# Australasian Health Facility Guidelines

## Part E - Building Services and Environmental Design

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# 01 INTRODUCTION

## 01.01 Introduction

Part E is written specifically as a guideline and not as a performance or outline specification. It precedes the 'Technical Brief' which directly references regulations and standards, and provides performance benchmarks for use by the Design Team in preparation of the Developed Design and Tender Documentation. Currently, Technical Briefs and Guidelines exist for some States (e.g. NSW, Victoria and WA). [Refer to References and Further Reading].

Engineering services account for a significant part of the capital cost of Health Facility construction and for this reason require equal attention in terms of whole of life costs, energy efficiency and sustainability.

Large buildings require complex engineering systems involving a project team of experts. To achieve an integrated building solution and an optimum project delivery process, members of the team need to have a general understanding of the areas of concern specific to each discipline. The increasing specialisation in Project procurement, combined with the introduction of new legislation and developments in risk management has added to the number of consultants in the team; making coordination and communication across design disciplines all the more necessary.

The preliminary briefing and design stage is one of the most important in the design process; the spatial and building design requirements for each engineering service need to be fully understood by Architects in particular, and by other members of the team to achieve the best outcome and avoid costly redesign.

This section of the guidelines addresses the provision of engineering services in Health Facilities as defined in HFG Part A. - Subsection 30: How to read - The Structure of these Guidelines, and lists the range of engineering services applicable to Health Facilities and the specific functions and issues relating to their provision.

The information provided is intended to be used by the design team in the preliminary stages of the project and is presented as subjects for consideration; which in turn can be used as a checklist to generate the brief. It is for individual members of the team to select and develop the information relevant to their discipline.

The early design process addresses the selection of appropriate engineering services systems, spatial requirements and the modification or reduction of particular services by a review of the climatic or building design options.

The procurement of capital infrastructure and the project delivery process for Health Facilities are covered by policy in most jurisdictions. Reference should be made to deliverables and reporting required at each stage of the project delivery process.

Reporting will generally identify elemental costs and life cycle costing - enabling comparison and assessment; it will also identify any additional costs caused to services by the building design.

Economical whole-of-life cost options should be implemented in preference to low capital/initial cost options. It should be noted however that 'Whole of Life' cost studies are part of a larger decision making process.

**Part E** is to be used in conjunction with the other parts of the Australasian Health Facility Guidelines for the design and operation of Health Facilities. Refer to:

**Part A** for all general information relating to use and aims of this guideline, and for facilities covered, glossary, references, regulations and accreditation.

**Part B** for Hospital Planning Unit (HPU) specific requirements. Part C for general OHS and security issues.

**Part D** for infection control issues.

**Part F** for Furniture, Fittings and Equipment, and Operational Commissioning
The topics covered in Part A are not repeated or expanded in Part E except where considered necessary.

## 01.02 Objectives

Part E has the following overall objectives:

- flexibility and innovation in design;
- improvements in the delivery of engineering services and sustainable outcomes by addressing advances in technology;
- cost efficiency;
- integration of relevant design disciplines; and
- principles of quality management.

The specific objective is to assist members of the design team in the preparation of the design brief and documentation for engineering services by covering the subjects that most frequently occur at this stage of the Health Facility design process.

The engineering services disciplines are listed in alphabetical order, to avoid conflict with existing construction classification systems which vary between countries, agencies and consultancies.

Structural and Civil engineering sections are omitted on the basis that the design issues are fully covered by regulation, standards and published specifications. Facility management, operation and maintenance, and traffic management are omitted except where these might influence the provision of Engineering Services.

Regulations and standards do not necessarily draw attention to all site and structural risks that apply to hospitals; these should be identified for each project and allowed for in the facility risk management plan (see 1.5.00).

The minimum requirements for the provision of all services installations in HealthCare Facilities will be covered by the Technical Brief. Australian Standards may apply in addition to the minimum requirements in Part E, and these will be governed by the type of facility and engineering services proposed.

Some of the information in the following sections may be additional to any statutory requirements.

It is assumed that accepted engineering practice, relevant codes and statutory regulations will be observed as part of normal professional services, and that these aspects require no specific reference.

## 01.03 Environment

Engineering services in health care facilities should satisfy the relevant requirements for general comfort, healthcare procedures and patient care, within acceptable noise levels. The operation, monitoring and control of services should be designed for the specific patient and healthcare procedure needs of the area serviced.

General acoustic requirements and acceptable noise levels must comply with AS 2107 recommendations. Vibration in occupied spaces must comply with AS 2670.1 and be prevented by design, selection, installation and operation of equipment or systems.

All equipment should be selected for the required use and for the environmental conditions in the intended location.

Sites should be investigated to determine they are free from contamination.

## 01.04 General

The design and layout of engineering services should ensure that they are located to avoid compromising possible developments, either that are currently proposed or in the future.

For alterations and additions to part of a medical service, all the supporting services appropriate to the required function should be included. The integrity, quality and reliability of site services should be maintained during and after the work. Planning should consider the sustainability and future life costs of the whole facility and not just the alteration or addition.

Healthcare procedure-specific equipment is normally excluded from the engineering services and scheduled separately. However engineering services should be provided for the equipment briefed and consideration should be given for the inclusion of an approved margin for growth and change.

Access points should be located outside patient areas and circulation areas to prevent disturbance to occupant and traffic. Controls should be tamperproof.

Each type of service should be easily identifiable, and designed for minimal dust/contamination collection and easy cleaning.

Engineering services should be designed for safe usage, and for ease and economy of maintenance. Maintenance should cause minimal disruption to healthcare procedures and minimal disturbance to patients.

The building and services should be designed to allow for maintenance and replacements to be undertaken with the minimum interference to the building fabric.

Services design and equipment selection should address the need to minimise maintenance in locations where technical resources may be scarce and should be coordinated with the existing protocols or requirements of 'local' Area Health Services.

Consideration should also be given to the issue of remote monitoring and control of building services.

For existing sites undergoing redevelopment a current services profile should be done. Eg. Electrical, water and sewer infrastructure should be known and the impact of an increase in load evaluated.

## 01.05 Design Brief

Project specific issues that may be expected to be covered in the Design Brief should address:

- nomination and listing of critical and sterile areas, including unacceptable risks;
- application of life cycle cost analysis and other financial requirements;
- provisions for foreseeable modifications and expansion;
- provisions for foreseeable developments in health care practice and technology;
- minimisation of environmental impact on surrounding environment;
- standby power generation and distribution;
- facility specific requirements;
- specific risks and risk management policy;
- trade wastes;
- service requirements for health care equipment;
- access for vehicles and equipment for fire fighting;
- access for vehicles and equipment, and provision of heavy lifting facilities for plant installation and removal;
- safe access for service providers;
- specific Management and Maintenance requirements;
- critical safety and performance parameters for inclusion in the maintenance regime; and
- energy recovery systems were justified by life cycle cost analysis and budget constraints.

For existing sites undergoing redevelopment input should be sought from the current Facility Maintenance contractor, either in-house or outsourced.

## 01.06 Sustainability

Engineering Services should comply with all relevant Environmental Sustainability Development polices and legislation. Sustainability must be included as a part of risk and cost management strategies.

The total impact of energy saving strategies should be considered in the evaluation of options, including new or innovative renewable energy technology.

Cost analysis should be prepared at the project level, whole of life costs considered for all project components, and options assessed in accordance with the relevant policies and standards. [Refer to AS 3595 Energy Management programs - Guidelines for financial evaluation of a project].

Sustainability targets should be set for the project - to be reviewed and monitored throughout the project. A long term maintenance strategy should be provided for all plant and equipment.

An energy and environment management plan (EMP) including environmental performance benchmarks and targets should be prepared. Design and financial criteria for EMP should be provided for major plant and reticulation systems in terms of capital and recurrent costs, payback periods and life-cycle energy costs. An energy management continual improvement process should be initiated.

[Refer to AS/NZS ISO 14000 (Set): Environmental management Standards Set].

Services systems (including standby and emergency arrangements) should be low maintenance and comply with the energy efficiency requirements of the Building Code of Australia.

An Asset Management and Waste Management Plan including a maintenance strategy should be prepared for all plant and equipment, and handed over immediately after commissioning to Facility Management personnel for implementation.

## 01.07 Risk Management

Part E does not attempt to cover all engineering options or define the requirements of a risk management system for engineering services. These systems should be developed during the design phase of the project to the relevant standards (e.g. AS 4360), statutory regulations and duty of care.

Operating policies for engineering services for each stage of the project should be included.

Engineering services should not cause any unacceptable hazard resulting from loss of operation. The particular risks involved with patients and healthcare procedures need to be considered. Where loss of service could cause an unacceptable risk, including post disaster function, services must be designed to operate reliably and meet statutory and critical demand requirements as covered by the Technical Brief.

Engineering services must be protected from unauthorised interference, or from conditions that will affect operation or damage the service, assets or persons. Protection should be provided with specific alarms, controls, warning devices or security devices; underground and all other services should be clearly identified and protected where required.

All services should be designed and installed in a manner that will minimise the opportunities for patient self-harm.

Services should not contribute to any risk to the environment. [Refer Sustainability]

At the completion of the works, or section of the works, testing will be required to prove the suitability and operation of the works or section of the works, and to ensure that the installation complies in full with the brief. The supply of as-built drawings and detailed Operation and Maintenance Manuals will be required at the end of a project.
Handover and commissioning procedures should provide for adequate pre- handover training for operations and maintenance personnel, especially in respect to complex control algorithms. Commissioning should include implementation of operating and maintenance arrangements that will deliver risk mitigation and designed whole of life performance.

# 02 COMMUNICATION

## 02.01 Scope

The following communications services should be considered in the Design Brief including:

- emergency call;
- patient nurse call;
- staff assistance call;
- building services and equipment monitoring;
- communications cabling systems;
- data communications;
- duress alarm systems (refer to Security section];
- emergency warning and intercom systems (EWIS);
- intercom systems;
- MATV signal distribution system;
- microwave systems;
- pocket paging;
- public address;
- radio;
- radio frequency screening;
- voice communications; and
- video systems.

## 02.02 General

Communications services should in addition to their technical and functional requirements not interfere with the delivery of healthcare services, nor cause disturbance to patients.

## 02.03 Design

Communications generally make a minimal demand on building design and planning, however the size and placement of communication and data equipment rooms can impact on layout and budget, especially if under provided for in the initial planning stages. The design of equipment enclosures will be governed by client, equipment manufacturer and supply authority requirements.

Other early design issues to consider may include the placement of antenna and masts for relay, and the provision for access to these.

# 03 ELECTRICAL

## 03.01 Scope

The following electrical supply services should be considered in the Design Brief including:

- general services;
- critical care services;
- essential services;
- UPS and Standby Power;
- electrical equipment;
- emergency lighting and signage;
- heating and cooling;
- lighting, including site and security lighting;
- patient protection systems;
- supply and distribution;
- switchgear and circuit protection;
- transformer equipment; and
- strategy for expansion.

## 03.02 General

Electrical services should be designed to provide:

- safety and reliability;
- capacity for all equipment and plant;
- capacity for expansion;
- flexibility for isolation, shutdown and maintenance;
- compatibility with existing on-site and facility systems;
- compatibility with provider network;
- cost efficiency;
- minimise electromagnetic interference; and
- distribution systems that will not see all modules of any critical service affected by any one interruption event e.g. modules of intensive care services should not be off a common sub main or one switchboard.

Lightning protection although a requirement, is not usually a design issue for consideration in the preliminary design stages.

## 03.03 Design

Consideration should be given to the location and requirements for:

- cabling;
- emergency battery supply;
- standby generating plant and fuel supply;
- substations and transformers;
- switchboards; and
- switch rooms.

Electrical supply is governed by supply authority regulations, standards and client policy. Sub stations are generally owned by the supply authority. Easements, substation location, security, access and egress for personnel and equipment should be considered.

Attention should be paid to the placement of sub stations and electrical mains as the former may provide a fire hazard, and both can adversely affect electrical and communications equipment. Later relocation or rectification can be costly.

# 04 FIRE

## 04.01 Scope

Fire services  that should be considered in the Design Brief include:

- fire detection and suppression systems;
- hydrants and hose reels;
- portable extinguishers;
- smoke control and air pressurisation (refer to Mechanical Section];
- signs and evacuation plans;
- warning and information systems;
- water supply; and
- water storage.

## 04.02 General

Fire protection is usually designated as an Active or Passive system. Both require consideration in the preliminary design stages.

Active systems involve engineering services solutions. Passive systems include compartments, egress routes, and fire and smoke rated construction. The employment of active systems can influence both the building design, and the extent and cost of passive provisions.

## 04.03 Design

The following active systems may require equipment enclosures and adequate access for fire fighting personnel and equipment:

- external hydrants / hose reel layout;
- fire control rooms;
- pumps, tanks, sprinkler boosters;
- water supply and distribution issues; and
- fire detection system.

The passive systems may include:

- compartmentation;
- construction;
- fire egress arrangements; and
- fire separation.

The requirement for sprinklers for example will add a vertical component to the ceiling space requirement, which in turn will affect the overall building height.

Passive solutions can play a major role in early planning and particular consideration should be given to compartment size and design. By building in flexibility and area safety margins, changes in briefing can be

anticipated and incorporated in later planning. The repositioning or addition of an egress stair as a result of modifications to compartment and egress layout can be difficult and costly.

# 05 HYDRAULIC

## 05.01 Scope

The following Hydraulics services should be considered in the Design Brief:

- fire hydrant and fire hose reel systems;
- hydrotherapy pools;
- natural or liquefied petroleum gas services;
- process waste water discharge conditioning facilities;
- roof plumbing;
- sanitary drainage service;
- sanitary fittings and fixtures;
- sewerage treatment facilities;
- storm water drainage;
- sub soil drainage; and
- water services;
- recycle water system; and
- rainwater storage and service.

Water Services may be expanded to include:

- bore water supplies;
- cold potable water service;
- external irrigation systems;
- flush services;
- hot potable water service;
- non potable cold water service;
- non potable hot water service;
- warm potable water service;
- water conservation;
- water filtering and conditioning equipment;
- special water services (Renal Dialysis Laboratory); and
- water storage tanks.

## 05.02 General

For Health Facilities associated with local disaster and post disaster roles, or for maintaining continuity of some acute medical services, design for security of supply consistent with failure risks.

Decisions concerning the scope, extent and type of services may affect cost and should be clarified early in the planning stages. These may require more detailed design decisions on the suitability of warm water system versus thermostatic mixing valves, heat recovery and sustainability measures.

Location, specifics of the site or buildings, and level of service may make additional demands on the provision of services.

## 05.03 Design

Any requirements for water storage and plant including access should be an early design decision, as these may impact on the building design and structure.

# 06 MECHANICAL

## 06.01 Scope

Mechanical services that should be considered in the Design Brief include:

- air cooling and heating services;
- building automation control systems;
- compressed air systems;
- energy management systems;
- fume and dust extraction systems;
- heat recovery systems;
- pneumatic transport systems;
- refrigeration (cool and freezer rooms);
- smoke control systems;
- steam systems;
- ventilation services;
- sterilizer equipment; and
- water treatment and microbial control systems.

## 06.02 General

Each planning unit and special functional area within Health Care Facilities is covered by regulation, policy, or industry standards.

Early consideration should be given to provision for the following:

- car park ventilation and exhaust;
- contaminated exhaust airl
- clean air systems (e.g. operating theatres);
- duplex systems for critical areas;
- emergency power for critical area HVAC;
- infection control;
- kitchen exhaust;
- smoke control [refer to Fire Services];
- ventilation systems; and
- cytotoxic room ventilation.

The following functional criteria should be considered:

- energy efficiency and conservation;
- flexibility;
- passive security measures; and

- reliability.

In addition to heating, cooling and ventilation, occupant comfort factors should include acoustic control.

## 06.03 Design

Climatic conditions are a known variable; however building position and orientation require careful consideration. The concept of energy/ performance modelling should be considered

The principal building design elements that influence HVAC systems comprise:

- active or passive solutions;
- building occupancies and loadings;
- external walls and roof;
- HVAC zone layout; and
- orientation.

The external envelope is the element most subject to variation throughout the design process. A variety of functions are served by the external wall design, these include; day lighting, view, external noise control, privacy control, thermal insulation and solar shading. Late changes to reduce costs e.g. the removal of external sun shading can have a major effect on the HVAC design.

Mechanical engineering systems occupy a significant proportion of the floor area allowance for services, and often suffer from inadequate space provision and inappropriate location. Adequate sizing of services risers and attention to the coordination of services risers with circulation routes will enable flexibility in planning options especially in later stages.

Inadequate height allowance in ceiling voids cannot be rectified easily in the later design stages without affecting cost. For this reason an accurate assessment of the structural system in the early stages is essential, including factors such as post disaster classification.

Other Services factors to consider are:

- central plant, including;
- chilled water supply;
- plant capacity;
- upgrade and replacement of existing equipment.existing services;
- provision of adequate space and facilities (incl. services, hoists etc.) for maintenance;
- plant access/egress (avoiding treatment areas; and
- underground services.

# 07 MEDICAL GASES

## 07.01 Scope

The following Medical gas services should be considered in the Design Brief:

- medical breathing air storage and reticulation;
- medical breathing air compression and conditioning;
- medical suction pumping storage and reticulation;
- nitrous oxide storage and reticulation; and
- oxygen storage and reticulation.

In addition the following gas services may be included:

- carbon dioxide systems;
- dental compressed air and suction;
- industrial and instrument compressed air systems;
- laboratory special gas supplies;
- mortuary equipment; and
- nitrogen systems.

## 07.02 General

The cost of Medical Gas services is directly proportional to the number of outlet points. For this reason the development of the briefing document in the form of the Room Data sheets should be carefully monitored. [Refer to HFG Standard Components - Room Data Sheets].

The scope and detailed definition of medical gases should be determined and included in the Design Brief Some early detailed decisions are required; one of these would be the choice between central vacuum and venturi systems for suction.

## 07.03 Design

The spatial requirements for medical gases and plant may often be low but consideration should be given to the effect of the building layout on the distribution or replication of plant.

In the early design stages an assessment of plant distribution and plant room areas should be made and incorporated into preliminary planning for the building.

Both plant and storage for each service should be centralised and reticulation provided throughout the facility from this central source. Plant and storage are subject to regulation which may dictate area, construction and location e.g. bulk oxygen storage.

# 08 SECURITY

## 08.01 Scope

The following Security services should be considered in the Design Brief:

- access control and tracking systems.;door intercommunication systems.
- duress systems.
- intrusion detection systems.;
- parking control systems;
- safes and strong rooms;
- security staff location;
- security information systems;
- security lighting [Refer Electrical services];
- security hardware, barriers, screens and fencing; and
- video surveillance systems.

In some cases security systems may integrate and form part of a communications system, to be covered under that section.

## 08.02 General

Security services together with Communications are subject to rapid change and growth. To establish a realistic brief some measure of forecasting is required. Since the services generally have low demands for space, the major consideration will be equipment costs. These will be determined by the type of service, and the extent of functions and coverage.

## 08.03 Design

Most design issues will relate to detailed design, however access control can influence decisions regarding entry points and circulation in early planning. Security solutions through environmental design and the elimination of design elements generating a security risk should be considered.

The required locations and area allowances for security staff should be adequately covered in the Schedules of Accommodation.

The levels and type of security will depend on the use and location of the Facility.

System selection may depend on availability of maintenance personnel in remote and rural areas.

# 09 TRANSPORTATION

## 09.01 Scope

Transportation services that should be considered in the Design Brief include:

- document and specimen conveyors [Refer to Mechanical services];
- escalators;
- goods conveyors;
- hoists; and
- lifts.

## 09.02 General

Transportation represents a significant cost element, with the provision for lifts accounting for the major outlay. The number and location of lifts should be determined as early as possible, and result from the early traffic studies.

## 09.03 Design

Lift traffic studies require a developed functional plan. This will show the distribution of Hospital planning units (HPUs), car parking and other functional areas within the facility, and include primary circulation routes and points of access and egress. In some cases the early implementation of a survey may improve accuracy in the outcome.

Security considerations, restrictions to access and hours of operation for specific areas should be included in the traffic studies.

The size of lift cars and shafts are determined by the intended use, this will vary from general public, patient bed transfer, to full critical care team requirements and special goods lifts.

Lifts for special use will usually be restricted to that use and exclude other uses such as public access; this can involve infection control issues, and may affect the number and distribution of lifts. Other special requirements such as patient transfer to and from Helipads need to be considered.

The location of lift motor rooms, building height restrictions, and access requirements should be considered at an early stage.

# 10 EQUIPMENT

## 10.01 Scope

The following Equipment or plant/storage areas requiring connection to services should be considered in the preliminary Equipment schedule:

- catering and kitchen equipment;
- chemical storage;
- cleaning equipment;
- cool rooms and freezer rooms;
- film processing equipment;
- flammable liquid storage;
- laboratory equipment;
- laundry equipment;
- medical electrical equipment;
- sterile supply equipment;
- ward equipment;
- ground equipment;
- materials handling equipment; and
- reverse osmosis plant and cooling systems for Medical Imaging equipment.

## 10.02 General

An assessment of equipment or plant/storage areas requiring connection to services can be extracted from the following sources:

- HFG Standard component Room Data Sheets (RDS) provides information on the generic type and quantity of equipment and the associated services requirements;
- Room Layout Sheets (RLS) provide spatial information and floor areas - they can also be used for early testing and adjustment of floor areas for the incorporation of non-standard equipment.

A preliminary schedule of generic equipment established in the early stages and will assist in determining the requirements for services and space. An early equipment budget will improve the accuracy of the total project cost estimate.

The schedules of accommodation in HFG Part B provide floor area information including circulation for each generic HPU (Hospital Planning Unit), any specific area requirements in the Room Data Sheets would be incorporated in the Project schedules of accommodation. Note: Interdepartmental Travel and Engineering is additional to the combined HPU area.

For information on the process of procuring and installing Furniture, Fittings and Equipment for a Health Care Facility. Refer to Part F Project Implementation, Subsection 680 Furniture, Fittings and Equipment.

## 10.03 Design

In addition to the general allowances for equipment listed above, other factors involving decanting or the transfer of existing equipment for reuse will affect the staging and final cost of the project.

The delivery and removal of equipment and plant should be considered by allowing adequate tolerances for horizontal and vertical transportation. This may require larger corridors, door openings, special sized lift cars, floor and ceiling hatches and provision for hoisting.

# AX APPENDICES

## AX.01 References

### ENGINEERING TECHNICAL BRIEFS

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SAA. AS/NZS 2107:2000 Acoustics-Recommended design sound levels and reverberation times for building interiors

SAA. AS 2670 Evaluation of human exposure to wholebody vibration.

AS 2670.1-2001 General requirements.

SAA. AS 3595:1990 Energy management programs-Guidelines for financial evaluation of a project.
SAA. AS/NZS ISO 14000 (Set):2004: Environmental management Standards Set.

## AX.02 Environment

Sites should be investigated to determine they are free from contamination.