhaust only and balanced from adjacent space	Odour Control
Shared patient en-suite	Negative	AS 1668.2	Greater of 15 or 15l/s/m2	Yes	-	un-controlled	un-controlled	45	Inward make-up air flow from bedroom	Inward flow from adjacent areas - usually exhaust only and balanced from adjacent space	Odour Control
Toilet /Cleaner	Negative	AS 1668.2	Greater of 10 or AS 1668.2	Yes	-	un-controlled	un-controlled	45	Inward make-up air flow from adjacent space	Inward flow from adjacent areas - usually exhaust only and balanced from adjacent space	Odour Control
Patient Bathrooms	Negative	AS 1668.2	Greater of 15 or 15l/s/m2	Yes	-	un-controlled	un-controlled	45	Inward make-up air flow from bedroom	Inward flow from adjacent areas - usually exhaust only and balanced from adjacent space	Odour Control
NURSING FACILITY											
Bathing Room	Negative	AS 1668.2	10	Yes	No	un-controlled	18-26 (l)	40	Type 1, Class A or B, G4 Prefilter and F7 Main Filter to AS 1324.1 or ISO/AS 16890 equivalent	Inward flow from adjacent areas - usually exhaust only and balanced from adjacent space	Moisture Control
Occupational Therapy	Neutral	2	6	no restriction	no restriction	(t)	21-25	35	Type 1, Class A or B, G4 Prefilter and F7 Main Filter to AS 1324.1 or ISO/AS 16890 equivalent	-	Air Conditioning
Physical Therapy	Negative	2	6	no restriction	no restriction	(t)	21-25	35	Type 1, Class A or B, G4 Prefilter and F7 Main Filter to AS 1324.1 or ISO/AS 16890 equivalent	-	Air Conditioning
Community Room /Day Activity /Dining	Neutral	4	8	no restriction	no restriction	(t)	21-25	40	Type 1, Class A or B, G4 Prefilter and F8 Main Filter to AS 1324.1 or ISO/AS 16890 equivalent	Exhaust over cooking/tea prep facilities. Avoid spill air from open plan day rooms towards staff/reception areas.	Air Conditioning
Resident Room	Neutral	2	6	no restriction	no restriction	(t)	21-25	35	Type 1, Class A or B, G4 Prefilter and F7 Main Filter to AS 1324.1 or ISO/AS 16890 equivalent	-	Air Conditioning
Resident Unit Corridor	Neutral	AS 1668.2	4	no restriction	no restriction	(t)	un-controlled	40	Type 1, Class A or B, G4 Prefilter and F7 Main Filter to AS 1324.1 or ISO/AS 16890 equivalent	Minimise risk of cross flow between patient rooms from common corridor.	Air Conditioning
RADIOLOGY											
Darkroom	Negative	3	15-25	Yes	No	un-controlled	un-controlled	40	Type 1, Class A or B, G4 Prefilter and F6 Main Filter to AS 1324.1 or ISO/AS 16890 equivalent	-	Air Conditioning
X-ray (Diagnostic and Treatment) (ai)	Neutral	2	6	no restriction	no restriction	(t)	22-26 (l)	40	Type 1, Class A or B, G4 Prefilter and F8 Main Filter to AS 1324.1 or ISO/AS 16890 equivalent	Exhaust above heat producing equipment where possible.	Air Conditioning

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X-ray (Surgical /Critical Care and Catheterisation) (ai)	Positive	3	15	no restriction	No	(t)	19-24 (l)	40	Type 1, Class A or B, G4 Prefilter and F8 Main Filter to AS 1324.1 or ISO/AS 16890 equivalent	Exhaust above heat producing equipment where possible. Otherwise, treat as OR as much as possible.	Air Conditioning
Magnetic Resonance Imaging (o), (i)	Neutral	2	6	no restriction	no restriction	(t)	21-25 (l)	40	Type 1, Class A or B, G4 Prefilter and F8 Main Filter to AS 1324.1 or ISO/AS 16890 equivalent	Exhaust above heat producing equipment where possible.	Air Conditioning
DIAGNOSTIC AND TREATMENT											
Mortuaries and Autopsy Room	Negative	100% OA	20 (10 when in set back mode)	Yes	No	(t)	19-23 (21-23 in humid climates)	40	Type 1, Class A or B, G4 Prefilter and F8 Main Filter to AS 1324.1 or ISO/AS 16890 equivalent	Inward to room from adjacent spaces. Direct and dedicated exhaust connection to specialist equipment including Autopsy table, staining tables, grossing tables, tissue cabinets and tissue sample cabinets.	Containment/Odour control
Bronchoscopy, Sputum Collection and Pentamidine Administration	Negative	3	12	Yes	No	(t)	20-23 (l)	40	Type 1, Class A or B, G4 Prefilter and F8 Main Filter to AS 1324.1 or ISO/AS 16890 equivalent	Exhaust from patient zone. Create upstream staff zone during tasks where possible.	Infection Control
Dialysis Treatment Area	Positive	2	6	no restriction	no restriction	(t)	22-26 (l)	35	Type 1, Class A or B, G4 Prefilter and F8 Main Filter to AS 1324.1 or ISO/AS 16890 equivalent	Patient comfort for long stay is priority.	Air Conditioning
Chemotherapy Treatment Area	Positive	2	6	no restriction	no restriction	(t)	22-26 (l)	35	Type 1, Class A or B, G4 Prefilter and F8 Main Filter to AS 1324.1 or ISO/AS 16890 equivalent	Patient comfort for long stay is priority.	Air Conditioning
Dialyser Reprocessing Room	Negative	no restriction	10	Yes	No	(t)	un-controlled	40	Type 1, Class A or B, G4 Prefilter and F8 Main Filter to AS 1324.1 or ISO/AS 16890 equivalent	Exhaust above heat/odour/fume producing equipment where possible.	Air Conditioning
Endoscope Cleaning	Negative	3	10	Yes. Drying cupboards to be exhausted.	No	(t)	un-controlled	40	Type 1, Class A or B, G4 Prefilter and F8 Main Filter to AS 1324.2 or ISO/AS 16890 equivalent	Exhaust above heat/odour/fume producing equipment where possible.	Air Conditioning
Gastrointestinal Endoscopy Procedure Room (v)	Pos/Neg (n)	4	15	no restriction	No	(t)	20-24 (l)	40	Type 1, Class A or B, G4 Prefilter, F8 Main Filter in AHU to AS 1324.1 or ISO/AS 16890 equivalent plus terminal H14 in room	As per Main OR details above where possible. Low Level Exhausts where anaesthetic gases provided.	Infection Control
General Examination Room	Neutral	2	6	no restriction	no restriction	(t)	21-25	40	Type 1, Class A or B, G4 Prefilter and F8 Main Filter to AS 1324.1 or ISO/AS 16890 equivalent	Patient or Staff protection bias subject to project specific IP&C Team input.	Air Conditioning
Hydrotherapy	Negative	2	6	no restriction	no restriction	(t)	28-32 - Select to minimise pool water evaporation	40	Type 1, Class A or B, G4 Prefilter and F7 Main Filter to AS 1324.1 or ISO/AS 16890 equivalent	Design for high humidity environment, avoid maintainable items over pool area, pool surface evaporation.	Air Conditioning/Evaporation Control
Laboratory Work Area, Bacteriology (b)	Negative	2	As per relevant Lab Design Standards	Yes	no restriction	(t)	21-25	40 (f)	G4/F8/- (y)	Subject to specialist design briefing and FF&E exhaust requirements	Air Conditioning & Containment
Laboratory Work Area, Biochemistry (b)	As Briefed	2	As per relevant Lab Design Standards	Yes	No	(t)	21-25	40 (f)	G4/F8/- (y)	Subject to specialist design briefing and FF&E exhaust requirements	Air Conditioning & Containment
Laboratory Work Area, Cytology (b)	Negative	2	As per relevant Lab Design Standards	Yes	No	(t)	21-25	40 (f)	G4/F8/- (y)	Subject to specialist design briefing and FF&E exhaust requirements	Air Conditioning & Containment

Function of Space	Pressure Relationship to Adjacent Areas (d)	Minimum Outdoor A/C/hr	Minimum Total A/C/hr	All Room air Exhausted Directly to Outdoors	Air Recirculated by Means of Room Units (a)	Design Relative Humidity (k) %	Design Temperature (l), (ad)	Internal Noise from engineering services RC (ac)	Air Filtration Grade Primary /Secondary /Final (y) (z) (ae) (ak)	Directional Airflow Guidance (subject to IP&C Team approval per project) (j)	Main purpose of A/C System
Laboratory Work Area, General (b)	Negative	2	As per relevant Lab Design Standards	no restriction	no restriction	(t)	21-25	40 (f)	G4/F8/- (y)	Subject to specialist design briefing and FF&E exhaust requirements	Air Conditioning
Laboratory Work Area, Glass washing (b)	Negative	3	As per relevant Lab Design Standards	Yes	no restriction	(t)	un-controlled	40 (f)	G4/F8/- (y)	Subject to specialist design briefing and FF&E exhaust requirements	Air Conditioning
Laboratory Work Area, Histology (b)	Negative	2	As per relevant Lab Design Standards	Yes	No	(t)	21-25	40 (f)	G4/F8/- (y)	Subject to specialist design briefing and FF&E exhaust requirements	Air Conditioning & Containment
Laboratory Work Area, Media Transfer (b)	Positive	2	As per relevant Lab Design Standards	no restriction	no restriction	(t)	21-25	40 (f)	G4/F8/- (y)	Subject to specialist design briefing and FF&E exhaust requirements	Air Conditioning & Containment
Laboratory Work Area, Microbiology (b)	Negative	2	As per relevant Lab Design Standards	Yes	No	(t)	21-25	40 (f)	G4/F8/- (y)	Subject to specialist design briefing and FF&E exhaust requirements	Air Conditioning & Containment
Laboratory Work Area, Nuclear Medicine (b)	Negative	2	As per relevant Lab Design Standards	Yes	No	(t)	21-25	40 (f)	G4/F8/- (y)	Subject to specialist design briefing and FF&E exhaust requirements	Air Conditioning & Containment
Laboratory Work Area, Pathology (b)	Negative	2	As per relevant Lab Design Standards	Yes	No	(t)	21-25	40 (f)	G4/F8/- (y)	Subject to specialist design briefing and FF&E exhaust requirements	Air Conditioning & Containment
Laboratory Work Area, Serology (b)	Negative	2	As per relevant Lab Design Standards	Yes	No	(t)	21-25	40 (f)	G4/F8/- (y)	Subject to specialist design briefing and FF&E exhaust requirements	Air Conditioning & Containment
Laboratory work Area, Sterilising (b)	Negative	3	As per relevant Lab Design Standards	Yes	no restriction	(t)	21-25	40 (f)	G4/F8/- (y)	Subject to specialist design briefing and FF&E exhaust requirements	Air Conditioning & Sterilization
Medication Room	Neutral	2	6	no restriction	No	(t)	21-25	40	Type 1, Class A or B, G4 Prefilter and F8 Main Filter to AS 1324.1 or ISO/AS 16890 equivalent	Spill from room to adjacent spaces.	Air Conditioning
Non refrigerated Body-holding Room (h)	Negative	no restriction	10	Yes	No	(t)	18-22 (l)	40	Type 1, Class A or B, G4 Prefilter and F8 Main Filter to AS 1324.1 or ISO/AS 16890 equivalent	Inward air make-up from adjacent spaces.	Containment/Odour control
Nuclear Medicine Hot Lab (b)	Negative	no restriction	6	Yes	No	(t)	21-25	40 (f)	G4/F8/- (y)	Subject to specialist design briefing and FF&E exhaust requirements	Air Conditioning
Nuclear Medicine Treatment Room	Negative	2	6	Yes	no restriction	un-controlled	21-25	40	Type 1, Class A or B, G4 Prefilter and F8 Main Filter to AS 1324.1 or ISO/AS 16890 equivalent	Patient or Staff protection bias subject to project specific IP&C Team input.	Air Conditioning
Pharmacy (b)	Pos (Aseptic) /Neg (Cyto)	2	As per relevant Pharmacy Design Standards	no restriction	No	(t)	21-25	40	Type 1, Class A or B, G4 Prefilter and F8 Main Filter to AS 1324.1 or ISO/AS 16890 equivalent	Subject to specialist design briefing, clean room design and FF&E exhaust requirements. Different requirements for Cyto/Aseptic spaces.	Air Conditioning

Function of Space	Pressure Relationship to Adjacent Areas (d)	Minimum Outdoor A/C/hr	Minimum Total A/C/hr	All Room air Exhausted Directly to Outdoors	Air Recirculated by Means of Room Units (a)	Design Relative Humidity (k) %	Design Temperature (l), (ad)	Internal Noise from engineering services RC (ac)	Air Filtration Grade Primary /Secondary /Final (y) (z) (ae) (ak)	Directional Airflow Guidance (subject to IP&C Team approval per project) (j)	Main purpose of A/C System
Physical Therapy /Rehab /Allied Health	Negative	2	6	no restriction	no restriction	un-controlled	21-25	40	Type 1, Class A or B, G4 Prefilter and F8 Main Filter to AS 1324.1 or ISO/AS 16890 equivalent	-	Air Conditioning
Special Examination Room (x)	Neutral	2	6	no restriction	no restriction	un-controlled	21-25	40	Type 1, Class A or B, G4 Prefilter and F8 Main Filter to AS 1324.1 or ISO/AS 16890 equivalent	Patient or Staff protection bias subject to project specific IP&C Team input.	Infection Control
Treatment Room	Neutral	2	6	no restriction	no restriction	(t)	21-25	40	Type 1, Class A or B, G4 Prefilter and F8 Main Filter to AS 1324.1 or ISO/AS 16890 equivalent	Patient or Staff protection bias subject to project specific IP&C Team input.	Infection Control
STERILISATION											
Steriliser Equipment Room (o)	Negative	no restriction	10	Yes	No	un-controlled	30Deg C Max	50	Type 1, Class A or B, G4 Prefilter and F6 Main Filter to AS 1324.1 or ISO/AS 16890 equivalent	Exhaust over heat producing equipment where possible. Separate exhaust system provided for emissions from any sterilisers and their aeration cabinets emitting hazardous gas or vapours.	Air Conditioning
STERILE PROCESSING DEPARTMENT											
Clean Workroom	Positive	2	6	no restriction	No	un-controlled	21-25	40	G4/F8/H14 HEPA (ae)	Spill from room to adjacent spaces.	Infection Control
Decontamination Room	Negative	2	6	Yes	No	un-controlled	18-24	40	Type 1, Class A or B, G4 Prefilter and F8 Main Filter to AS 1324.1 or ISO/AS 16890 equivalent	Exhaust over heat producing equipment where possible.	Infection Control
Sterile Stock /Store Room	Positive	2	10	no restriction	no restriction	(t), and where required by AS/NZS 5369	19-24	45	G4/F8/H14 HEPA (ae)	Spill from room to adjacent spaces.	Infection Control
SERVICES											
Bathroom	Negative	no restriction	Greater of 10 or 10 l/s/m2	Yes	No	un-controlled	un-controlled	45	Type 1, Class A or B, G4 Prefilter and F6 Main Filter to AS 1324.1 or ISO/AS 16890 equivalent	Inward air make-up from adjacent spaces.	Moisture Control
Clean Linen Storage	Positive	no restriction	10	no restriction	no restriction	un-controlled	un-controlled	50	Type 1, Class A or B, G4 Prefilter and F8 Main Filter to AS 1324.1 or ISO/AS 16890 equivalent	-	Air Conditioning
Dietary Storage	Neutral	no restriction	no restriction	no restriction	No	un-controlled	(aa)	50	Type 1, Class A or B, G4 Prefilter and F6 Main Filter to AS 1324.1 or ISO/AS 16890 equivalent	-	Air Conditioning
Production and Re-heat Kitchens	Negative	3 or to suit AS 1668.2	no restriction	no restriction	No	un-controlled	(aa)	45	Type 1, Class A or B, G4 Prefilter and F6 Main Filter to AS 1324.1 or ISO/AS 16890 equivalent	Exhaust over heat/fume/odour producing equipment where possible.	Air Conditioning
Cleaners Cupboard	Negative	no restriction	Greater of 10 or 10 l/s/m2	Yes	No	un-controlled	un-controlled	50	Type 1, Class A or B, G4 Prefilter and F6 Main Filter to AS 1324.1 or ISO/AS 16890 equivalent	Inward air make-up from adjacent spaces.	Air Conditioning
Laundry, General (ah)	Negative	3	10	Yes	No	un-controlled	Max 26Deg C	50	Type 1, Class A or B, G4 Prefilter and F6 Main Filter to AS 1324.1 or ISO/AS 16890 equivalent	Exhaust over heat producing equipment where possible. Design for high humidity load in occupied spaces.	Air Conditioning
Soiled Linen Sorting and Storage	Negative	no restriction	10	Yes	No	un-controlled	un-controlled	50	Type 1, Class A or B, G4 Prefilter and F6 Main Filter to AS 1324.1 or ISO/AS 16890 equivalent	Inward air make-up from adjacent spaces.	Air Conditioning
Clean Utility	Positive	2	10	no restriction	No	(t)	21-25 and to suit medications stored outside of drugs fridges	40	Type 1, Class A or B, G4 Prefilter and F8 Main Filter to AS 1324.1 or ISO/AS 16890 equivalent	Spill from room to adjacent spaces.	Air Conditioning
Dirty Utility	Negative	no restriction	Greater of 10 or 10 l/s/m2	Yes	No	un-controlled	un-controlled	50	Type 1, Class A or B, G4 Prefilter and F6 Main Filter to AS 1324.1 or ISO/AS 16890 equivalent	Inward air make-up from adjacent spaces. Consider 20 A/C/hr in warmer/humid climates.	Air Conditioning

Function of Space	Pressure Relationship to Adjacent Areas (d)	Minimum Outdoor A/C/hr	Minimum Total A/C/hr	All Room air Exhausted Directly to Outdoors	Air Recirculated by Means of Room Units (a)	Design Relative Humidity (k) %	Design Temperature (l), (ad)	Internal Noise from engineering services RC (ac)	Air Filtration Grade Primary /Secondary /Final (y) (z) (ae) (ak)	Directional Airflow Guidance (subject to IP&C Team approval per project) (j)	Main purpose of A/C System
SUPPORT SPACE											
Clean Workroom or Clean Holding	Positive	2	6	no restriction	no restriction	un-controlled	un-controlled	40	G4/F8/H14 HEPA (ae)	Spill from room to adjacent spaces.	Air Conditioning
Hazardous Material Storage	Negative	As per DG consultant advice	10	Yes	No	un-controlled	un-controlled	50	As per DG Consultant Advice	Subject to specific Dangerous Goods Advice for each space.	Containment
Soiled Workroom or Soiled Holding	Negative	3	10	Yes	No	un-controlled	un-controlled	50	Type 1, Class A or B, G4 Prefilter and F6 Main Filter to AS 1324.1 or ISO/AS 16890 equivalent	Inward air make-up from adjacent spaces.	Odour Control
Small Meeting Room	Neutral	2	6	no restriction	no restriction	(t)	21-25	40	Type 1, Class A or B, G4 Prefilter and F7 Main Filter to AS 1324.1 or ISO/AS 16890 equivalent	-	Air Conditioning
Large Meeting Room	Neutral	2	6	no restriction	no restriction	(t)	21-25	40	Type 1, Class A or B, G4 Prefilter and F7 Main Filter to AS 1324.1 or ISO/AS 16890 equivalent	-	Air Conditioning
Private office	Neutral	2	6	no restriction	No	(t)	21-25	40	Type 1, Class A or B, G4 Prefilter and F7 Main Filter to AS 1324.1 or ISO/AS 16890 equivalent	-	Air Conditioning
Atrium	Neutral	As per As 1668.2	no restriction	no restriction	no restriction	(t)	18-26	45	-	Potentially designed around smoke exhaust and inlet air requirements. Provide for local heating/cooling to occupied zones (reception desks etc.)	Air Conditioning

Key Notes

a) Except where indicated by a “No” in this column, in ceiling or wall mounted recirculating room units (with heating and/or cooling function) are acceptable for providing that portion of the minimum total air changes per hour. Due to the cleaning difficulty and potential for build-up of contaminants, recirculating room units shall not be used in areas marked “No”. Recirculating devices with high-efficiency particulate air filters (H14) are acceptable in existing facility refurbishments as interim, supplemental environmental controls to meet requirements for the control of airborne infectious agents. The design of either portable or fixed systems should prevent stagnation and short circuiting of airflow. The design of such systems should also allow for easy access for scheduled preventative maintenance and cleaning.

b) Pharmacy compounding and other Laboratory areas may have additional air changes, varying temperatures or differential pressures, and enhanced filtration requirements beyond the minimum criteria set out in this table, depending on the type of facility, the regulatory requirements, associated level of risk of the work carried out, and the equipment used in the space. Refer to the appropriate Australian Standard or specialist user advice for the specialist containment facility being designed. Provision should be made for safe methods of decontamination for maintenance of laboratory safety cabinets and fume cupboards including localised extraction of fumigants.

Diagnostic and analysis equipment heat rejection exhaust should be direct coupled and discharged external to the building where their equipment permits such a connection.

Laboratories used for genetic manipulation shall be accredited by the NHMRC and comply with The Guidelines for Small Scale Genetic Manipulation Work.

Designers should note that the design, certification and approval of cytotoxic and aseptic suites may fall under the requirements of the Therapeutic Goods Administration (TGA) and should check in the concept phase whether this approval is required.

For complex laboratories and pharmaceutical drug manufacturing facilities, specialist Compliance Consultant and/or Third Party Assessor advice should be sought at the concept design stage to coordinate client specific requirements and define mandatory compliance requirements.

c) NC 55 in rooms with UCV hoods.

d) Pressure relationships shall be maintained when the room is unoccupied, including where any set-back mode is applied. Where pressure-monitoring device alarms are installed, allowances should be made to prevent nuisance alarms. Short-term excursions from required pressure relationships are expected while doors are moving or temporarily open. Where pressure monitoring devices are not fitted, simple visual methods such as smoke trail, ball-in-tube, or flutterstrip are permitted for verification of airflow direction.

e) The minimum differential pressure between the isolation room and adjacent ambient pressure areas should be minimum 20 to 30Pa if the isolation room has an ante room and 10 to 15Pa where there is no anteroom. Pressure differential refers to a reference pressure measured from the corridor. Refer to AusHFG Isolation Rooms - Engineering and Design Requirements guidelines for definitive pressure relationship requirements within Isolation Rooms and suites.

f) NC 60 within 1m of fume cupboards.

g) Positive to corridor, neutral to anaesthetic rooms, negative to sterile prep /set up.

h) A non-refrigerated body-holding room is applicable only to facilities that do not perform autopsies on-site and use the space for short periods while waiting for the body to be transferred.

i) All materials within the Faraday cage shall be non-ferrous and MRI safe.

j) Ventilation air movement in ward areas should normally achieve a positive airflow from corridors to bedrooms and from bedrooms to ensuites (may be reversed subject to patient cohort and Infection Control Team endorsement).

k) The RH ranges listed are a controlled minimum and/or maximum allowable at any point within the centralised or user-controlled temperature range required for that space. Systems shall be capable of maintaining the rooms within the range during normal operation, throughout the year. Lower or higher humidity may be required when specific patients’ comfort and/or medical conditions /equipment require those conditions, as a specific brief requirement. Rooms or areas that have a nominated humidity range are deemed "critical" areas, and AHU cooling and reheat coils shall be selected for "critical" designated external ambient conditions. In areas listed as "uncontrolled" or with keynote (t), upper level RH% will be managed by the natural coil sensible and latent cooling process (coil dehumidification), and no defined lower limit RH% control will apply. Humidity levels outside the range of 30% to 70% may be experienced for parts of the year depending on the external conditions.

l) The temperature ranges listed are in-room user controllable minimum and maximum allowable. HVAC systems shall be capable of maintaining the space at any set point within the defined range during normal operation (allowing for suitable deadband control where applicable). Lower or higher temperatures may be required when patients’ comfort and/or medical conditions /equipment require those conditions, as a project specific brief requirement. Operating Rooms, Cardiac Catheter Labs, Procedure Rooms and Trauma /Resuscitation Rooms will be user adjustable within room. All other design temperature ranges without the (l) designation are standard upper (cooling) and lower (heating) temperature bands, with up to 2DegC deadband control, generally centrally controlled and not individually user controlled per room.

m) 50% return air will be from low level grilles. Where there is a risk of exposure to waste aesthetic gases and vapours and control of occupational exposure to nitrous oxide, local exhaust (anaesthetic gas scavenging) is required.

n) Positive for Endoscopy procedures & Negative for Gastroscopy procedures. Ventilation shall limit any chemical emission concentrations to comply with the Safe Work Australia Adopted National Exposure Standards (NOHSC 1003). Any chemical storage cupboards and hazardous chemical cleaned endoscope storage cupboards shall be exhaust ventilated and subject to separate Dangerous goods consultant recommendations. Incoming air to endoscope storage cupboards shall be filtered to Grade 2 HEPA standard with air uniformly diffused downward over the endoscopy table.

o) Specialist Equipment and/or surgical procedures may require room temperatures, ventilation rates, humidity ranges, and/or air distribution methods that are more stringent than the minimum indicated ranges.

p) Treatment rooms used for bronchoscopy shall be treated as bronchoscopy rooms. Treatment rooms used for procedures with nitrous oxide shall contain provisions for exhausting anaesthetic waste gases.

q) In a recirculating ventilation system, HEPA filters shall be permitted instead of exhausting the air from these spaces to the outdoors, provided that the return air passes through the HEPA filters before it is introduced into any other spaces. The entire minimum total air changes per hour of recirculating airflow shall pass through HEPA filters. When these areas are open to larger, non-waiting spaces, the exhaust air volume shall be calculated based on the seating area of the waiting area.

r) Reversible airflow provisions for the purpose of switching between Class P and Class N functions shall not be permitted.

s) The Class N and Class Q rooms described in this guideline shall be used for isolating the airborne spread of infectious diseases, such as measles, varicella, or tuberculosis. When the Class N and Class Q room is not used for airborne infection isolation, the pressure relationship to adjacent areas, when measured with the door closed, shall remain unchanged, and the minimum total air change rate shall be 6 A/C/hr.

t) Humidity management so there is no condensation on room surfaces. Generally maintained at less than 70% RH, with no defined lower limit RH% control.

u) The requirement that all room air is exhausted directly to outdoors applies only to radiology waiting rooms intended to hold patients who are waiting for chest x-rays for diagnosis of respiratory disease.

v) If the planned space is designated in the organization’s operational plan to be used for both bronchoscopy and gastrointestinal endoscopy, the design parameters for “bronchoscopy, sputum collection, and pentamidine administration” shall be used.

w) For single-bed patient rooms using displacement diffusers, a minimum total of 6 A/C/hr shall be provided and calculated based on the volume from finished floor to 2m above the floor.

x) Examination rooms for use by patients with undiagnosed gastrointestinal symptoms, undiagnosed respiratory symptoms, or undiagnosed skin symptoms (likely located within Infectious Diseases Units or ILI pathways within ED Triage system).

y) Filtration requirements may alter due to specialist equipment or procedures.

z) Supply HEPA filtration may be located in the main air handling plant for all non-theatre, non-cleanroom locations, subject to agreement with the Dept Lead, IP&C team and FM based on operational needs.

aa) To comply with food handling regulations for the method of food handling.

ab) Airflow patterns over cots to be controlled to avoid draughts, rapid change in supply air temperature and excessive air velocity.

ac) RC curves are provided for noise from engineering services only. In the event the space under assessment is affected by other noise sources (i.e. external noise impacts, etc.) further considerations should be made by the acoustic consultant and mechanical engineer to ensure adequate allowances are made to ensure the overall cumulative noise level inside the space complies with the A-Weighted number of the RC Curve.

ad) Where no other specific temperature control deadband provisions are nominated, the NCC/BCA nominated provisions shall be applied.

ae) Where supply HEPA filters are specified, they shall be HEPA Grade 2 to AS 4260. HEPA filters shall have: Current performance certification complying with AS 1807. High limit flow resistance alarms.

af) Specific Burns Unit temperature requirements may be as high as 42DegC - detailed consultation with the clinical leads prior to design detailing is essential.

ag) Where flammable anaesthetic gases are used, the room humidity control range shall be adjusted to 55 to 70%.

ah) Laundry room air should be supplied at high level in a manner that minimises turbulence, and exhaust at low level with cleanable lint screens. Suitable lint traps shall be provided at dryer exhaust discharges where the efficiency of the integrated filter at the dryer is less than 85%.

ai) Lint screens on return air grilles may be required to protect filters in recirculating air handling units which serve these rooms. Variable duty fan filter loading measures should be applied accordingly to address loading.

(aj) Neo-natal operating rooms may require the controllable temperature range extended to between 18 and 38 DegC.

(ak) For approximate AS 1324.1 to AS 16890 equivalent filter classifications for ePM_{10}, $ePM_{2.5}$ and ePM_{1} filter ratings, refer to AIRAH DA15 and the approximate equivalent table included in the filters section of the Mechanical Chapter of this guide.

26 APPENDIX – ELECTRICAL DESIGN PARAMETERS

The following data is supplementary to, and shall be read in conjunction with, chapter "*Engineering Services, Electrical*".

26.1.1 Vital Supply

Refer to chapter "*Engineering Services, Electrical*", section "*Mains and Submains*" and clause "*vital services"*, additional requirements for services to be provided with Vital power supply in addition to AS/NZS 3009 are listed below.

Where areas are identified as requiring 100% of lighting or power connected to a vital supply, every area/room shall be provided with a minimum of 2 separate circuits and these shall be wired from separate distribution switchboards where available. Where the requirements of the FOP and FRMP specifically do not require 100% of the load to be connected to a vital supply, an alternative of 50% each on normal and vital supply should be considered.

AREA/FACILITY	LIGHTING	POWER
Angiography Laboratory - angiography equipment	100%	100% 100%
Blood bank refrigerators	30%	100%
Blood bank type and cross matching areas	30%	100%
Building management and control system (BMCS)		100%
Cardiac catheterisation room - catheter lab equipment	100%	100% 100%
Coronary Care Unit - patient bed spaces - elsewhere	 100% 60%	 all socket outlets per bed 50% socket outlets
Critical Care Areas	50%	100%
Diagnostic laboratories (e.g. cardiac)	30%	30%
Emergency department - all patient bays - procedure and treatment rooms - staff stations - elsewhere	 100% 100% 100% 50%	 all socket outlets per bed 100% socket outlets 60% socket outlets 30% socket outlets
Kitchens (main)	50%	30%
Intensive Care Unit - patient bed spaces - elsewhere - ventilation	 100% 50% 100%	 all socket outlets per bed 50% socket outlets ventilation system

AREA/FACILITY	LIGHTING	POWER
Maternity services - birthing suite - staff station and work area - recovery rooms	 30% 30% 30%	 all socket outlets all socket outlets all socket outlets
Renal dialysis units plus the RO plant	30%	100%
Neonatal intensive care units	50%	100%
Operating theatre suite - operating rooms - anaesthetic prep rooms and sterile stores - elsewhere	 100% 100% 30%	 all socket outlets all socket outlets 60% socket outlets
Inpatient Units - bed rooms	100%	all socket outlets
Close observation unit beds	100%	all socket outlets per bed
Mortuary (refrigerated storage)	100%	100%
Severe burns inpatient unit	100%	100%
Lifts	-	all lifts
All ICT/communications rooms/distributors	50%	100%
Fire alarm system	-	100%
Security alarm system	-	100%
Medical gases, suction and air system	-	100%
Offices and workspace	30%	30%
Toilets/bathrooms	50%	-
Change rooms	30%	-
Therapy rooms	30%	50%
Reception/waiting	30%	60%
Dirty utility	30%	-
Clean utility	30%	30%
Tutorial room	30%	-
Consult room	30%	30%
Engineering workshop	30%	30%
General corridors	50%	-
Helipad	100%	100%
Plant serving all of the above	100%	100%

26.1.2 Major Medical Equipment

Refer to chapter "*Engineering Services, Electrical*", section "*Mains and Submains*" *vital supply* and *instantaneous* services, power source requirements for major medical equipment:

MAJOR MEDICAL EQUIPMENT CATEGORY	STANDBY POWER (VITAL SUPPLY)	UPS (INSTANTANEOUS SUPPLY)	NOTES
Fixed general and specialised x-ray machines (general, chest or, trauma rooms)	Yes	Yes	UPS to power computing equipment. UPS to supply the table and monitoring may be required.
Mobile x-ray machines	No	No	Where units contain batteries which are charged from a Vital Supply wall outlet when not in use.
Fluoroscopy rooms with fixed screening or multi-purpose equipment	Yes	Yes	UPS to power computing equipment. Table, monitoring and fluoro functionality may require UPS.
Mobile fluoroscopy machines (often called C-arms or Image Intensifiers)	No	No	
CT scanners	Yes	Yes	UPS to power computing and control equipment. UPS to enable table movement may be required.
MRI scanners	Yes	Yes	UPS to power computing and control equipment. UPS to enable table movement may be required.
Imaging workstations	Yes	Yes	
Plate readers for computed radiology systems	Yes	No	
Mammography machines	Yes	No	
Dental x-ray machines	Yes	No	
Orthopantomography machines	Yes	No	
Ultrasonic Scanners	Yes	No	

MAJOR MEDICAL EQUIPMENT CATEGORY	STANDBY POWER (VITAL SUPPLY)	UPS (INSTANTANEOUS SUPPLY)	NOTES
Gamma Cameras	Yes	Yes	
SPECT-CT Scanners	Yes	Yes	
PET Scanners	Yes	Yes	
Ceiling or floor-mounted imaging systems with associated haemodynamic monitoring	Yes	Yes	UPS to power computing equipment. Table, monitoring and fluoro functionality may require high rated UPS.
Linear accelerators	Yes	Yes	Many of these devices have UPS supplied with them.
Brachytherapy devices	Yes	Yes	Many of these devices have UPS supplied with them.
Superficial orthovoltage devices	Yes	Yes	Many of these devices have UPS supplied with them.
Planning CT scanners	Yes	Yes	Many of these devices have UPS supplied with them.
Simulation devices	Yes	Yes	Many of these devices have UPS supplied with them.
Operating theatre, including, operating lights, pendants, monitors, anaesthetic machines & monitors,	Yes	Yes	
Operating theatre integration products	Yes	Yes	Many manufacturers supply UPS with the server rack equipment.
Integrated imaging systems	Yes	Yes	UPS to power computing and control equipment. Table, monitoring and fluoroscopy functionality may require high rated UPS.
Operating theatre tables	Yes	No	
Surgical microscopes	Yes	No	
Surgical diathermy units and associated surgical plume evacuators	Yes	No	

MAJOR MEDICAL EQUIPMENT CATEGORY	STANDBY POWER (VITAL SUPPLY)	UPS (INSTANTANEOUS SUPPLY)	NOTES
Surgical lasers of various types	Yes	No	
Suction devices including mobile devices	Yes	No	
Ultrasonic cleaners	Yes	No	
Washer/steriliser/disinfectors (cart washer/steriliser, batch washer/sterilisers, tunnel washers/sterilisers, etc.)	Yes	No	Minimum one washer/steriliser to be on standby power.
Pre-vacuum steam sterilisers	Yes	No	
Low temperature sterilisers	Yes	No	
Steam sterilisers	Yes	No	Minimum one washer to be on standby power.
Drying cabinets	Yes	No	
Endoscope washers/disinfectors (re-processors)	Yes	No	
Endoscope drying & storage cabinets	Yes	No	
Bulk detergent dispensing plant	Yes	No	
Reverse osmosis treatment units	Yes	No	
Instrument tracking systems	Yes	Yes	
Dental chairs	Yes	No	
Dental lights (if separate from the chair and dental unit)	Yes	No	
Dental x-ray units	Yes	No	
Dental sterilisers	Yes	No	

MAJOR MEDICAL EQUIPMENT CATEGORY	STANDBY POWER (VITAL SUPPLY)	UPS (INSTANTANEOUS SUPPLY)	NOTES
Dental plate scanners	Yes	No	
ICU/HDU/NICU and ED Resus Bay Pendants	Yes	Yes	
Switchable glazing, where used	Yes	No	
EEG	Yes	Yes	Important when used to monitor seizures such as is needed in epilepsy services
Hospital-wide cardiac monitoring equipment including telemetry and wireless monitors	Yes	Yes, for communications	
Hospital-wide central monitors at the Staff Stations	Yes	Yes	
ECG management systems and associated ECG recorders and carts	Yes	No	UPS may be required for the server.
Clinical information systems	Yes	Yes	
Other clinical equipment including continuous haemodialysis and high frequency oscillation ventilation (HFOV)	Yes	Yes	
Pharmacy robotic systems	Yes	No	
Medication dispensing systems	Yes	No	
Ophthalmological diagnostic equipment	Yes	No	

26.1.3 Treatment/Procedure/Operating Rooms

Refer to chapter “Engineering Services, Electrical”, additional notes regarding fit out requirements applicable to treatment, procedure and operating rooms, to be read in conjunction with AusHFG template information:

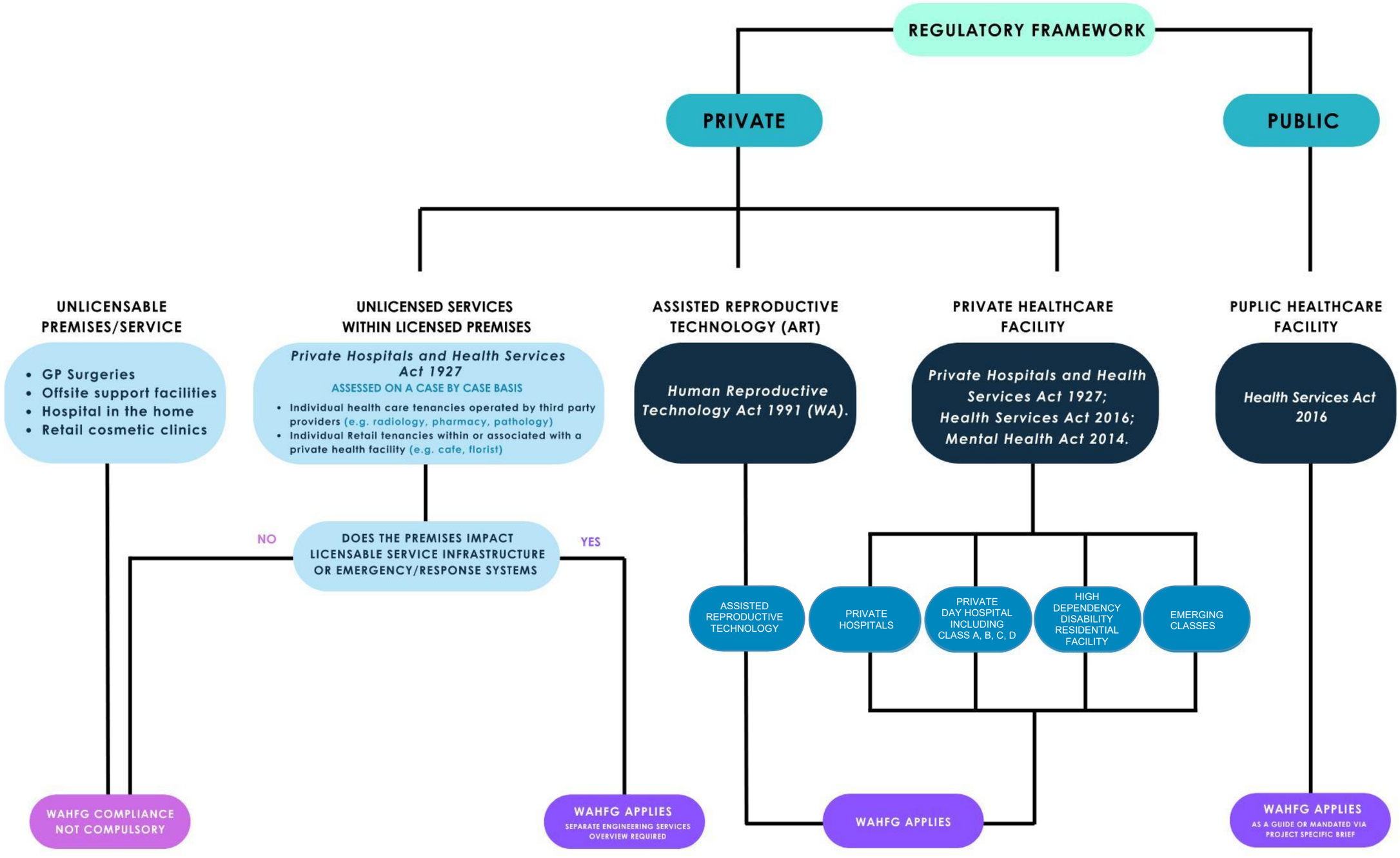
ITEM	REQUIREMENT	
Vital/essential supply power circuits in all Treatment/Procedure/Operating Rooms	to minimum of 25% and maximum of 75% of socket outlets at the bed head, on medical pendants, or major services panels	
Instantaneous supply power circuits in all Treatment/Procedure/Operating Rooms	required to minimum of 25% of socket outlets at the bed head on medical pendants or major services panels	
LIOM protection	to all UPS outlets	
General lighting circuits	connected to minimum two circuits each from separate DB/source of supply	
Lighting		
• Treatment	Single procedure light connected to essential/vital supply. The light to be a minimum of 20,000 lux (at 1m affl).	
• Endoscopy Procedures	Single procedure light connected to essential/vital supply. The light to be a minimum of 50,000 lux (at 1m affl).	
• Procedures	Single procedure light connected to essential/vital supply. The light to be a minimum of 50,000 lux (at 1m affl).	
• Operating (Small)	Single surgical light connected to UPS. The light to be a minimum of 125,000 lux (at 1m affl).	Sterile “clean room” type general lighting ‘X-ray/Laser In Use’ illuminated sign outside each entry. Room in Use lights outside each entry. Minimum of one pendant.
• Operating (General)	Single surgical light connected to UPS. The light to be a minimum of 160,000 lux (at 1m affl).	Sterile “clean room” type general lighting ‘X-ray/Laser In Use’ illuminated sign outside each entry. Room in Use lights outside each entry. Minimum of one pendant.
• Operating (Large)	Single surgical light connected to UPS. The light to be a minimum of 160,000 lux (at 1m affl).	Multiple surgical lights connected to UPS. The primary light to be a minimum

ITEM	REQUIREMENT	
		of 160,000 lux (at 1m affl) and the satellite to be a minimum of 125,000 lux (at 1m affl). Sterile “clean room” type general lighting ‘X-ray/Laser In Use’ illuminated outside each entry. Room in Use lights outside each entry. Minimum of two pendants.
• Interventional	Multiple surgical lights connected to UPS. The primary light to be a minimum of 160,000 lux (at 1m affl) and satellite to be a minimum of 125,000 lux (at 1m affl).	Sterile “clean room” type general lighting ‘X-ray/Laser In Use’ illuminated outside each entry. Room in Use lights outside each entry. Minimum of two pendants.
• Hybrid	Multiple surgical lights connected to UPS. The primary light to be a minimum of 160,000 lux (at 1m affl) and satellite to be a minimum of 125,000 lux (at 1m affl).	Sterile “clean room” type general lighting ‘X-ray/Laser In Use’ illuminated sign outside each entry. Room in Use lights outside each entry. Minimum of two pendants.

27 APPENDIX – LARU DECISION TREE

LARU DECISION TREE - APPLICABILITY OF WA HFG'S

IS THE PREMISES A PUBLIC OR PRIVATE HEALTH CARE FACILITY (OR LOCATED WITHIN)?



28 APPENDIX – MINOR WORKS DECISION MATRIX

28.1 Definition

28.1.1 Minor works carried out within licensed premises refer to tasks that are classified as low in complexity and scale. These include assets, resources, major medical equipment and clinical accommodation at the facility that involve upgrading, reconfiguration, or alterations in use, to meet the standards suitable for their intended functions.

These works include minor refurbishment, minor reconfiguration of clinical areas or individual clinical accommodation or change of room function from non-clinical to clinical and clinical to non-clinical in nature. Minor works also include any works that potentially impact or temporarily disrupt fire and life safety systems or clinical operations.

A minor works project can include works undertaken in an unlicensed service that exists within the licensed premises where the service impacts on the infrastructure and/or emergency response systems of the licensed premises. Refer to Appendix "*LARU Decision Tree*".

Minor Works do not include planned preventative maintenance of any kind, ongoing functional testing of plant and equipment, removal or like-for-like replacement of redundant or end of life plant and equipment, or minor door and opening changes (providing that any such works listed above do not adversely impact fire egress or clinical operations), and minor external and landscape works.

28.2 Considerations

28.2.1 All minor works submissions are reviewed by the Licensing and Accreditation Regulatory Unit on a case-by-case basis.

The cost associated with a minor works project is not a factor in determining the suitability as a minor works.

28.3 Minor Works Decision Matrix

28.3.1 The applicant is to undertake a construction risk assessment utilising Tables 1 to 4 outlined below to assess the risk and type of work to the determine Class of works.

The minor works application shall include:

- the extent of the construction works
- impact patient care/flow/experience
- management of the continuity of services
- potential of contaminant exposure
- IPC and WHS management
- compliance with:
  - Western Australian Health Facility Guidelines for Engineering Services
  - Western Australian Health Facility Guidelines for Architectural Requirements
  - Department of Health Licensing Standards

28.3.2 **Step 1**: Identify the construction activity type

Type A	Type B	Type C	Type D
No interruption to clinical services No dust generation No interruption to services No IPC or WHS considerations No change to egress routes No changes to engineering services (electrical, mechanical, hydraulic or fire)	Minimal disruption to clinical services. Dust generation can be controlled. Minimal IPC or WHS considerations Minor engineering installations/removals	Significant disruption to clinical services Dust generating works Minor demolition works Removal of built-in building components Ceiling works Multiple IPC and/or WHS recommendations Multiple minor engineering installations	Any works requiring major architectural and engineering works shall be required to follow the Building Approval Process. Multiple minor works within the same department or area of the facility shall be required to become a Staged project and follow the Building Approval Process

Table 1: **Definition of Construction Activity Types**

28.3.3 **Step 2**: Select the location of the works

Group 1 – Low	Group 2 – Medium	Group 3 – Medium High	Group 4 - Highest
Office areas Non- patient areas Low risk areas not listed elsewhere	Patient care and other areas not listed under Groups 3 or 4 Laundry Staff cafeteria/dining room Admissions Discharge lounge Mixed use public corridors Storeroom outside clinical areas Kitchen	Emergency department Recovery room Delivery rooms High dependency unit Newborn nursery Wards Endoscopy Bronchoscopy Dialysis Assisted Reproductive Technology Laboratory	Oncology/Chemotherapy units Operating rooms Sterile supply units (CSSD/TSSU/SSU) Interventional angiography and cardiology labs Intensive Care Units Perfusion Room Burns units

Table 2: **Location of minor works (Infection Control Risk Groups)**

28.3.4 **Step 3**: Determine the Works Construction Classification

Using the construction activity type and the location table, apply the matrix below to determine the construction classification class.

The construction classification class determines the management of the minor works.

Location	Construction			
	Type A	Type B	Type C	Type D
Group 1	Class I	Class II	Class II	Class IV
Group 2	Class I	Class II	Class III	Class IV
Group 3	Class I	Class III	Class III	Class IV
Group 4	Class III	Class III	Class III	Class IV

Table 3: **Determination of Class of the Works**

28.3.5 **Step 4**: Minor works determination

Class	Determination and Requirements
Class I	Consideration made for the MW to proceed with Licence Holder accepting risk and liability. Licence Holder to complete a minor works declaration. (Declaration covers adherence to the WAHFG's, AusHFG – Section D – Infection Control, and Australian Standards)
Class II	Minor works – Review by the LARU consultants. Compliance with requirements of the WAHFG's, AusHFG – Section D – Infection Control, and Australian Standards.
Class III	Minor works – Review by the LARU consultants. Compliance with requirements of the WAHFG's, AusHFG – Section D – Infection Control, and Australian Standards. Project may require an Approval to Occupy inspection or a desktop audit on completion, prior to occupancy.
Class IV	Project to be reviewed via the Building Approval Process – Concept meeting, Approval in Principle, Approval to Construct and Approval to Occupy.

Table 4: **Determination Matrix of Minor Works**

29 APPENDIX – DECLARATION OF CONFORMANCE TEMPLATE

29.1 Requirement

When an application for approval is presented to LARU, a Declaration of Conformance shall be included covering all engineering disciplines relevant to the application.

This declaration shall be provided at every phase of approval (AIP, ATC, ATO) as part of the building submission. The declaration is also necessary for a minor works (MW) submission, with specific notes for MW listed later.

A separate declaration shall be provided for each engineering discipline, i.e. aligned with every chapter (numbers 9 to 18) of the Guidelines.

Every declaration shall be prepared and signed by the respective engineering designer (responsible for the design) and endorsed by a suitable representative (or if applicable, representatives) of the Clinical Team (confirming acknowledgement of the implications of the design on the operational requirements for the facility).

After endorsement by the engineering designer and clinical team(s), the declaration shall be signed by the Licence Holder/Applicant, as the person responsible for the licenced facility.

Engineering designers shall include their credentials confirming compliance with the "*Personnel definitions*" clause of the Guidelines.

Each signatory is responsible for ensuring the implications of the declaration are accepted by all signatories, including the Licence Holder/Applicant and Clinical Team representatives.

Presenting this declaration of conformance is supplementary to, and not a substitute for, the Contractor's and Consultant's certification required at ATO, refer to details in attachments to Appendix "*Approval to Occupy (ATO) inspection*".

Declaration for Minor Works (MW) shall be made noting the following items:

- proposed building programme (start date, finish date, /or temporary use date range) shall be provided
- all building modifications, shall comply with the National Construction Code (NCC), the Western Australian Health Facility Building Guidelines for Architectural Requirements (WAHFG AR) current edition and the Western Australian Health Facility Guidelines for Engineering Services (WAHFG ES) current edition.
- the Declarant agrees:
    - to comply with the Guidelines
    - that if it is subsequently found that the works do not meet the requirements of the Guidelines, the works shall be rectified to achieve compliance
- no dispensations or exemptions from the Guidelines will be granted

A template in the format that shall be used for the Declaration of Conformance is provided on the next page. This template is applicable to all applications; be the project require 3-step approval or it is a minor works application.

Portions of the typical template shown in colour denotes text that shall be modified to reflect the details of the specific application for approval. Note if the application fully conforms with the Guidelines, the schedule of non-conformance shall be shown "N/A".

Note that the onus is on the signatories of the declaration to ensure that all areas of non-conformance are listed in the declaration and that any aspect not so declared shall be deemed as fully conforming.

29.2 Template

Typical Consultant's Declaration of Conformance – Template

This declaration shall be presented on company letterhead

Declaration of Conformance

Project: Anywhere Private Hospital

Phase: Approval in Principle (AIP)/Approval to Construct (ATC)/Approval to Occupy (ATO)/Minor Works(MW)

Discipline: Civil/Communications/Electrical/Fire Engineering/Fire Services/Hydraulic/Mechanical/Medical Gases/Security/Structure /Vertical Transportation

Issued to: LARU, Attention: insert name/title of intended recipient

Date: date/month/year

We, the undersigned, are responsible for the design for the services listed above and confirm that the design as presented and detailed conforms to the requirements of WAHFG ES and all associated Codes, Standards and Requirements, with the exception of the following. All areas of non-conformance are listed in the schedule below:

Clause reference	Requirement	Reason for non-conformance
Provide details of every non-conformance. Example of non-conformance, below:		
11.17.10	Switchboards shall be colour coded - in line with colour coding of outlets for AS/NZS 3003 patient areas.	This project is a small extension of an existing ward. To avoid confusion on the site, colours will be kept same as existing which are contrasting for each section but not white, red and blue per AS3003.

Endorsed by:	Details	Signature
Engineer/Designer	Company_ Person_ Qualifications	
Clinical/IP&C team	Company_ Person_ Role	

The information contained in this application form is true and correct. I understand that if it is subsequently established that any information provided is not true or correct, any licence issued may be suspended or revoked. I am duly authorised to make this declaration

Declaration:	Details	Signature
Licence Holder/Applicant	Company_ Person_ Role	

Government of Western Australia
Department of Health